Monitoring the effects of oak woodland restoration on birds in the Willamette Valley, Oregon

Elena Martinez[1], Joan Hagar[2]
1-College of Agriculture, Bioresource Research, Oregon State University, Corvallis, OR 97330
2- United States Geological Survey, Corvallis, OR 97330

Abstract

Oregon White Oaks (*Quercus garryana*) were once abundant in the Willamette Valley, Oregon, but have drastically decreased because of fire suppression, agriculture, and human development. Oaks are an important ecosystem because they provide a diverse habitat for bird species that are insectivorous and/or cavity nesters. We studied the oak restoration project at Pigeon Butte in Finley National Wildlife Refuge in Corvallis, Oregon. This case study compared the capture rates of all species, Swainson's Thrush (*Catharus ustulatus*), Bewick's Wren (*Thryomanes bewickii*) and Spotted Towhee (*Pipilo maculatus*) between the untreated and treated areas before and after restoration, and the overall capture rates from before restoration to after restoration. All species were positively affected by restoration, while Swainson's Thrushes were negatively affected. Bewick's Wrens and Spotted Towhees did not appear to be affected by restoration, but with further study it may be found that they will benefit from restoration.

Introduction

Diverse habitats are important for supporting biodiversity. Oregon White Oak (*Quercus garryana*) woodlands are a unique habitat in Oregon and are home to unique species of plants and animals that depend on the oaks for food and shelter (Hagar and Stern 2001). Such bird species include the Lewis's Woodpecker (*Melanerpes lewis*), Acorn Woodpecker (*Melanerpes formicivorus*) and White-breasted Nuthatch (*Sitta carolinensis*).

Oak woodlands in Oregon have become more rare and isolated because of fire suppression, agriculture and human development. Fire suppression over the last century allowed oak saplings that would normally be burned away to grow in dense groves (Gould et al. 2011). When oaks grow in dense groves, the trees have underdeveloped canopies. Oaks with room to grow have large, rounded canopies. These large, rounded canopies are made of live branches that produce acorns, as well as dead limbs that are important for cavity-nesting bird species. Oaks with large canopies also produce more acorns than oaks with thinner canopies (Peter and Harrington 2002 cited in Vesely and Rosenberg 2010). Acorn production is important for oak reproduction and as a food source for animals. Slowing acorn production and a denser canopy led to lower rates of oak establishment. Oak is a shade-intolerant species so saplings that do manage to regenerate under a dense canopy are unlikely to grow to maturity (Gould et al. 2011). At the same time, shade tolerant species like Douglas-fir (*Pseudotsuga menziesii*) invaded from the nearby foothills of the Cascade and Coast Range Mountains, and were able to grow and shade out the oaks.

While oaks are being shaded out, oak woodlands are also becoming more isolated from each other because oak groves are being removed for agriculture and human development. The soil in oak woodlands is often rich and ideal for agriculture and grazing (Vesely and Rosenberg 2010), which is a huge part of the economy of the Willamette Valley. The oak woodlands remaining are small and isolated from each other. These habitats support fewer animals and the distance between oak habitats makes it harder for animals to travel between the habitats. For example, Acorn Woodpecker colonies typically occupy oak woodlands that are 8-20 hectares in size (ODFW 2006 cited in Vesely and Rosenberg 2010). Oak woodlands smaller than this are becoming more common in the Willamette Valley (Vesely and Rosenberg 2010).

The loss of oaks means a loss of habitat for birds. Oak woodlands in the Willamette Valley support greater avian species diversity than conifers (Anderson 1970). This high species diversity may be related to abundant food and cover resources provided by oaks. In addition to acorns, which are a food source for several species, oaks are also important for insectivorous species because they support greater insect abundance than conifers (Hammond and Miller 1998). Oaks also support more cavities that are needed for cavity nesters like the Acorn Woodpecker, White-breasted Nuthatch, and Western Bluebird. The Lewis's Woodpecker is a cavity-nesting, oak associated species that has already been extirpated from the Willamette Valley. There is concern that more oak-associated species like the White-breasted nuthatch could follow (Hagar and Stern 2001).

In order to preserve oak woodlands and their associated biodiversity, many land managers are undertaking restoration projects in oak woodlands. Goals of oak woodland restoration are to decrease competition for light by removing shade tolerant tree species such as Douglas-fire and maple, and to open up the oak groves enough for the oaks to produce acorns, regenerate in the understory, and grow large tree limbs for cavity nesters. There is no precise amount of openness that will accomplish these goals, so several degrees of openness may need to be tested.

For our case study, we investigated the effects of one restoration effort on the bird community. We chose one site that was being restored and where bird data was available: Pigeon Butte in William L. Finley National Wildlife Refuge. The goal of restoration at Pigeon Butte is to restore the oak woodlands by removing non-oak species and thinning out some of the oaks. Native grasses and shrubs grow around and between the trees. In closed-canopy oak woodlands, the trees have small diameters and reduced canopies, and produce few acorns because of competition for resources. Managers at Finley Refuge made a restoration plan for Pigeon Butte based on historical accounts and photos. All non-oak tree species and tall shrubs in the understory were removed from a section from Pigeon Butte. Native grasses were planted and maintained by annual mowing, and low native shrubs were allowed to grow. Historical accounts of plants and animals helped guide managers in their restoration decisions (US Forest Service 1972).

We selected three focal species that were abundant at the site and were expected to respond either positively or negatively to restoration. Hagar and Stern (2001) predicted that avian species associated with conifers would decrease in abundance while those associated with oak woodlands would increase in abundance in response to restoration. Swainson's Thrushes (*Catharus ustulatus*) are more often found in coniferous forests (Mack 2000), so we chose them to represent a conifer-associated species. Bewick's Wren (*Thryomanes bewickii*) and Spotted Towhee (*Pipilo maculatus*) represent oak-associated species that were expected to benefit from oak restoration. Specifically, we hypothesized that capture rates of Swainson's thrush would decrease after restoration activities removed conifers and decreased canopy cover, and that capture rates of Bewick's Wren and Spotted Towhee would increase.

