AVIAN MONITORING AND ECOLOGICAL RESTORATION: A COMPARISON OF DATA COLLECTION METHODS

by

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A THESIS

Presented to the Department of Environmental Studies
and the Robert D. Clark Honors College
in partial fulfillment of the requirements for the degree of
Bachelor of Science

June 2025

An Abstract of the Thesis of

Gracie Sheaman for the degree of Bachelor of Science
in the Department of Environmental Studies to be taken June 2025

Title: Avian Monitoring and Ecological Restoration: A Comparison of Data Collection Methods

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Oak savanna and grassland prairie habitats are facing significant threats of ecological extinction in the Pacific Northwest. Previously prominent throughout Oregon under the stewardship of Indigenous communities and managed using prescribed fire, oak savannas and prairies experienced major declines after European settlement introduced fire suppression laws in the mid-19th century. As a result, native oak savanna and grassland prairie ecosystems were lost to encroaching conifer woodlands and agricultural development. Now, an estimated less than five percent of native oak savanna and prairie ecosystems remain, and associated bird species are among the most threatened avian populations in Oregon. For the conservation of these species, the restoration of oak savanna and grassland prairie habitats is of the greatest concern. The Howard Buford Recreation Area is a public recreational park managed by local organizations with the mission to restore native oak savanna and prairie ecosystems using traditional prescribed fire. Previous research conducted by the Environmental Leadership Program-sponsored Wildlife and Parks team at the University of Oregon evaluated the effects of park management methods on oak savanna and prairie bird behavior. This thesis expands on the Wildlife and Park team's research and investigates the efficacy of different avian monitoring methods as an indicator of ecosystem restoration progress. This research compares the Wildlife and Park team's five-minute point count methodology to data collected by an Autonomous Recording Unit (ARU). I evaluated the species detection of both by analyzing the richness of ARU species lists constructed using the same five-minute periods as the point counts. The mean number of species detected by the ARU (12, SE 2.7) was significantly higher than that of the Wildlife and Park team's point count data (9, SE 1.0) ($p = 0.054$, $n = 4$, $\alpha = 0.1$) during the designated pre- and post-treatment data collection periods. For three out of the four compared data collection periods, the ARU detected more species than the point counts; the only exception occurred on May 31st when both methods detected the same number of species. Additionally, during pre- and post-treatment periods, the ARU detected multiple oak savanna- and prairie-associated species relevant to the study that the point counts missed. Further, over the course of its total recorded hours, the ARU detected two important, at-risk oak savanna/grassland species previously missed in the Wildlife and Parks team's point count data collection (Acorn Woodpecker and White-breasted Nuthatch) that are crucial to the evaluation of HBRA's ecosystem restoration progress. This thesis concludes that ARUs are an accurate, efficient, and excellent source of avian data collection and can serve as useful tools in ecological restoration areas by detecting bird species that indicate oak savanna and grassland prairie habitat wellness. For maximum detectability and accuracy, I recommend using ARUs and point counts in tandem. Together, both methods provide a more holistic glimpse into avian populations and, therefore, ecosystem health.

This thesis includes collaboratively produced work.

Land Acknowledgement

This research was conducted on the traditional homelands of the Kalapuya people, the original inhabitants and stewards of the Willamette Valley, including the area now known as the Howard Buford Recreation Area in Springfield, Oregon. Following a series of treaties with the United States government in the 1850s, the Kalapuya people were systematically dispossessed of their ancestral territories and forcibly removed to the Grand Ronde and Siletz Reservations in Western Oregon. These removals were part of broader policies of settler colonialism that disrupted Indigenous lifeways and governance. Today, the descendants of the Kalapuya people are citizens of the Confederated Tribes of the Grand Ronde Community of Oregon and the Confederated Tribes of Siletz Indians. These sovereign nations continue to maintain cultural and political ties to their ancestral lands and are actively engaged in cultural revitalization, land stewardship, and tribal governance.

I respectfully acknowledge the enduring presence of the Kalapuya people, and I offer this statement as a gesture of recognition and respect. I am mindful that the benefits of my academic work are made possible through access to lands that were unjustly taken from Indigenous communities. As such, I wish to honor the Kalapuya people and to affirm their ongoing contributions and sovereignty in this region.

Acknowledgements

I would first like to thank Peg Boulay, my Primary Thesis Advisor, for her support, encouragement, and feedback throughout this process. Without her guidance, I would not have been able to complete my thesis project, nor would it have been as fun. I would like to thank my Clarks Honors College Representative Jean Faye as well, for his inspiring questions and enthusiastic engagement with my work. I would also like to express my great appreciation to Ethan Torres and my Wildlife and Parks team members. Their hard work and collaboration provided the foundation for my thesis, and working with them was one of the greatest experiences I've had at the University of Oregon. Finally, I would like to thank the Environmental Leadership Program for the opportunity and resources to conduct meaningful, collaborative research as an undergraduate. Under this program, I gained invaluable experience that made my individual research not only possible, but successful.

