Distribution and Relative Abundance of Common Poorwills (*Phalaenoptilus nuttallii)* During the Breeding Season in Western Nebraska

INTRODUCTION

Nightjars (Order: Caprimulgiformes, Family: Caprimulgidae) are nocturnal, insectivorous, cryptically-colored, ground-roosting birds that aerially capture prey (del Hoyo et al. 1999). The Common Poorwill (*Phaenoptilus nuttallii*), the smallest of the nightjars, occurs across much of the arid Great Plains in western North America (Csada and Brigham 1992, Vanner 2005). Determining the distribution, abundance, and associated conservation status of crepuscular and nocturnal bird species is often challenging because most surveys often occur during daylight hours, periods when these species are inactive and difficult to detect.

In Nebraska, the Common Poorwill is at the eastern edge of its range in North America (Sharpe et al. 2001). Poorwills are believed to be widely distributed and relatively numerous in western Nebraska, but information supporting these conclusions is limited (Mollhoff 2001). Common Poorwills begin to return to Nebraska in late April/early May, and initiate nests soon after (Sharpe et al. 2001). Records of young in Nebraska have been noted as early as 20 May (Sharpe et al. 2001). In Nebraska Poorwills have been suggested to have an association with native prairie, and occur in rocky, broken terrain in conjunction with a wide variety of forest types, including pines and brushy woodlands (Mollhoff 2001, Sharpe et al. 2001) and also in rocky areas near reservoirs (Thomas Walker, Nebraska Game and Parks Commission, pers. comm.). Poorwills are listed as probable regular breeders with a widespread (though localized)

distribution in Nebraska, but are also suggested to be underreported (Molhoff 2001, Sharpe et al. 2001). However, Rosche (1982) considered this species an uncommon to fairly common spring and autumn transient and summer resident, and further noted it was most common in Sioux County.

Currently, the Common Poorwill is listed as a Tier II species of conservation concern in Nebraska (Schneider et al. 2005). Information regarding habitat requirements and relative abundances for Common Poorwill was lacking throughout Nebraska. Therefore, there was a need for targeted breeding surveys in Nebraska. Our study objective was to determine the factors associated with Common Poorwill distribution and relative abundance in western Nebraska during the breeding season.

METHODS

Study Area and Site Selection

We conducted Common Poorwill surveys in western Nebraska. Within this region we focused on rocky outcrops based on the suggested breeding ecology of the species (Csada and Brigham 1992, Sharpe et al. 2001, Mollhoff 2001). We identified rocky outcrops and areas of high topographic relief using maps created from shapefiles derived from Soil Survey Geographic Data (SSURGO) and a Digital Elevation Model (DEM; 30m). We then stratified the study area into 7 geographic survey regions: Pine Ridge (PR), Northern Platte Breaks (NPB), Wildcat Hills North (WHN), Wildcat Hills South (WHS), Southwestern Panhandle (SWP), Southeastern Panhandle (SEP), and the Loess Canyons (LC).

Potential survey areas were based on the following criteria: 1) “blocks”, or variable sized pieces of land, with either suitable or marginal habitat based on SSURGO

and DEM outputs, and 2) areas located in proximity to a road or with access granted from private landowners. This selection process eliminated some areas of suitable/marginal habitat where access was limited. Although most agricultural land was eliminated from survey inclusion, we ensured that at least a small percentage of surveys were conducted in marginal breeding habitats (Sharpe et al. 2001). Marginal habitat blocks included 1) steep, rough terrain in a largely crop field matrix, 2) steep, rough terrain without trees, and 3) relatively flat native grasslands. The number of potential survey blocks per geographic region ranged from 5 to 14.