Swainson's Thrushes prefer dense, shrubby habitats (Mack 2000), so they will likely stay in the untreated area of Pigeon Butte. They do no need tree cavities for nesting, but prefer to nest in dense brush (Mack 2000). The removal of dense brush from the treated area means there will be less nesting sites for the Swainson's Thrushes, so the population may decrease. Swainson's Thrushes feed on insects during the breeding season, switching to berries before Fall migration (Marshall et al. 2003). Therefore, Swainson's Thrushes may benefit from the greater insect abundance provided by the restored oak woodland, but also be negatively affected by the loss of blackberries from restoration efforts. A study by Chambers in 1996 (cited in Marshall et al. 2003) found that Swainson's Thrush abundance decreases as canopy cover decreases, so thinning out the canopy at Pigeon Butte will likely cause a decrease in Swainson's Thrush capture rates. Swainson's Thrushes breed prolifically in the coniferous Pacific Northwest (Marshall et al. 2003), so losing some habitat to oak restoration should not hurt the species population overall. Swainson's Thrushes are migratory, wintering in South America (Mack 2000), so the population at Pigeon Butte may also be affected by outside influences—such as deforestation in wintering grounds—that will not affect resident species. Therefore, conclusions about how the treatment has affected the capture rates of Swainson's Thrush should be made with care.

Bewick's Wrens benefit from opening up canopies (Nehls 1981 cited in Marshall et al. 2003) because more sunlight can reach the understory, allowing more brush to develop in the understory. However, annual mowing at Pigeon Butte in order to control non-native plant species may be delaying the development of native understory. Until the native understory is re-established, the Bewick's Wren may be negatively affected by restoration. Bewick's Wrens love to hide in shrubs, especially blackberries (Marshall et al. 2003). Unfortunately, restoration efforts included removing a large number of blackberries from Pigeon Butte. Once the blackberries are replaced with native brush, the Bewick's Wren should do well, but an initial drop in capture rates may be expected. Continued monitoring of the Bewick's Wren population will be needed. Tree cavities are important for the Bewick's Wren because they are cavity nesters (Marshall et al. 2003). The large limbs of oaks support more nesting cavities than conifers, so the Bewick's Wren should benefit from oak restoration. Oaks also support more insect abundance and diversity (Hammond and Miller 1998). Because Bewick's Wrens are insectivorous (Marshall et al. 2003), they should benefit from oak restoration. Bewick's Wrens are winter residents in the Willamette Valley (Marshall et al. 2003), so they would be good environmental indicators of the health of Pigeon Butte year-round. Watching the

Bewick's Wren population at Pigeon Butte could benefit future studies of oak habitat restoration in the Willamette Valley.

Like the Bewick's Wren, Spotted Towhees also prefer to stay close to brushy areas (Marshall et al. 2003). According to Anderson 1972 (cited in Marshall et al. 2003), researchers found 88 birds/40 ha in white oak stands and only 22 birds/ 40 ha in Douglas-fir stands. Based on Anderson 1972, Spotted Towhees should benefit from oak restoration. However, Spotted Towhees also love Himalayan blackberries (Marshall et al. 2003). Part of the restoration plan at Pigeon Butte called for the removal of Himalayan blackberries and other non-native plants. Himalayan blackberry removal could negatively affect Spotted Towhees until it is replaced with native brush. Spotted Towhees are mostly insectivorous in the breeding season and switch to seeds in the winter. Oaks support greater insect abundance (Hammond and Miller 1998), so Spotted Towhees should benefit from the increase in insect abundance. Spotted Towhees also overwinter in the Willamette Valley (Marshall et al. 2003), so the health of the Spotted Towhee population at Pigeon Butte could be a good indicator of the environmental health of Pigeon Butte.

We compared the captures for each focal species and for all species combined (total capture rate) between the restored (treated) and unrestored (untreated) sections of Pigeon Butte before and after restoration.

Methods

Study Site

Image 1: Aerial map of Pigeon Butte study site after restoration. Treated area is outlined in yellow. Image provided by Joan Hagar.

William L. Finley National Wildlife Refuge is located south of Corvallis, Oregon in the Willamette Valley. Our study site, Pigeon Butte, is on the western edge of the Willamette Valley in close proximity to the Coast Range Douglas-fir zone. Being so close to the Douglas-fir zone made it easy for the area to be invaded by Douglas-fir following a regime of fire suppression. Pigeon Butte Natural Research Area was established in 1966 as an exemplar of Oregon white oak (US Forest Service 1972). Oregon white oak was the most common tree species on the Butte, while Douglas-fir were uncommon until recent decades (US Forest Service 1972). Fire suppression led to closed-canopy oak stands because the saplings were able to grow in dense groves. Oak reproduction slowed in the closed-canopy areas (US Forest Service 1972) because the crowded oaks produced fewer acorns and the oak saplings could not grow in the shaded understory. More shade-tolerant species like Douglas-fir and Bigleaf maple were able to grow up and over the oaks, shading the oaks and decreasing oak growth and regeneration rate.

Oak woodland restoration took place in 2008 at Pigeon Butte (Image 1). The area of restored oak woodland is in the southeastern corner and is approximately 4 hectares. The oak woodland once had a well-developed shrub and herbs layer (US Forest Service 1972), but restoration efforts removed many of the shrubs and non-oak species.

The shrub and herbs layer are returning post-restoration, but may not be as developed as was recorded previously because of disturbance from restoration and competition from non-natives. Annual mowing is used in an effort to control non-natives.

Study Design

To test the hypotheses about restoration effects on the focal species, we compared capture rates between an area that had been treated for restoration and an untreated treated area. Data was separated into two temporal categories, 5 years of pre-restoration data (1999 to 2002, and 2007; Hagar 2008) and 5 years of post-restoration data (2009 to 2013). Before restoration, we expected to see no difference in capture rates between the treated area and the untreated area. We expected to see a difference between the treated and untreated areas after restoration so the time periods were separated for comparison.

Mist-Netting

We used mist-nets to capture birds during the 10 cumulative years of the study (Dunn and Ralph 2004) in order to investigate bird response to restoration. There were twelve 12.0 X 2.6 m, 30mm mesh mist nets placed in the eastern one-third of the woodland on Pigeon Butte. Nets 1-6 were in the untreated area and nets 7-12 were in the treated area. These nets were set up at dawn and checked every 50 minutes for approximately 6 hours a day (Ralph et al. 1993). During net checks, birds were retrieved from nets, placed individually in cloth bags and brought back to the banding area. Each unbanded bird was fitted with a band and the band number was recorded. Captured banded birds were recorded as recaptures and their band number recorded. Capture data was added into the MAPSPROG (Institute for Bird Population 2013) database.