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Literature Review

Grassland and Oak Savanna Habitats

Oak savannas and grassland prairies are critically endangered in the Oregon Willamette Valley (Noss et al. 1995, ODFW 2016). In the Pacific Northwest, oak savannas and prairies have experienced more significant habitat degradation than most other regional ecosystems (Vesely and Rosenberg 2010). Oak savannas, previously affluent and carefully managed ecosystems in Oregon, have been reduced to less than five percent of their previous acreage (ODFW 2016). They are at risk of extinction due to competition with tall, fast-growing conifer forests (Hunter and Barbour 2001). Coniferous trees grow quicker and larger than oak trees, outcompeting oaks for necessary resources, such as sunlight, and inhibiting their growth. The encroachment of conifers and the hindered development of large, open-grown oak trees can lead to reduced oak crowns and side branching, thereby reducing structural diversity and habitat features depended on by oak-associated birds (von Oheimb et al. 2011). Previously in Oregon's history, Indigenous peoples relied on oak ecosystems for food and shelter and utilized strategic fire to protect and promote their longevity (Askins et al. 2007, Evans-Peters et al. 2024, Johannessen et al. 1971). Colonization in Oregon and the loss of Native American land stewardship during the 19th century introduced fire suppression laws and catalyzed the decline of prosperous oak savanna ecosystems (Hagar and Stern 2001).

Native grassland prairies provide abundant habitat for a diverse range of avian species and are a crucially productive ecosystem (Petermann and Buzhdygan 2021). However, less than one percent of native grassland prairies remain in the Oregon Willamette Valley (Alverson 2005, Samson and Knopf 1994). These ecosystem losses are greatly due to urban development and conversion into agricultural land, namely grain and grass seed production as a result of colonization (Askins et al. 2007, Johannessen et al. 1971). Additionally, grassland prairie ecosystem services are under threat of increasing climate change, such as carbon sequestration and forage production (DiGaudio et al. 2017). Understanding and supporting grassland ecology is crucial for the restoration of grassland prairie habitat, as well as the biodiversity and productivity they provide (Askins et al. 2007).

Grassland and Oak Savanna Bird Populations

Grassland and oak savanna ecosystems support both plant and animal biodiversity and provide habitat for many avian species in the Pacific Northwest, and the degradation of these ecosystems greatly threatens the bird populations that inhabit them. Almost half of the censused oak savanna- and grassland prairie-associated birds in the Pacific Northwest are facing population declines, range contractions, or extirpation (Altman 2011). The main oak savanna- and prairie-associated species at risk in the Willamette Valley include the Acorn Woodpecker, Chipping Sparrow, Oregon Vesper Sparrow, Western Bluebird, Western Meadowlark, and White-breasted Nuthatch (Altman and Stephens 2012, Myers and Kreager 2010, Vesely and Rosenberg 2010). As native avian populations face increasing threats, regions in Oregon have begun ecological restoration efforts. Birds serve as a useful indicator of ecosystem health (Hutto 1998) and provide a more inclusive and applicable assessment of restoration progress than vegetation metrics alone (Stephens et al. 2021). Previous research on the restoration of oak savanna habitats indicates a positive trend in oak-associated avian community composition with the implementation of prescribed fire in conifer-encroaching oak areas (Stephens et al. 2021). In a study comparing the efficacy of various oak restoration strategies, researchers found that prescribed burns were notably more successful than conifer removal alone (Livingston et al.

2016). Restoration of oak ecosystems enhances reproductive success for oak-associated birds compared to undisturbed closed-canopy forests (Brawn 2006). Further, while the loss of oak ecosystems leads to the reduction of oak-associated avian species, the restoration of oak habitats through the decrease of conifers does not significantly affect the abundance of forest-associated bird species (Brawn 2006).

The potential for grassland bird species extinction is of considerable concern (Samson and Knopf 1994). Across breeding biomes, grassland bird populations have shown the steepest, most consistent, and most widespread declines of any North American bird guild (Knopf 1994, Roseberg et al. 2019). Grassland prairie habitats provide valuable resources for a diverse range of birds (Askins et al. 2007) and support proper fuel and fattening for migrating species at stopover sites, which are a critical factor in the annual avian cycle (West and Swanson 2025). Previous conservation studies have indicated that the restoration of grassland prairie habitats leads to increased population densities of several vulnerable and threatened bird species (Pavlacky Jr. et al. 2021). Due to their important ecological role as habitat providers and hubs of avian biodiversity, oak savanna and grassland prairie ecosystems are of the highest concern, and their restoration is a top ecological priority.

Previous Research at Howard Buford Recreation Area

The Howard Buford Recreation Area in Springfield, Oregon is managed by several local organizations with the goal of restoring native oak savanna and prairie habitat, mainly using prescribed fire, to conserve and support the diversity of historically prevalent wildlife species (Habitat Management Plan 2018). In the spring of 2024, the Wildlife and Parks team of the Environmental Leadership Program at the University of Oregon, under the Environmental Studies department, conducted a four-week research project in partnership with Friends of

Buford Park and Mount Pisgah (FBPMP) (Binder et al. 2024). This research project, led by 11 undergraduate University of Oregon students, centered around the effects of park management strategies on bird populations inhabiting the area, designed to promote effective park management while minimizing the disturbance of sensitive avian wildlife (Binder et al. 2024). This thesis expands on the Wildlife and Park team's research by analyzing data from an additional audio recording source to evaluate avian monitoring methods and provide Friends of Buford Park with suggestions for continuous monitoring efforts.