We randomly selected survey blocks from the pool of potential blocks within the 7 geographic regions. We allocated survey effort in proportion to the number of potential blocks in each region. Within each survey block, we established a line transect along a randomly selected road (vehicular survey) or interior point (walking survey). We conducted point counts every 800m along transects (10 points on road transects, 6 points on walking transects) until unsuitable habitat was encountered. The 800m was based on the maximum distance that radio tracked Poorwills were found traveling (500m) from nests (Csada and Brigham 1992), in order to reduce the number of double-counted birds. We randomly selected a total of 45 blocks, and surveyed each block at least once. We attempted to repeat surveys on approximately 20% of the selected blocks to assess impacts of migrant Common Poorwills on the number of individuals detected. We also used repeat surveys to assess the effects of time, moon phase, climatic conditions and survey methods on Poorwill detectability. A total of 55 surveys were conducted from 16 May – 13 June 2008, a period when Common Poorwills are establishing territories and are actively calling (Sharpe et al. 2001).

Common Poorwill Surveys

We used call playback surveys for Poorwills beginning in late April to identify when Poorwills started calling. Surveys were not conducted if wind speeds exceeded 32 km-hr^{-1} or if it was raining. We initiated surveys at dusk and continued through dawn on evenings when temperatures were 45 degrees Fahrenheit or higher. Research suggests that Poorwills enter torpor between 40 and 50 degrees (Csada and Brigham 1992). We recorded sky conditions and obtained percent moon illuminations from the U.S. Navy website (http://aa.usno.navy.mil/faq/docs/moon_phases), because moonlight is an indicator of Poorwill activity (Csada and Brigham 1992). We recorded habitat characteristics at each survey point, including tree presence/absence and type (deciduous/coniferous), overall landscape composition (native grassland/broken, rocky terrain/cropland), and relative topography (flat/steep).

Male Poorwills "call" to attract mates and protect their territory, and they are vocal throughout the entire breeding season, but calling is believed to be most intense early in the breeding season (Csada and Brigham 1992). Call playback is typically not used for nightjar surveys (U.S. Nightjar Survey Network, USNSN). It was believed that call playback would not be needed in our study area (Mike Wilson, USNSN, pers. comm.) and would only add a potential "male" bias to the study. However, while we conducted passive listening surveys for Common Poorwills at every point, we opted to conduct a call playback survey following the passive listening survey at every fifth survey point to stimulate vocal activity. Call playback surveys were conducted by playing 1 minute of Common Poorwill "call" prior to the 6 minute removal sampling period using a game caller (Model 48 Game Caller, FOXPRO, Inc., Lewistown, PA). We

collected data in the same manner during all surveys to identify any potential differences between the two survey methods.

We recorded Poorwills calling during the survey only once (during the first minute in which they were heard) during a six-minute survey, broken down into one-minute intervals. This allowed us to estimate detection probability for Common Poorwills using removal sampling (Farnsworth et al. 2002). Estimating detection probability allowed us to estimate the proportion of locations at which Common Poorwills were present but were not detected.

Analytical Methods

We estimated our detection probabilities using "time to detection" within each survey. We calculated the probability of a "first detection" at the time indicated using a geometric distribution at points where at least one Poorwill was recorded. We constructed a set of 10 models to explain variation in detection probability and included the following vaiables: wind speed, moon phase (proportion of full moon), sky condition (clear or overcast), surveyor, and use of call playback. Moon phase and sky condition were always included together along with their pairwise interaction, because sky condition influences the visibility of the moon. Five individuals conducted surveys; three individuals surveyed ≥ 30 points each and 2 individuals surveyed < 30 points each. We combined data for the two individuals with the fewest surveys to avoid numerical issues during model fitting. We created 6 main effect models including the null model (intercept only). The remaining 4 models were combinations of wind and the other main effects, including a global model with all effects and their pairwise interactions. We did not include interactions between surveyor and other main effects because of numerical

convergence issues. We used AIC_c to rank models (Burnham and Anderson 2002). We calculated model-averaged estimates and set the value of a given parameter to zero if the parameter was not included in a model. .