Data Analysis

To standardize captures by netting effort, we divided the numbers of captures of each species, and all species combined by the sum of the total number of hours nets were opened in each treatment (treated and untreated) for each year. We multiplied by 100 to create a standardized response variable, captures-per-100-net-hours, that is comparable across reports in the literature. We calculated the mean capture rates for each species, as well as all species combined, in each phase (pre-treatment and post-treatment) and treatment (untreated and treated). A two-tailed t-test was used to make 2 comparisons for each species of interest and total capture rate of all species combined: 1) mean capture rate in the untreated area versus the treated area before restoration, and 2) mean capture rate in the untreated area versus the treated area after restoration.

Results

Before restoration there was a significant difference between untreated and treated areas in capture rates for all species (Figure 1, $p=0.04$) and Swainson's Thrush (Figure 2, $p=0.019$). There was no significant difference between capture rates before restoration in the untreated versus treated areas for Bewick's Wren (Figure 3, p=0.837) and Spotted Towhee (Figure 4, p=0.405). Bewick's Wren and Spotted Towhee also had high variation in capture rates before restoration.

After restoration, these patterns persisted. Again, there was a significant difference between areas for all species (Figure 1, p=0.019) and Swainson's Thrush (Figure 2, p=0.001), but no significant difference for Bewick's Wren (Figure 3, p=0.705) and Spotted Towhee (Figure 4, p=0.368). In all species, Swainson's Thrush and Bewick's Wren, numbers declined under both treatments, but Spotted Towhee abundances were not significantly different post-restoration.

There was variation in overall capture rates from year to year for all species (Figure 5), Swainson's Thrush (Figure 6), Bewick's Wren (Figure 7) and Spotted Towhee (Figure 8).

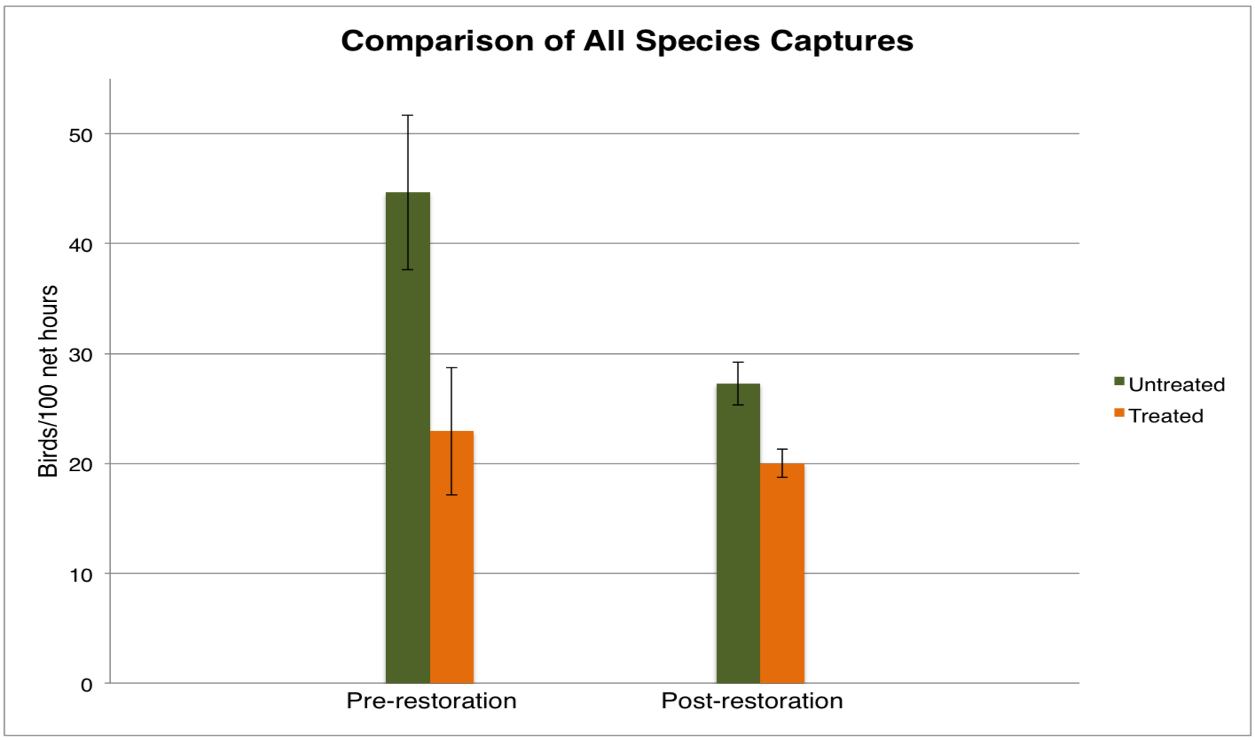

Figure 1: Comparison of capture rates of all species between untreated and treated areas before (p=0.044, σ_U=7.028, σ_T=5.804) and after (p=0.019, σ_U=1.944, σ_T=1.305) restoration of an oak woodland in Finley NWR, Oregon.