Friends of Buford Park and Mount Pisgah's mission is to "nurture and restore [human] connection to nature" (Friends of Buford Park & Mt. Pisgah 2025). At Howard Buford Recreation Area, FBPMP encourages human recreation by maintaining hiking and equestrian trails and hosting guided tours. Human connection with nature is increasingly important each year as environmental issues worsen. Supporting immersion into nature is crucial for supporting the field of environmental science, as it promotes education, care for, and involvement in environmental issues (Friends of Buford Park & Mt. Pisgah 2025). The goal of this thesis is to support FBPMP's mission by comparing the ease and efficacy of two ecological data collection methods and providing strategies for future avian monitoring to most efficiently track restoration progress in the park.

Previous Point Count and Autonomous Recording Unit Comparisons

In recent years, Autonomous Recording Units (ARUs) have become a more commonly practiced data collection method in ecological research (Mennill 2024), though there are certain limitations to this technology and its use in the field. The main reservations ornithologists have regarding ARUs in avian research are the lower detection probabilities of cryptic species (those that vocalize quieter and less often relative to other birds), difficulty in estimating population size, and a large volume of data to process (Acevedo and Villanueva-Rivera 2006, Schuster et al. 2024). However, ARUs allow for non-invasive and time-effective data collection compared to traditional point counts (Gibb et al. 2018). There is conflicting research regarding the efficacy and detectability of ARUs compared to human-run point counts (Acevedo and Villanueva-Rivera 2006, Alquezar and Machado 2015, Castro et al. 2019, Hutto and Stutzman 2009, Mennill 2024). Some research found that ARUs exhibit significantly lower detectability or underestimate species richness compared to point counts (Hutto and Stutzman 2009, Mennill 2024), while others found similar or increased detectability in ARUs (Acevedo and Villanueva-Rivera 2006, Alquezar and Machado 2015, Castro et al. 2019). Even studies that determined successful detection in ARUs noted the importance and lack of the visual component attainable by point counts as opposed to ARUs (Acevedo and Villanueva-Rivera 2006, Alquezar and Machado 2015). Overall, though, Acevedo and Villanueva-Rivera (2006), Alquezar and Machado (2015), and Castro et al. (2019) determined that ARUs can be a useful, accurate, and cost-effective method for avian data collection. Further study is necessary in this area of ecological data collection and observation to establish and maximize the benefits of ARUs in conservation and restoration research.

Methods

Study Site

The Howard Buford Recreation Area (HBRA) (Appendix A), established in the 1970s, is a natural area located in Springfield, Oregon, in the Southern Willamette Valley near the Coast Fork of the Willamette River. It is owned by Lane County and managed by several organizations, including Lane County Parks, Mount Pisgah Arboretum, and Friends of Buford Park and Mount Pisgah. The HBRA is a popular recreation site among Eugene and Springfield residents, visited by both regulars and passersby alike. In addition to the beautiful Mount Pisgah and 17 miles of hiking trails, the HBRA offers various habitat types (oak savanna, grassland prairies, wetlands, riparian forests, oak woodlands, and coniferous forests) and abundant wildlife for observation and admiration by visitors. Friends of Buford Park and Mount Pisgah, a non-profit organization established in 1989, has been dedicated to restoring HBRA's oak savanna and prairie habitats for decades. To combat threats of encroaching coniferous trees, FBPMP has been implementing prescribed burns to revitalize and restore the native oak savanna habitat and support the native species that inhabit these ecosystems. Friends of Buford Park and Mount Pisgah prioritize the restoration and management of native ecosystems while simultaneously promoting recreational human use at the HBRA, supporting human immersion into nature to inspire connection, understanding, and education regarding pressing environmental issues.

Point Counts

Point Count Protocol

This study compares current data to data from previous research conducted by the Wildlife and Parks team of the Environmental Leadership Program at the University of Oregon in 2024 (Binder et al. 2024). The Wildlife and Parks team analyzed the relative abundance of oak savanna and grassland birds to measure the impact of motorized brush cutting using a Before-After Treatment design. The team implemented five-minute, multiple observer point counts (Nichols et al. 2000) at four brush cutting treatment sites in the HBRA: electric brush cutting in oak savanna, electric in grassland prairie, gas-powered in oak savanna, and gas-powered in grassland prairie. Stations were placed in areas with significant nesting resources to gauge the effect of trail maintenance on avian behavior. Initial point counts were conducted on Friday, May 24th, and Friday, May 31st, at approximately 7:40 am. Weather data (temperature, cloud cover, wind speed) was recorded to account for possible influence on bird behavior and detectability. Point counts were performed by groups of three to four Wildlife and Parks team members for maximum accuracy (Nichols et al. 2000). One individual served as the recorder/scribe, while the others acted as observers facing different directions to enhance the field of vision. The point counts were conducted using a 50-meter radius distance threshold, and species were recorded as being either within or outside of this radius, or as flyovers. Wildlife and Parks team members utilized technology such as Merlin Bird Sound ID to assist in species identification. Species were recorded using standard XXXX avian format (Klimkiewicz and Robbins 1978) on a standardized point count data sheet.

Before-After Treatment Procedure

After the initial 5-minute point count, there was a 10-minute rest period implemented before brush cutting treatment took place. After 10 minutes, volunteers of Friends of Buford Park used an HBRA-supplied gas-powered brush cutter for 10 minutes at the center of the designated point count range. Another 10-minute rest period occurred after brush cutting was completed, and lastly, a second and final five-minute point count was conducted. This provided data on birds present before and after noisy brush cutting occurred.