We compared Poorwill relative abundance among different habitat types. We also estimated relative densities for each geographic region to discern areas of highest Common Poorwill concentration in western Nebraska.

RESULTS

Our goal was to survey 45 different blocks (and also perform 10 repeat surveys), but we surveyed only 27 blocks (with 4 repeat surveys; Table 1). These 31 surveys were composed of 319 individual point counts (Table 1). Our first Poorwill detection was on 25 April 2008 during a Northern Saw-whet Owl (*Aegolius acadicus*) survey in the eastern Pine Ridge of the northern panhandle. We detected 124 potentially breeding Common Poorwills in western Nebraska. We encountered on ~60% of the survey transects (19 of 31). We recorded 124 Poorwills on 25% (n = 82) of the individual point counts (Figure 1). Recorded Poorwills ranged from a minimum of 1 (n = 45) to 4 (n = 3) individuals at a point (mean = 1.59). The amount of time we conducted surveys varied by geographic area with a minimum of 85 minutes in the North Platte Breaks to a maximum of 867 minutes in the Pine Ridge (Table 1). Our results indicated that Common Poorwill relative abundance was highest in the Wildcat Hills South, followed closely by the Southeast Panhandle and Pine Ridge (Table 1, Figure 2).

The global model of detection probability had the lowest AIC_c score (Table 2), but only had a weight of 0.38, indicating substantial model selection uncertainty. Four models had weights > 0.1, and all included the use of call playback. The most

parsimonious model included only call playback, suggesting that model nesting (Richard 2005) drove the apparent model selection. This conclusion is confirmed on inspection of the model-averaged parameter estimates (Table 3), which show that the only coefficient that is relatively strong ($t > 1.96$, df = ??) is the effect of call playback. The second best model nearly matched the top model, and included the effects that exceeded the null model on their own: wind, call playback and surveyor (Table 2). Thus, we used this model for subsequent prediction and analysis.

Detection probability decreased with increasing wind speed, and increased following call playback (Table 4, Figure 3). Detection probability and presumed activity (vocalizing) appeared to have little correlation with lunar phase/light levels (Figure 4), as had been previously reported for this species (Brigham and Barclay 1992) and other nightjars (Mills 1986). Without call playback we estimated detection probability = 0.39 (95% CI 0.30 - 0.49) per minute; but with call playback detection probability increased to 0.81 (95% CI 0.30 - 0.98). These detection rates correspond to a 95% and 99.9% chance respectively of detecting a Common Poorwill within 6 minutes.

Relative Poorwill abundances for our various habitat metrics fell in line with what we hypothesized to represent breeding habitat. Poorwill relative abundance was greatest in areas with large amounts of topographic relief compared to relatively flat areas (Figure 5), in areas with rough, broken terrain and native grasslands compared to agricultural fields (Figure 6), and in areas with a stand of tress (predominantly coniferous) surrounded by or intermixed with native prairie (Figure 7).

DISCUSSION

We detected Poorwills on over 60% of the blocks that we were able to survey, but we were limited in our effort by the number of available survey days that met our weather conditions. Breeding records for Poorwills in our study area range from nests being incubated in early June (9 and 11 June in Dawes County; Bennett 1975 and 1977, respectively), to the presence of a downy chick in Scottsbluff County on 18 July (Wayne Mollhoff, Nebraska Breeding Bird Atlas Coordinator, personal communication). Poorwills have a 20-21 day incubation period (Csada and Brigham 1992), suggesting that Poorwills may still be involved in nest initiation activities and could vocalizing in mid to late June. It could also suggest that Poorwills are raising multiple broods, further supported by the presence of a soft shelled egg in the oviduct of a bird harvested in Thomas County on 8 July, 1957 (Ford 1959).