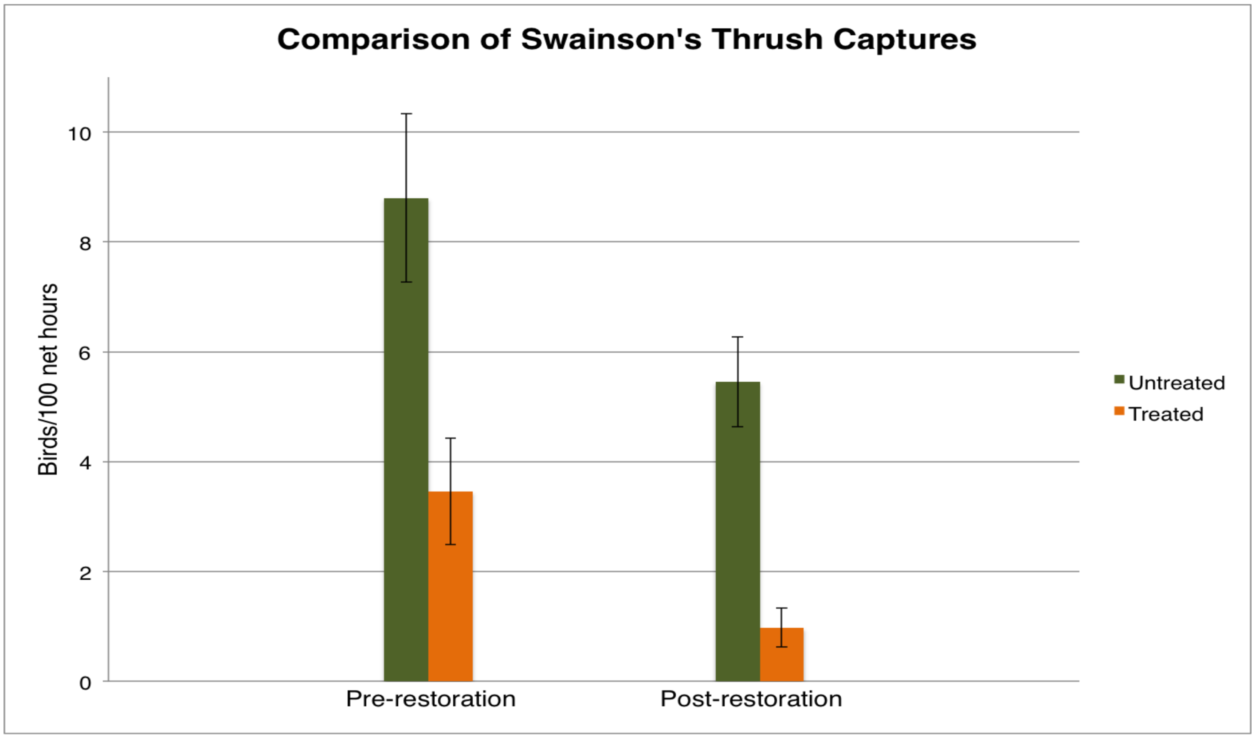

Figure 2: Comparison of capture rates of Swainson's Thrush between untreated and treated areas before ($p=0.019$, $\sigma_U=1.538$, $\sigma_T=0.968$), and after ($p=0.001$, $\sigma_U=0.816$, $\sigma_T=0.354$) restoration of an oak woodland in Finley NWR, Oregon.

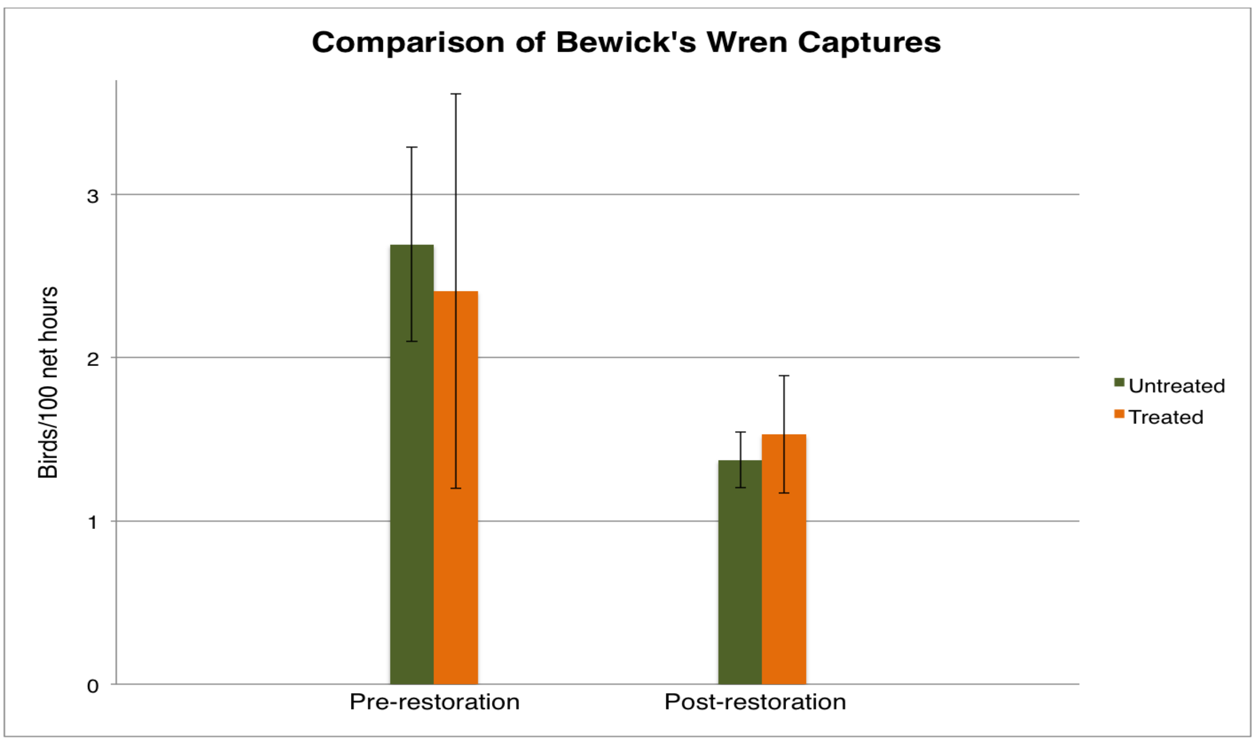

Figure 3: Comparison of capture rates of Bewick's Wren between untreated and treated areas before ($p=0.837$, $\sigma_U=0.594$, $\sigma_T=1.208$) and after ($p=0.705$, $\sigma_U=0.171$, $\sigma_T=0.359$) restoration of an oak woodland in Finley NWR, Oregon.