Autonomous Recording Unit (ARU) Protocol

During data collection at HBRA, two Wildlife Acoustics Song Meter Micro 2 ARUs were secured to oak tree branches along the trails of HBRA. They were placed on the evenings of Thursday, May 23rd, 2024, and Thursday, May 30th, 2024. These ARUs were retrieved in the afternoons of Sunday, May 26th, and Sunday, June 2nd. The ARUs recorded three hours of audio between 7 am and 10 am on Friday, May 24th, and Friday, May 31st, to collect additional data beyond our avian point counts. These dates marked the final two weeks of avian point count data collection. Similarly to the point counts, each ARU device was assigned a brush cutting treatment – gas or electric – and was positioned near its dedicated treatment zone. Both devices were secured to oak trees at least 15 meters away from the designated trail to avoid being seen by visitors and to prevent human interference or tampering with the ARUs. Due to complications with the microSD card in the ARU established at the electric treatment site, this thesis focuses solely on the audio collected by the device placed in the gas treatment zone. The audio data recorded by the gas treatment ARU was analyzed to identify bird calls and create a species list.

Analysis

I uploaded ARU audio to the computer program Kaleidoscope Lite, in which each hour of audio was separated into individual files. Through the program, the audio was exported into spectrograms and playable files. I played back the audio between a range of 2 and 11 kilohertz to isolate bird call/song frequencies and omit lower frequency distraction noises, such as traffic sounds and human voices. This frequency range proved to be sufficient for detecting bird sounds accurately. I attempted to use Kaleidoscope Pro’s cluster analysis software to separate different bird species' vocalizations but found it convoluted and unhelpful for my analysis. Instead, I played each hour of audio in full and recorded each bird species detected by call or song using the same XXXX avian format as the point count data. I identified species using Merlin Bird Sound ID as well as personal knowledge. I cross-referenced species detected by Merlin against previous literature regarding Oregon and Willamette Valley bird populations (Altman 2011, Gullion 1951, Myers and Kreager 2010, Shelton 1917) for validation and reasonability. I clipped the ARU recordings to match the exact five-minute pre- and post-treatment periods in which the Wildlife and Parks team conducted their original point counts (Binder et al. 2024) and created separate species lists using this ARU data for the May 24th and May 31st treatment periods. I also constructed a complete ARU species list over the range of the total recorded hours and analyzed it individually. I evaluated point count data and ARU data for species richness; ARU recordings do not account for the detection of multiple individuals, so I was unable to analyze relative abundance. I compared the data and performed a statistical analysis to investigate significant differences between the two data sources. This study utilized a one-sided t-test at an alpha of 0.1; ecological data analysis is typically conducted using an alpha of 0.05, but given the small sample size of this study, 0.1 is appropriate. My hypotheses in this analysis were as follows:

H_o: The mean number of species detected by the ARU and point counts is the same
H_a: The mean number of species detected by the ARU is greater than that of the point counts

I performed my statistical analysis in the computer program JMP Pro 17.

Results

Before-After Treatment Data Comparison

The first analysis evaluated differences between the initial data collected from the Wildlife and Parks team's point counts and the data collected from the ARU in the same time period. Except for the May 31st post-treatment period, the ARU detected a greater number of species than the point count (Fig. 1). During the post-treatment period on May 31st, the ARU and point count detected the same number of species (8). The greatest difference between the ARU and point count species detection occurred during the May 24th post-treatment period, when the ARU detected six more species than the point count (Fig. 1).

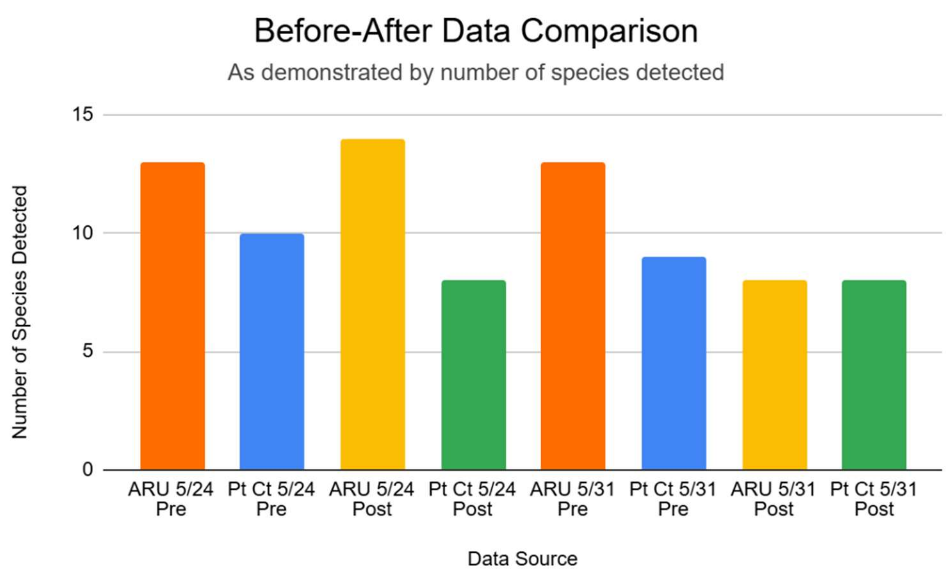


Figure 1: Before-After Treatment Data Comparison.

Comparison of ARU and Point Count data before and after gas brush cutting treatment. The maximum species count is 14 (ARU 5/24 Post), and the minimum is 8. The mean ARU species count is 12, and the mean point count species count is 8.75.