We suggest Poorwills detected during owl surveys in late April were likely migrants, and that mid-May was the proper time to begin our surveys. However, we lack empirical data to fully support this assumption. We conducted a small number of surveys (n = 2) in mid-June (9 and 13 June), and on 9 June in the Wildcat Hills North we detected the highest number of calling Poorwills (n = 10) during our study, just shy of the high count for Nebraska (n = 12 in Sowbelly Canyon on 13 June 1998; Sharpe et al. 2001). We did not hear any Poorwills on 13 June, but we considered the block we surveyed to be marginal habitat (e.g., rough, sagebrush prairie). This suggests that Poorwills in western Nebraska may be on breeding territories in the middle of May, they may be actively calling much later than we thought, and therefore surveys could possibly be conducted for at least an additional two weeks compared to our a priori survey cutoff of 31 May.

The geographic areas we surveyed represented various-sized “islands” of breeding habitat. Relative abundance of Poorwills between our geographic regions varied greatly, but was highest in the Wildcat Hills South. This area was composed of rough terrain and stands of Ponderosa Pine (*Pinus ponderosa*), and had relatively little human development when compared with the Wildcat Hills North. The Southeast Panhandle and Pine Ridge areas also fit these criteria, and had the next highest densities of Poorwills. We detected Poorwills on one transect in the Southwest Panhandle that was located adjacent to rocky terrain and a small “island” of Limber Pine (*Pinus flexilis*). This was the only area in our study where breeding Poorwills (e.g., nestlings located in nest on 29 June 2007) had been documented in the last 32 years (Wayne Mollhoff, Nebraska Breeding Bird Atlas Coordinator, pers. comm.). While relative abundances of Poorwills were highest in the Wildcat Hills South and Southeastern Panhandle, we believe that the greatest abundance of Poorwills in western Nebraska still occurs within the Pine Ridge. This belief is based on the amount of available breeding habitat that is suitable for Poorwills in western Nebraska. The Northern Platte Breaks (rolling rocky terrain without trees) had the lowest relative abundance, but also had the least amount of survey effort. However, if Poorwills had been present at survey points within this region, our detection probability estimates suggest that we would have detected them at least once during the sampling interval. Similarly, the Loess Canyons area had a comparatively low relative abundance, but this was the only area where we were not able to use call playback. We do believe using call playback in the Loess Canyons would have resulted in a few more detections, but would not have significantly affected our relative abundance estimates for this area.

The six-minute removal sampling period was effective in detecting Common Poorwills in western Nebraska; without call playback we had a 95% chance of detecting a Poorwill if one was present. However, more precise estimates of Poorwill detectability would have been obtained had we distinguished individual Poorwills and recorded presence of each individual for every minute we heard them. Similarly, surveys without call playback (n = 267) provided suitable data for analysis, but surveys with call playback (n = 52) provided a better detection curve by allowing us to hear more Poorwills earlier in the sampling period. Call playback also proved to be important in increasing Poorwill detection probability regardless of other confounding variables. However, the use of call playback did not affect our relative abundance estimates, but rather increased our ability to detect a Poorwill if one was present at a site. However, the probability of detecting a Poorwill over the six-minute interval without call playback was 95% and nearly 100% when call playback was used, so we expect that our relative abundance estimates are only very slightly underestimated.

Not only did using call playback increase our detection probability, it also increased detectability in climatic conditions that may have otherwise thwarted attempts to survey this species (e.g., high winds). However, it remains unclear at what wind speed a surveyor's ability to detect Poorwill calls becomes limited in these high wind conditions, even with the use of call playback. Therefore, we suggest that the 32 km/hr wind speed cutoff used in this study was an appropriate limit for discontinuing surveys for Poorwills in western Nebraska. It appears possible that using call playback to conduct these surveys could lengthen the survey window from which sampling could realistically be done for this species. Regardless of lunar phase, type of survey, and sky

conditions, the use of call playback could be used to conduct surveys in sub-optimal conditions and therefore increase the number of available survey days in a year.