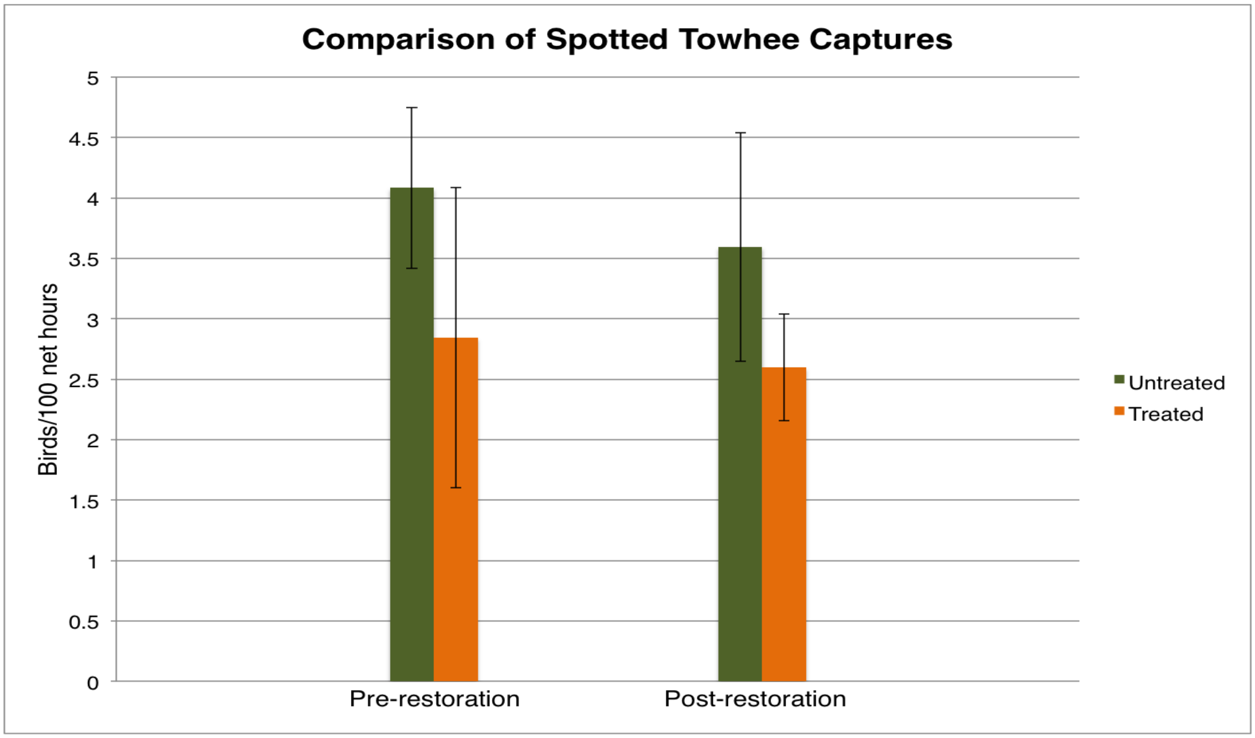

Figure 4: Comparison of capture rates of Spotted Towhee between untreated and treated areas before ($p=0.405$, $\sigma_U=0.666$, $\sigma_T=1.241$) and after ($p=0.368$, $\sigma_U=0.947$, $\sigma_T=0.441$) restoration of an oak woodland in Finley NWR, Oregon.

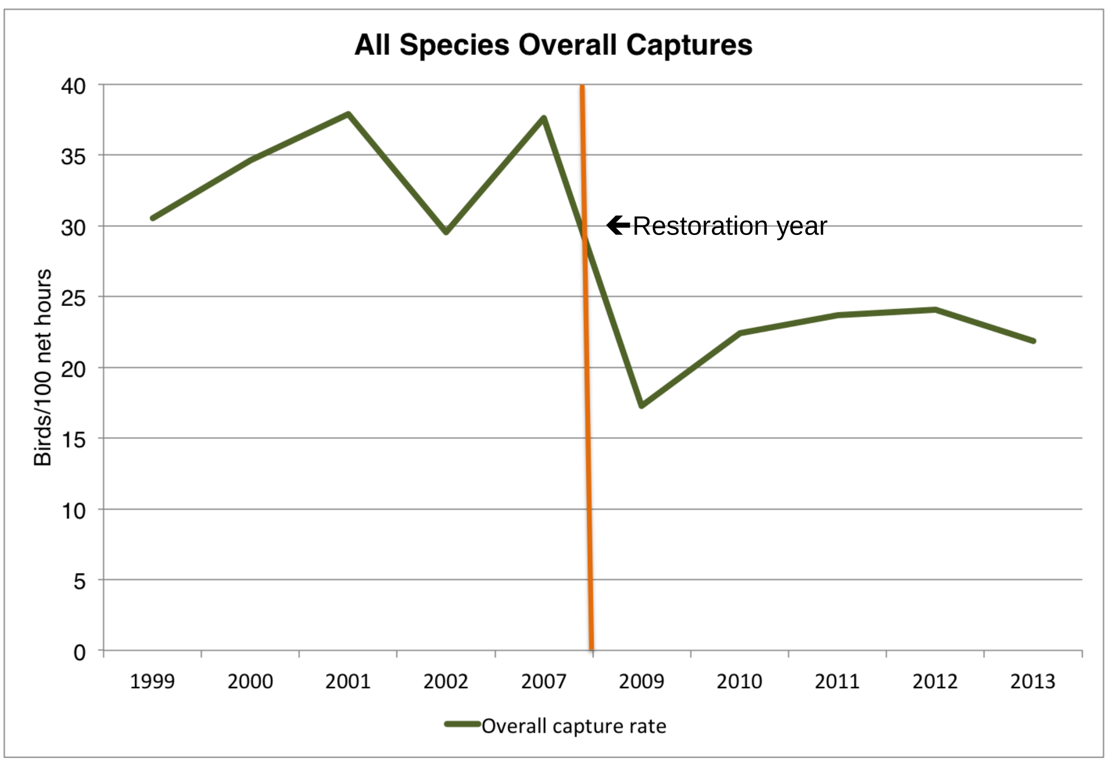

Figure 5: Comparison of all species overall captures before versus after ($p<0.001$, $\sigma_{pre}=1.738$, $\sigma_{post}=1.217$) restoration of an oak woodland in Finley NWR, Oregon.