Statistical significance was evaluated by calculating the mean number of species detected for ARU and point count data. The mean number of species detected by the ARU across pre- and post-treatment periods (12, SE 2.7) was greater than that detected by point counts (8.75, SE 1.0) ($p = 0.054$, $n = 4$). With a one-sided t-test, the calculated p-value was 0.054, which rejects the null hypothesis and supports the hypothesis that the number of species detected by the ARU is greater than that of the point counts.

Unique Species Detection

The second analysis conducted in this study evaluated and compared unique species detected by the ARU and point counts. During both days of data collection, the number of species detected by both the ARU and point counts was greater than the number of unique species detected by either the ARU or point counts only (Figs. 2, 3). On May 31st, both the ARU and point counts detected the majority of unique bird species recorded (58.8%). On May 24th, less than half of the unique bird species recorded were detected by both the ARU and point counts (45.8%). In both distributions, more than one-third of the total species detected were unique to the ARU only and not recorded during the point counts (May 24th, 37.5%; May 31st, 35.3%). On May 24th, the ARU detected more unique species (9) than on May 31st (6) (Figs. 2, 3). This pattern is present in the point count data collections as well, with more unique species detected on May 24th (4) than on May 31st (1) (Figs. 2, 3). During both treatment data collection periods, more species were detected by the ARU and missed by the point counts than vice versa. On May 24th, the ARU detected 20 total species, and the point counts detected 15 (Fig. 2, Table 1). On May 31st, the ARU detected 16 total species, and the point counts detected 11 (Fig. 3, Table 2).

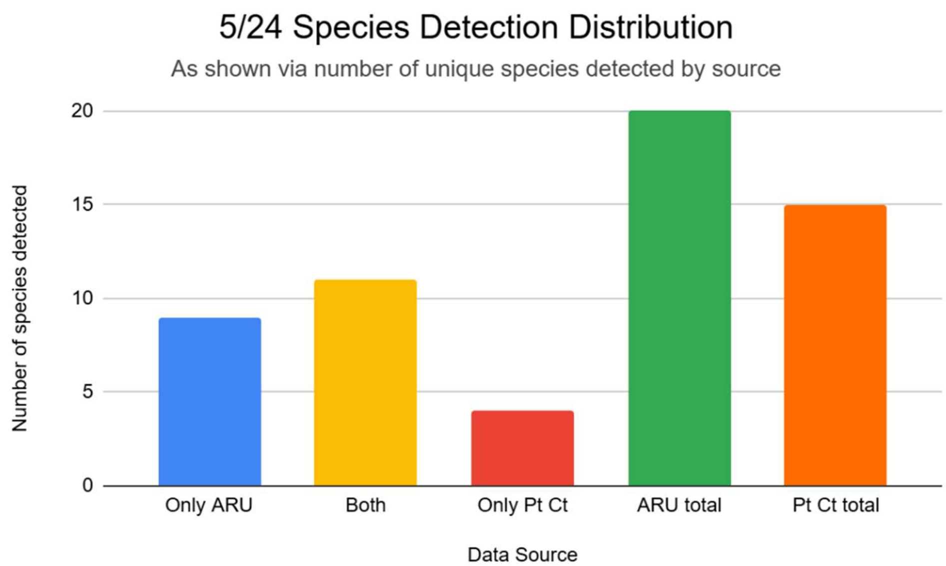


Figure 2: 5/24 Species Detection Numerical Distribution

The number of recorded species detected by either ARU, point counts, or both on May 24th. The greatest number of species recorded (11) was detected by both the ARU and point counts. The ARU detected more unique species (9) than the point counts (4).

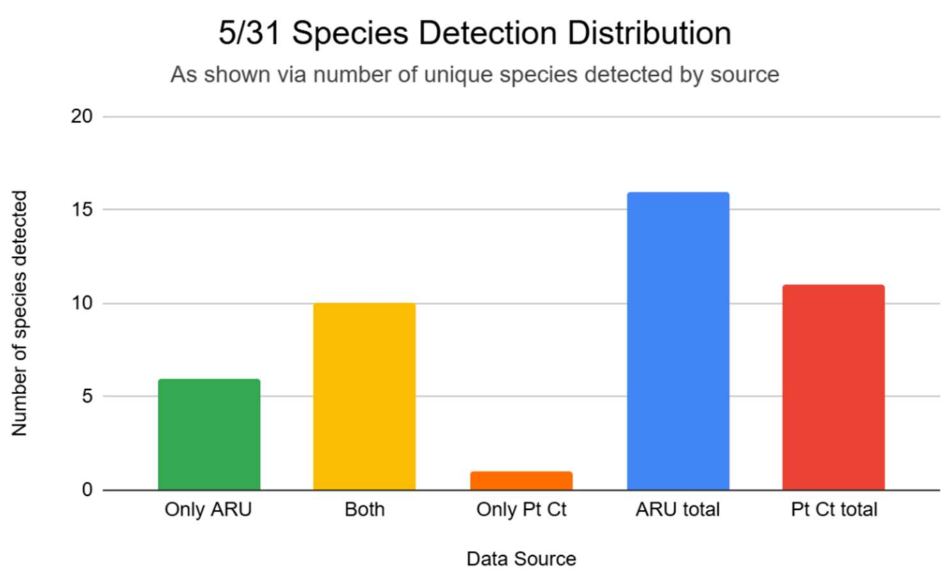


Figure 3: 5/31 Species Detection Numerical Distribution

The number of recorded species detected by either ARU, point counts, or both on May 31st. The greatest number of species recorded (10) was detected by both the ARU and point counts. The ARU detected more unique species (6) than the point counts (1).