Poorwills were most often detected in areas with rough/rocky terrain, native vegetation, and a stand of coniferous trees with open prairie nearby. Our data suggest that presence of a stand of coniferous trees near open prairie was most important in encountering Poorwills. Of the 12 blocks where Poorwills were not encountered, all contained rough, rugged terrain but only 9 contained any significant amount of trees. Whether trees serve primarily as perches for capturing prey or serve a role in the nesting behavior of this species is uncertain. We did not locate nests during this survey, but instead based our results on the presence of calling birds (assumed to be males) during the breeding season. Therefore, our habitat associations are merely assumed to represent those of breeding birds, instead of being based on descriptions of actual nest sites. Our data did not allow us to determine the fine-scale habitat features that caused Poorwill relative abundances to vary among areas with similar large-scale habitat features. Future studies should address this question with respect to nesting sites, where fine-scale habitat conditions could be measured to better understand the breeding ecology of this species.

In conclusion, our study found that Common Poorwills are relatively common during the breeding season in localized areas throughout western Nebraska. Such areas contain rough terrain, coniferous forest stands, and high topographic relief. We suggest that a study addressing actual nesting habitat be conducted to further our knowledge on the breeding ecology of this species. Developing a baseline population estimate and understanding of Poorwill breeding ecology in Nebraska is important for the future,

especially considering potential impacts that land management and other conservation actions could have on this under-surveyed species.

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Table 1. Survey effort, number of Common Poorwills detected, and adjusted Common Poorwill survey densities for the various regions surveyed in western Nebraska during the spring of 2008.

Region	Transects	Surveys	Point Counts	Survey Minutes	Poorwills Detected	Poorwills / Survey Minute
Pine Ridge	8	8	97	867	31	0.036
North Platte Breaks	1	1	8	85	0	0.000
Wildcat Hills North	5	6	53	570	20	0.035
Wildcat Hills South	4	5	51	515	38	0.074
Southwest Panhandle	3	3	30	351	6	0.017
Southeast Panhandle	4	4	43	475	24	0.051
Loess Canyons	2	4	37	292	5	0.017
Total	27	31	319	3155	124	0.039

Table 2. Models of Common Poorwill detection probability, including the number of parameters in each model (*k)*, the distance between each model and the top model (ΔAIC_c) and the Akaike weight of evidence in favor of each model (w).

Model	*k*	ΔAIC_c	*w*
(1)wind * moon + sky + wind:sky + moon:sky _condition + Surveyor + broadcast + broadcast:wind	12	0.00	0.38
(2)wind * broadcast + Surveyor	7	0.18	0.34
(3)wind * broadcast	4	1.89	0.15
(4)broadcast	2	2.70	0.10
(5)wind + Surveyor	5	5.43	0.02
(6)wind	2	7.56	0.01
(7)Surveyor	4	11.43	0.00
(8)wind * moon + sky + wind:sky + moon:sky	7	12.80	0.00
(9)Null	1	13.16	0.00
(10)moon * sky	4	13.18	0.00

moon = moon phase; sky = sky condition; broadcast = use of call playback

Table 3. Model-averaged parameter estimates of factors influencing Common Poorwill detection probability; approximate *p* values assume 96 degrees of freedom (108 Poorwills – 12 parameters) and are a test of the hypothesis that the parameter is equal to zero.

Parameter	*Estimate*	*SE*	*t*	*Approximate p*
(Intercept)	-0.52	0.91	-0.58	0.566
wind	-0.22	0.18	-1.24	0.219
moon_phase	0.45	0.68	0.66	0.512
sky_conditionOvercast	-0.14	0.38	-0.36	0.720
SurveyorCombined	-0.07	0.54	-0.13	0.897
Surveyor1	0.65	0.87	0.74	0.459
Surveyor2	1.05	0.75	1.40	0.164
call_playbackYes	**2.04**	**0.72**	**2.82**	**0.006**
wind:moon_phase	0.11	0.17	0.64	0.524
wind:sky_conditionOvercast	0.12	0.17	0.71	0.479
moon_phase:sky_conditionOvercast	0.34	0.61	0.55	0.584
wind:call_playbackYes	-0.10	0.35	-0.28	0.778

Table 4. Parameter estimates for the selected model. Degrees of freedom for the *p* values are 96. The response variable for these models was Common Poorwill presence/absence.