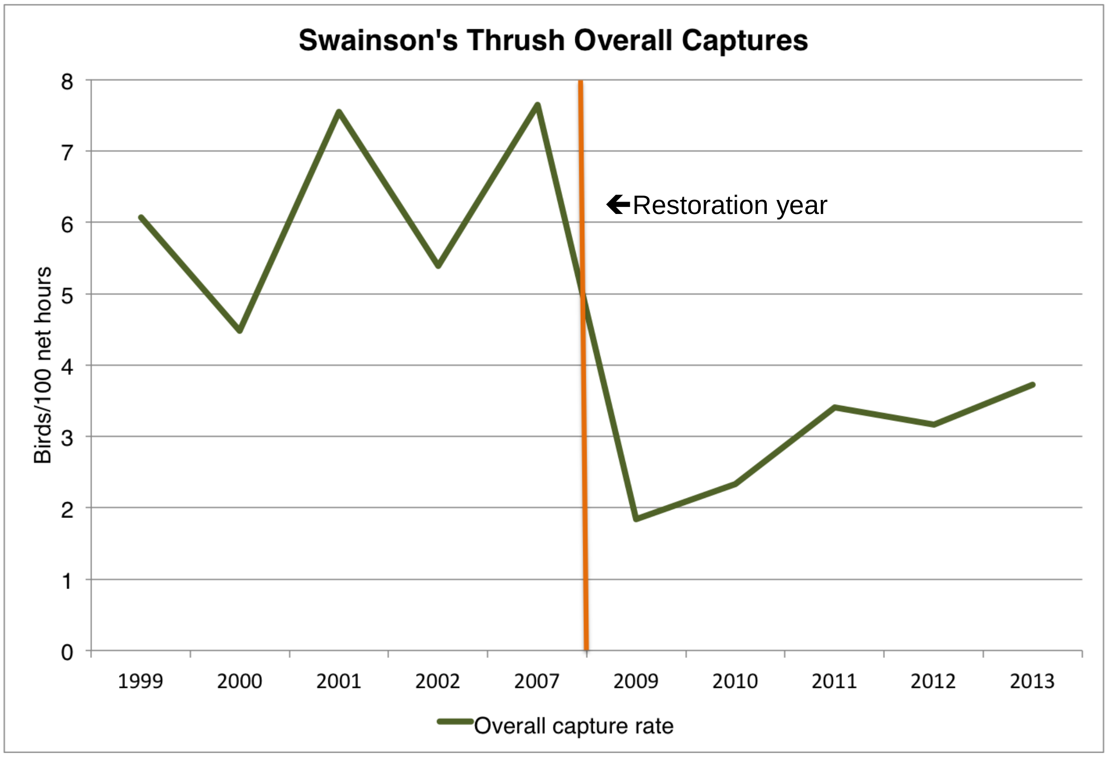

Figure 6: Comparison of Swainson's Thrush overall captures before versus after ($p=0.002$, $\sigma_{pre}=0.614$, $\sigma_{post}=0.350$) restoration of an oak woodland in Finley NWR, Oregon.

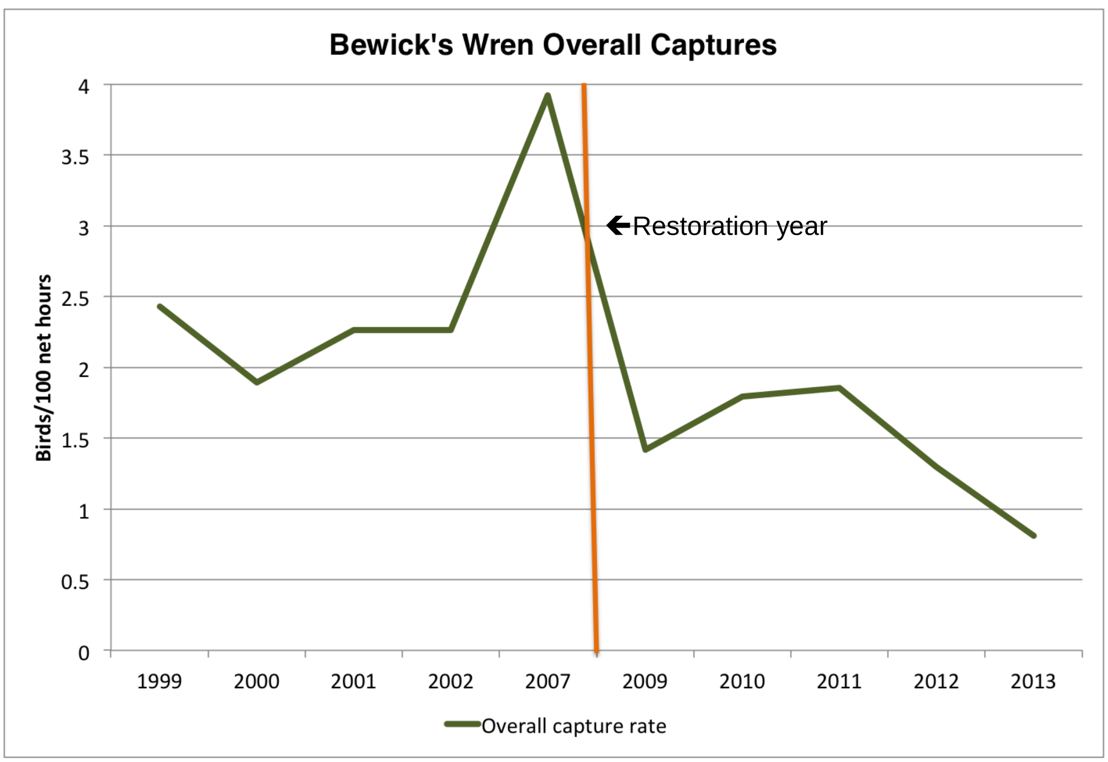

Figure 7: Comparison of Bewick's Wren overall captures before versus after ($p=0.013$, $\sigma_{pre}=0.353$, $\sigma_{post}=0.189$) restoration of an oak woodland in Finley NWR, Oregon.