List of Species, 5/24 treatment		
ARU Only	Both ARU and Point Count	Point Count Only
Bewick's Wren	American Robin	Black-throated Gray Warbler
Brown-headed Cowbird	Black-headed Grosbeak	Chipping Sparrow
Cassin's Vireo	Cedar Waxwing	Turkey Vulture
Song Sparrow	Common Yellowthroat	Yellow-rumped Warbler
Warbling Vireo	House Wren	
Western Tanager	Lazuli Bunting	
White-breasted Nuthatch	Lesser Goldfinch	
Willow Flycatcher	Spotted Towhee	
Wilson's Warbler	Violet-green Swallow	
	Western Flycatcher	
	Western Wood Pewee	

Table 1: Species List, May 24th Treatment Analysis.

Species that inhabit oak savanna and grassland prairie habitats are highlighted in purple.

List of Species, 5/31 treatment		
ARU Only	Both ARU and Point Count	Point Count Only
Bewick's Wren	American Robin	Steller's Jay
California Scrub-Jay	Black-headed Grosbeak	
Cassin's Vireo	Cedar Waxwing	
Common Yellowthroat	House Wren	
Red-winged Blackbird	Lazuli Bunting	
Song Sparrow	Lesser Goldfinch	
	Pine Siskin	
	Spotted Towhee	
	Violet-green Swallow	
	Western Wood Pewee	

Table 2: Species List, May 31st Treatment Analysis.

Species that inhabit oak savanna and grassland prairie habitats are highlighted in purple.

Total Species Detection

The final analysis in this study evaluated the total species richness recorded by the ARU during the pre- and post-treatment data collection periods and the entirety of its three-hour recording. On both May 24th and May 31st, the complete three-hour recording detected more species than the pre- and post-treatment data collection periods combined (Fig. 4). In total, the ARU detected 47 species between the May 24th and May 31st recordings (Fig. 4) (Appendix B).

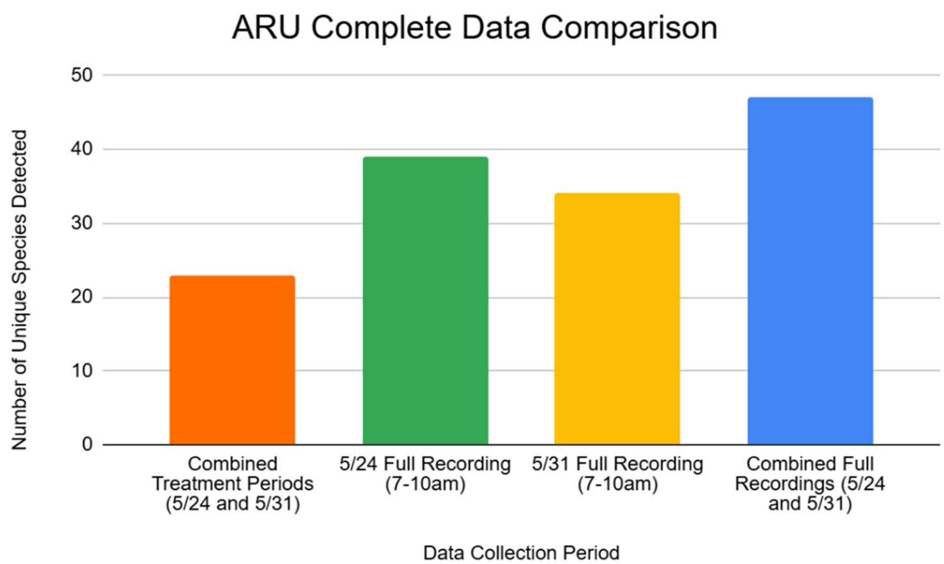


Figure 4: ARU Total Data Comparison

The distribution of the number of species detected by the ARU during treatment data collection compared to complete three-hour recordings. More species were detected on May 24th than May 31st (39 and 34, respectively). The combined ARU data between May 24th and May 31st recordings detected a total of 47 species.

Discussion

Treatment Data Comparison

The ARU detected significantly more species than the point counts during the pre- and post-treatment data collection periods. ARU devices detect sounds at greater distances than point counts, which means that it is possible the ARU, rather than detecting a larger number of oak savanna and grassland species, merely picked up bird sounds from non-oak savanna or prairie habitats. However, upon further investigation and analysis of the species list gathered by the ARU data during the pre- and post-treatment periods (Tables 1, 2), this study found that the ARU detected multiple oak savanna and grassland prairie species that the point counts did not. These species include Bewick’s Wren, Brown-headed Cowbird, California Scrub-Jay, Red-winged Blackbird, Song Sparrow, and White-breasted Nuthatch (Cornell Lab of Ornithology, Vesely and Rosenberg 2010) (Tables 1, 2). The ARU also detects birds at a range greater than that of the 50-meter point counts, so louder birds, such as the Bewick’s Wren, California Scrub-Jay, and Song Sparrow, can be heard at a farther distance, though in the same habitat. The ARU detection of previously missed and relevant species must be noted in the conversation regarding effective avian data collection strategies. Of course, there were species detected by point counts that were absent from the ARU data species list, including Black-throated Gray Warbler, Chipping Sparrow, Steller’s Jay, Turkey Vulture (flyover), and Yellow-rumped Warbler (Binder et al. 2024) (Tables 1, 2). Of these species, only the Chipping Sparrow is dependent on oak savanna habitats (Cornell Lab of Ornithology, Vesely and Rosenberg 2010). This research demonstrates that the ARU detected more species relevant to the study of threatened oak savanna and grassland bird species than the 2024 point counts.