Parameter	*Estimate*	*SE*	*t*	*p*
(Intercept)	0.03	0.21	0.14	0.890
Wind	**-0.13**	**0.04**	**-3.22**	**0.002**
SurveyorCombined	-0.53	0.49	-1.09	0.279
Surveyor1	0.20	0.53	0.38	0.702
Surveyor2	**0.90**	**0.27**	**3.28**	**0.001**
call_playbackYes	**2.02**	**0.67**	**3.02**	**0.003**
wind:call_playbackYes	-0.04	0.37	-0.10	0.921

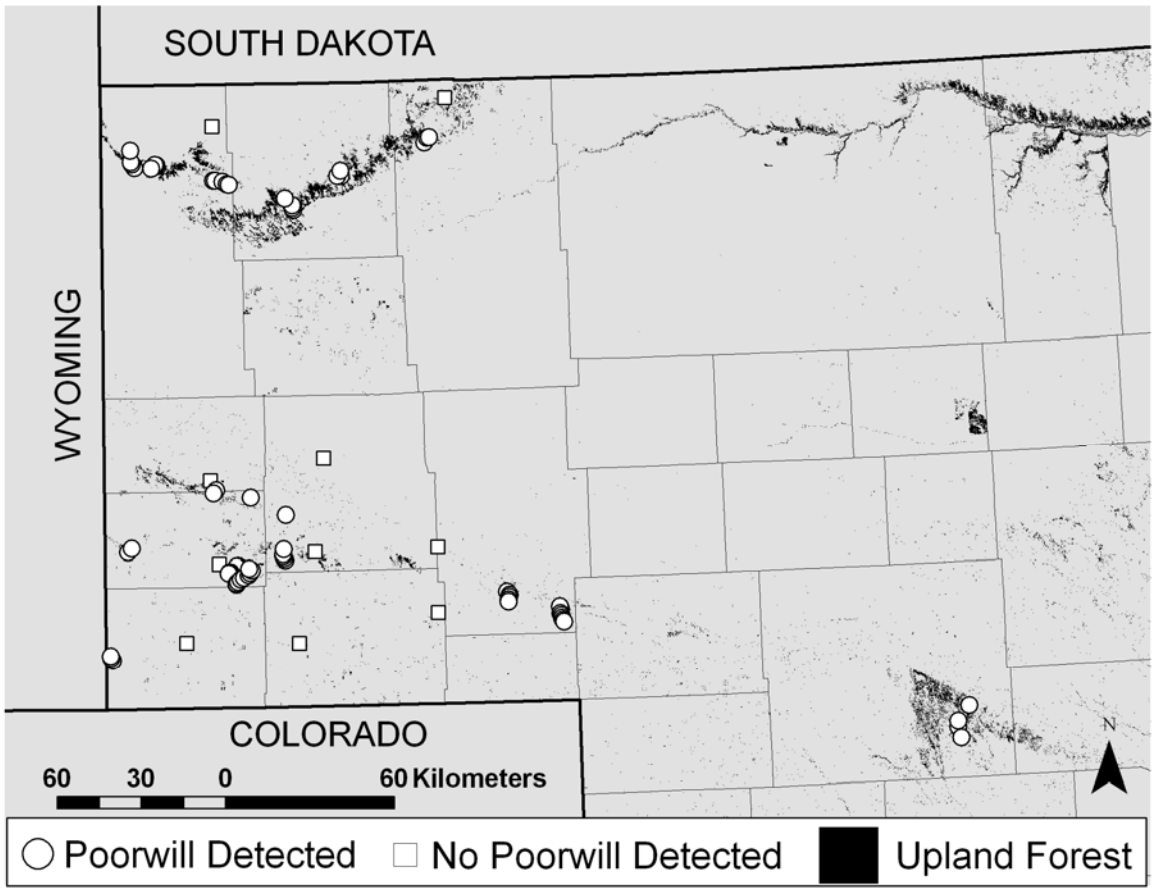

Figure 1. Survey points where Common Poorwills were encountered (white circles) and transects where they were not encountered (white squares) in western Nebraska during surveys in late May and early June 2008.