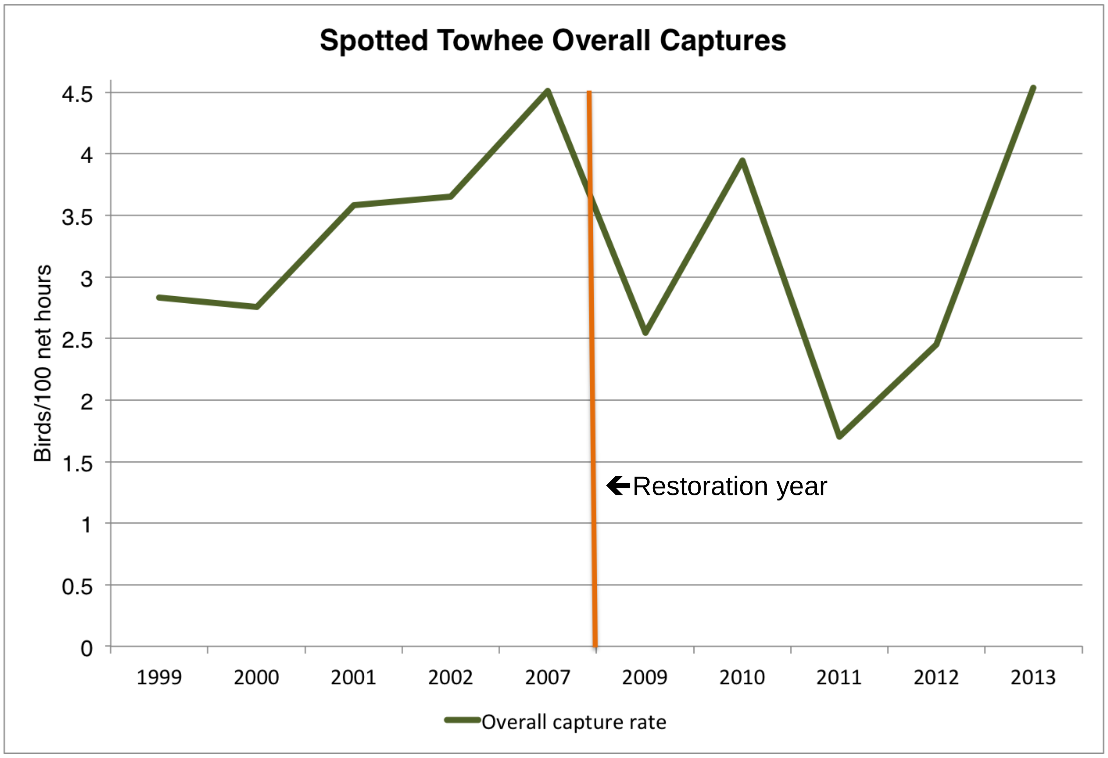

Figure 8: Comparison of Spotted Towhee overall captures before versus after (p=0.502, σ_{pre}=0.320, σ_{post}=0.522) restoration of an oak woodland in Finley NWR, Oregon.

Discussion

Before restoration, all species were captured significantly more often in the untreated area than the treated area (Figure 1, p=0.04), although it was predicted that there would be no difference. All species were captured more frequently in the untreated nets than the treated nets both before and after restoration. Figure 1 show that the capture rate in the untreated nets fell greatly from before restoration to after restoration, but the capture rate in the treated nets only fell a small amount. If there was no effect from restoration, we would expect the relationship between the capture rates in the untreated and treated areas to stay the same from before restoration to after restoration. The change in the relationship suggests that treatment positively affected all species. When comparing capture rates in all nets from before restoration versus after restoration, all species overall capture rates were significantly less after restoration than before restoration (Figure 5, p<0.001). Many bird species have experienced population declines in Oregon (Sauer et al. 2014), so the drop in overall capture rates is not surprising, but is alarming. Clearly something statewide is affecting birds and needs to be addressed.

There was a significant difference in the capture rates in untreated versus treated areas before restoration for Swainson's Thrush (Figure 2, p=0.019). Swainson's Thrushes were also captured more frequently in the untreated area than the treated area after restoration (Figure 2, p=0.001). Swainson's Thrush overall capture rates have fallen from before restoration to after restoration (Figure 6, p=0.002). The decrease in capture rates of Swainson's Thrush across all categories makes sense because Swainson's Thrushes prefer dense, closed canopy habitats with plenty of brush in which to nest (Mack 2000). The relationship between the untreated and treated area remained the same from before restoration to after restoration, suggesting that restoration had no affect on Swainson's Thrushes at Pigeon Butte. Swainson's Thrushes probably used the treated area less before restoration because it was an edge habitat (Image 1) and more exposed to the elements. Restoring the area encouraged them to stay out of the area because the canopy opened up and the understory brush was cleared out. The Swainson's Thrush population in Oregon has been falling since 1966: the population decreased by 1.32% from 2002 to 2012 (Sauer et al. 2014). A decrease in the population throughout the state is partially responsible for the decreased capture rate of Swainson's Thrush from before restoration to after restoration.

There was no significant difference before restoration in the capture rates of Bewick's Wren for untreated versus treated areas (Figure 3, p=0.837). There was also no difference in the capture rates after restoration between untreated versus treated areas for Bewick's Wren (Figure 3, p=0.705). Because the relationship between the untreated and treated area remained the same after restoration, restoration did not appear to affect Bewick's Wrens. It did appear that the relationship was beginning to change between untreated and treated areas, but not yet at a statistical significance. Bewick's Wrens were captured less before restoration than after restoration (Figure 7, p=0.013). The increase in overall capture rates suggests that the restoration may have had a positive affect on the Bewick's Wren. Once the brushy understory is allowed to develop more a Pigeon Butte, more Bewick's Wrens should be captured in the treated area. Like the population at Pigeon Butte, the Bewick's Wren population has also been falling in Oregon, decreasing by 0.20% from 2002 to 2012 (Sauer et al. 2014). This population decrease is not surprising because of the loss of oak woodlands across the Willamette Valley.

There was no significant change in the differences between Spotted Towhee capture in the untreated versus treated nets before (Figure 4, p=0.405) and after (Figure 4, p=0.368) restoration, although they appear to be more likely to be captured in the untreated area. This suggests that Spotted Towhees were not affected by treatment. The overall capture rate of Spotted Towhees at Pigeon Butte has also remained the same from before restoration to after restoration (Figure 8, p=0.502), although there is variation from year to year. Notably, the Spotted Towhee population in Oregon has been decreasing at a growing rate since 1966: the population decreased by 1.14% from 1966 to 2002 and 1.74% from 2002 to 2012 (Sauer et al. 2014). It is interesting that the population seems to be remaining fairly stable at Pigeon Butte. The habitat seems to be sustaining the population of Spotted Towhees at Pigeon Butte, and has reached the point of saturation. It appears that small oak habitats can be useful for Spotted Towhees.