Extended ARU Data

Throughout the six total hours of recording time on May 24th and May 31st, the ARU detected 47 species (Appendix B). During pre- and post-treatment data collection periods on both May 24th and May 31st, the ARU detected 23 species. Among the 24 species detected by the ARU outside of the treatment data collection periods, seven are oak savanna or grassland prairie birds. These species are Acorn Woodpecker, American Goldfinch, Chipping Sparrow, Downy Woodpecker, Killdeer, Northern Flicker, and Tree Swallow (Cornell Lab of Ornithology 2025, Vesely and Rosenberg 2010). The Acorn Woodpecker, Chipping Sparrow, and White-breasted Nuthatch are oak savanna birds considered to be of conservation concern under the Oregon Department of Fish and Wildlife (Altman and Stephens 2012, ODFW 2016). In this study, only the White-breasted Nuthatch was detected during the pre- and post-treatment data collection periods, as designated by the Wildlife and Park team's research (Binder et al. 2024). The extended recording time of the ARU was crucial in this study to detect two additional high-risk oak savanna bird species.

As the state of Oregon and conservation-focused public parks, such as the HBRA, continue to combat threats to oak savanna and grassland prairie habitats, bird monitoring practices are increasingly important. The detection of at-risk species provides critical data, and the discrepancies demonstrated in this study indicate shortcomings of short data collection periods. By using ARUs to collect data, management at the HBRA may be able to better detect and monitor valuable species of concern. Birds are indicator species of habitat prosperity, so by using more extensive data collection strategies that have a higher avian detection rate, the FBPMP can further their mission of restoring threatened habitats at HBRA through bird detection analysis, as demonstrated in this study. Additionally, management can implement

ARUs at various habitats throughout the park. One of the HBRA's goals is to restore Oregon Vesper Sparrow habitat in the Spring Box area of the park. In their research, the Wildlife and Parks team did not determine presence of the Oregon Vesper Sparrow at HBRA following an area search procedure (Binder et al. 2024). Rather than relying primarily on visuals to investigate Oregon Vesper Sparrows, ecosystem managers at the HBRA can place an ARU in the Spring Box Management Unit. This allows for more exact data regarding the date of the Oregon Vesper Sparrow's arrival at the park, and tools present in the Kaleidoscope computer analysis program, such as frequency isolation, increase the Oregon Vesper Sparrow's aural detection probability by drowning out distracting noise.

ARU Benefits

It is also important to note the decreased avian disturbance caused by the ARU compared to the point counts (Acevedo and Villanueva-Rivera 2006). In a popular recreational public park such as the HBRA, where the avian populations are accustomed to human presence, the less invasive characteristics of the ARU are moot. However, in future studies conducted in areas with little to no human and avian crossover, the inconspicuous nature of ARUs may prove invaluable. Further, ARU programming allows for the recording of specific dates and time ranges. This eliminates possible human error or unforeseen complications when it comes to replicating the exact timing of point counts or other data collection in a consistent study, such as that conducted by the Wildlife and Parks team (Binder et al. 2024). Especially in avian research studies, carefully repeated timing is crucial to maintain consistency and validity in data, as birds' behavior changes throughout the day. Limiting human error as much as possible is key to performing a reliable scientific study.

ARUs also offer ease and convenience as a data collection method. They reduce the time and resources required for consistent travel and set up that point counts necessitate and offer data collection over greater spatial and temporal scales (Acevedo and Villanueva-Rivera 2006, Gibb et al. 2018). This makes them especially efficient and valuable for long-term monitoring projects, which are necessary for the study of ecosystem and species conservation and restoration.