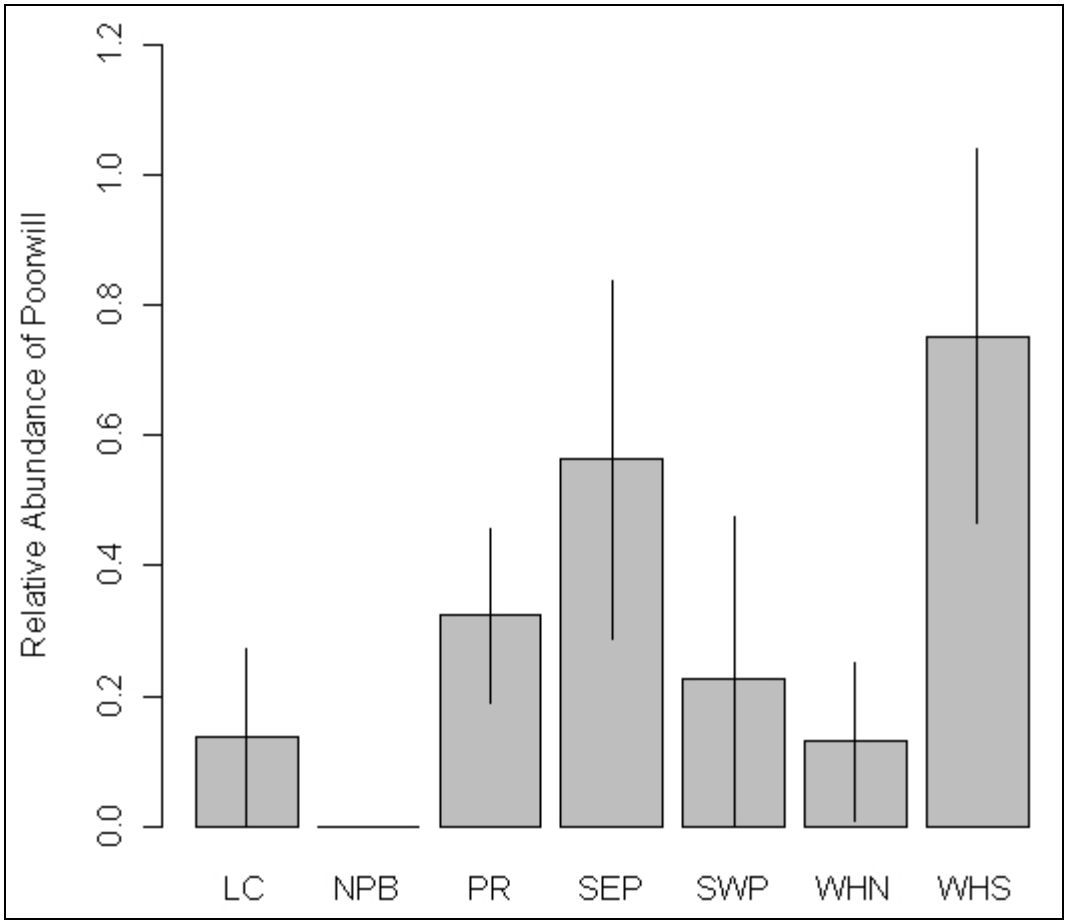

Figure 2. Relative abundances of Common Poorwill (Common Poorwills / 6 minute point count) and associated 95% confidence intervals (95% C.I. = 1.96 * SE) among the study regions surveyed in western Nebraska in late May and early June 2008. Regions include the Loess Canyons (LC), Northern Platte Breaks (NPB), Pine Ridge (PR), Southeastern Panhandle (SEP), Southwestern Panhandle (SWP), Wildcat Hills North (WHN), and Wildcat Hills South (WHS).