The lower capture rate in the area to be treated compared to the untreated area before the treatment was applied was unexpected. Edge effects may have contributed to lower capture rates in the treated area during the pre-treatment phase because several nets in the treated area were located along edges of the woodland (Image 1). Birds are more susceptible to predation in edge habitats and are more exposed to the elements (McCollin 1998). This might result in fewer birds using the treated area because it is the edge habitat. It would be interesting to see if similar results would be found at a site at which both the untreated and treated areas were surrounded by woodland, so that neither would be an edge habitat.

The treated area was closer to an agricultural field where large, loud farming equipment is often used. This may have discouraged birds from using this area even before treatment, explaining why there was a difference between capture rates in the untreated and treated areas even before restoration. Francis et al. (2011) found that birds nested further away from noise disturbances that interfered with the frequency of their calls. The Francis et al. (2011) study took place in an area where heavy equipment was used 24 hours a day, 365 days a year. The farming equipment may not have as great an effect on the birds in our study because it is not used every day, but it is still possible that it had some effect.

It is possible that some of the lower capture rates did not reflect actual declines in abundance, but were caused by logistics related to mist-netting. It is much easier to see mist nets in lighter areas. The more open canopy of the treated area allowed more sunlight into the understory, making the nets easier to see. Birds in the treated area could easily avoid being captured by flying around the more visible nets.

Conclusion

From 1999-2013 the bird community abundance at Pigeon Butte has decreased. These reductions could be a reflection of the decreasing bird populations across Oregon. Over fifty bird species have decreased in abundance since 2002 (Sauer et al. 2014). Previous studies suggested there would be greater, not lower, abundances in opened canopy areas of the treated areas of Pigeon Butte. In combination with potential regional declines, there could be several factors contributing to these patterns including site characteristics, study design or temporal variations.

We have noted the potential confounding factors associated with edge habitats in transition between treated and untreated areas of the study site. Moreover species that prefer the untreated area could be decreasing because of the loss of closed canopy habitat in Pigeon Butte following treatment.

This study will be expanded by several more years of data collection of the ongoing restoration. More capture data will help detect long-term patterns in bird response to woodland management It would also be beneficial to establish replicate study sites that represent the variability in oak woodlands and restoration projects in the Willamette Valley, Oregon. For example, there is annual mowing at Pigeon Butte, which simulates disturbance by seasonal fires, but it would be interesting to study a site that used controlled burns to maintain restoration efforts. Future sites may include areas where the treated habitat is in a protected area and the untreated area is on the edge of the habitat in order to see if edge effects play a role in capture rates. Future studies should also focus on describing habitat by taking an inventory of plants present, especially potential and important food sources for birds.

There should be a study conducted to look at the health and acorn production of the oak trees. Although dead oak limbs are great for cavity nesters, they are not good for producing acorns. Acorn production is important for a food source for birds and other animals, oak reproduction and as a nutrient source for the soil. If acorns are not being produced in abundance, then restoration may have little or no effect.

Bird conservation across Oregon needs to be a greater priority because all bird species populations of interest are decreasing across the state. One restoration site is not enough to help these populations if oak woodlands continue to disappear throughout the Willamette Valley. Results from this and related studies can inform private landowners about the ecological benefits of oak woodlands on their property and encourage them to keep more oaks in their fields. In addition this research may help state agencies decide how to carry out oak woodlands restoration and raise public awareness of this unique natural resource. Though this study has contributed to our knowledge about migratory songbirds in the Willamette Valley it leaves more questions about the ecological effects of Oregon white oak restoration. These questions will benefit from the continuing study at Pigeon Butte.

Acknowledgements

During the summer of 2013, Joan Hagar, Molly Monroe, and myself collected data at Pigeon Butte. I also used data previously collected from 1999 to 2002, 2007, and 2009 to 2012 by Joan Hagar and her associates.

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Primary Mentor: Dr. Joan Hagar, US Geological Survey
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Appendix

Table 1: Mean capture rates of all bird species captured at Pigeon Butte. Focal species of this study are in bold font.

Species	Before Restoration	After Restoration	Difference
American Goldfinch	0.15	0.12	-0.02
American Robin	1.82	1.06	-0.77
Black-capped Chickadee	1.82	0.47	-1.36
Bewick's Wren	2.53	1.43	-1.10
Brown-headed Cowbird	0.07	0.16	0.08
Black-headed Grosbeak	0.15	0.09	-0.06
Brown Creeper	1.12	0.87	-0.25
Black-throated Gray Warbler	0.67	0.19	-0.48
Bushtit	0.07	0.00	-0.07
California Quail	0.00	0.03	0.03
Cassin's Vireo	0.00	0.12	0.12
Cedar Waxwing	0.00	0.12	0.12
Common Yellowthroat	1.26	0.93	-0.33
Downy Woodpecker	0.22	0.34	0.12
Hairy Woodpecker	0.11	0.12	0.01
House Wren	0.04	0.25	0.21
Hudson's Vireo	0.19	0.09	-0.09
Lazuli Bunting	0.11	0.43	0.32
MaGillivray's Warbler	0.37	0.00	-0.37
Northern Flicker	0.00	0.03	0.03
Orange-crowned Warbler	4.50	1.71	-2.79
Oregon Junco	0.22	0.22	-0.01
Pacific Slope Flycatcher	0.71	0.56	-0.15
Purple Finch	0.89	1.18	0.29
Red-breastead Nuthatch	0.00	0.06	0.06
Red-bellied Sapsucker	0.19	0.12	-0.06
Red-shafted flicker	0.04	0.03	-0.01
Rufous Hummingbird	1.75	0.96	-0.78
Song Sparrow	1.67	0.87	-0.80
Spotted Towhee	3.46	2.98	-0.48
Stellar's Jay	0.04	0.00	-0.04
Swainson's Thrush	6.17	2.89	-3.28
Warbling Vireo	0.00	0.06	0.06
White-breasted Nuthatch	0.07	0.28	0.21
Western Bluebird	0.00	0.03	0.03
Western Scrub-jay	0.04	0.03	-0.01
Western Tanager	0.89	1.15	0.26
Western Wood-Pewee	0.56	0.71	0.16
Willow Flycatcher	0.04	0.00	-0.04

Wilson's Warbler	0.63	0.25	-0.38
Pacific Wren	1.41	0.68	-0.73
Wrentit	0.00	0.16	0.16
Yellow-breasted Chat	0.04	0.00	-0.04
Grand Total	34.01	21.79	-12.22

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