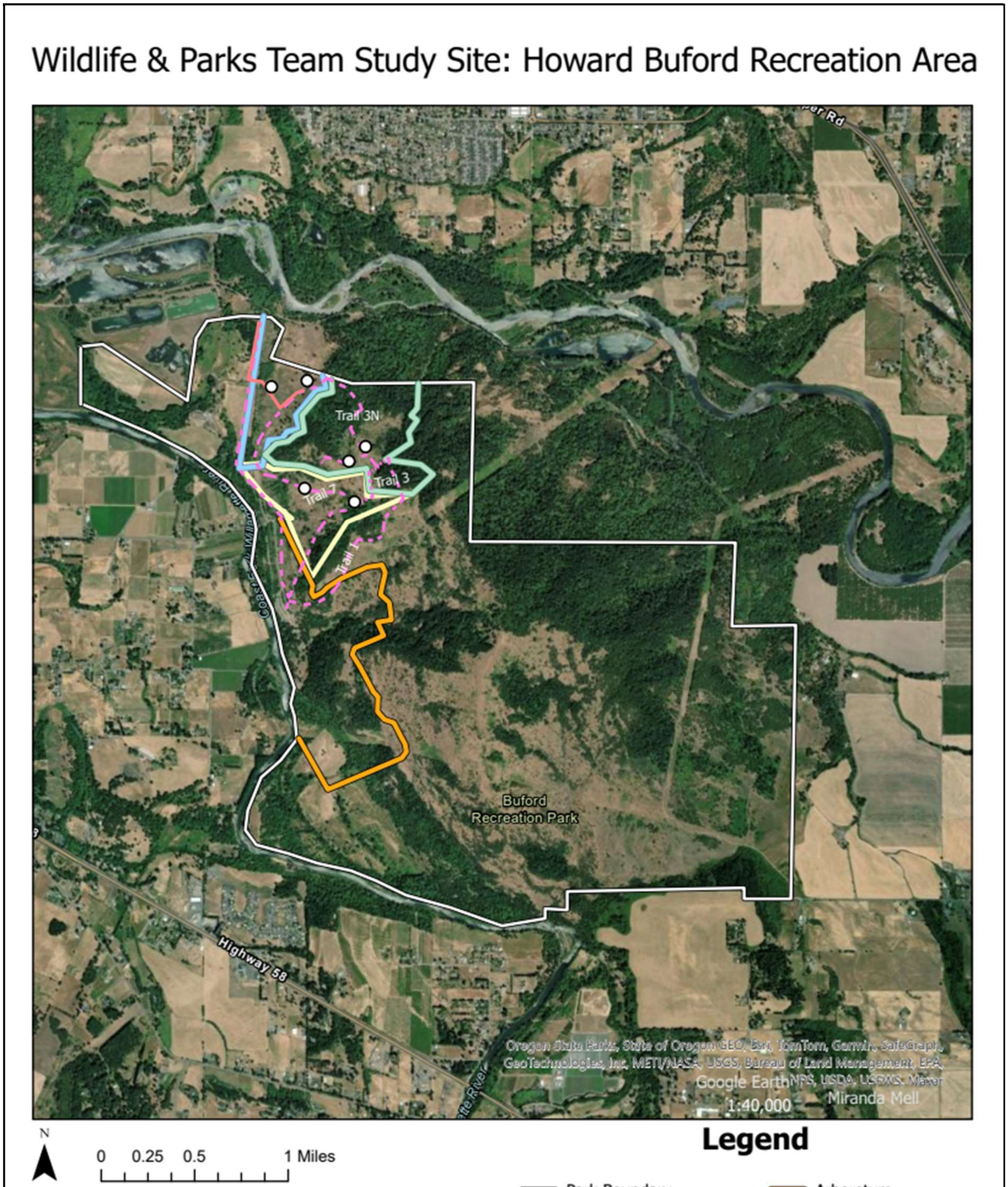
The two main limitations of ARU data collection in comparison to point counts are an inability to evaluate the number of individuals of a species (Acevedo and Villanueva-Rivera 2006, Schuster et al. 2024) and the distance of the bird sounds the ARU detects, which allows for population density estimates. Point counts also offer valuable visual information regarding the presence and behavior of the bird (Acevedo and Villanueva-Rivera 2006, Alquezar and Machado 2015), including the notation of flyovers and reproductive behavior. Despite these shortcomings, ARUs provide excellent data for species richness studies or presence-absence evaluations, especially for less-experienced birders who are unfamiliar with or lack the developed skill required for conducting point counts.

For maximum detectability and accuracy, I recommend using ARUs and point counts in tandem. Together, both methods provide a more holistic glimpse into avian populations and, therefore, ecosystem health. Point counts offer important visual data, and ARUs serve as an inclusive and accessible data collection method for projects with limited resources run by individuals who lack professional bird knowledge. With the enhanced detection of at-risk avian species utilizing ARUs in addition to traditional point counts, park managers can better evaluate habitat restoration progress; as indicator species, the studied observation of target species provides information on the wellness of oak savanna and grassland prairie habitats at HBRA and supports their improvement and longevity.

Conclusion

As oak savanna and grassland prairie bird species experience continued declines and population threats, the restoration of their habitat ecosystems is of top priority. The work of conservation-centered parks like the HBRA is crucial to the wellness of at-risk avian species, and efficient monitoring strategies are vital to their success. With the implementation of ARUs as a primary data collection tool and point counts as an additional method, these parks can more accurately and efficiently assess bird populations and ecosystem restoration progress to evaluate the best ways to revive healthy and productive natural environments.

APPENDIX A. Howard Buford Recreation Area Map



The map depicts Howard Buford Recreation Area, Wildlife & Park's study site. It includes the management units, arboretum, and trail system used throughout the project. The area search route and point count sites are used for park monitoring.

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APPENDIX B. ARU Complete Species List

Acorn Woodpecker
American Goldfinch
American Robin
Bewick's Wren
Black-headed Grosbeak
Black-throated Gray Warbler
Brown-headed Cowbird
Bullock's Oriole
Bushtit
California Scrub-Jay
Cassin's Vireo
Cedar Waxwing
Chipping Sparrow
Common Yellowthroat
Dark-eyed Junco
Downy Woodpecker
European Starling
Evening Grosbeak
Hermit Thrush
House Finch
House Wren
Hutton's Vireo
Killdeer
Lazuli Bunting
Lesser Goldfinch
Northern Flicker
Orange-crowned Warbler
Pine Siskin
Purple Finch
Purple Martin
Red-winged Blackbird
Song Sparrow
Spotted Towhee
Steller's Jay
Swainson's Thrush
Tree Swallow
Violet-green Swallow
Warbling Vireo
Western Flycatcher
Western Tanager
Western Wood Pewee
White-breasted Nuthatch
Willow Flycatcher

Wilson's Warbler
Wrentit
Yellow Warbler
Yellow-breasted Chat

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