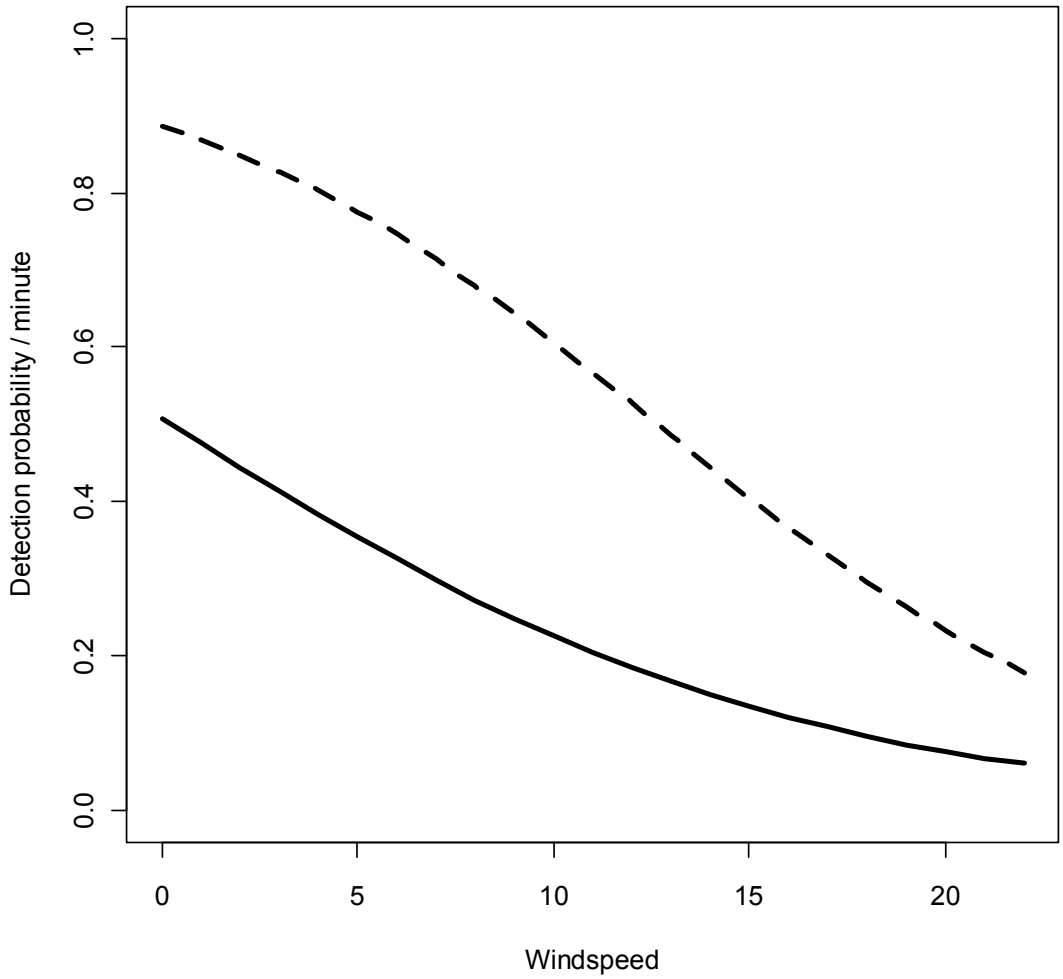

Figure 3. Detection probability as a function of wind speed for Common Poorwills in western Nebraska, 2008. Solid line is without call playback, dashed line is with call playback.

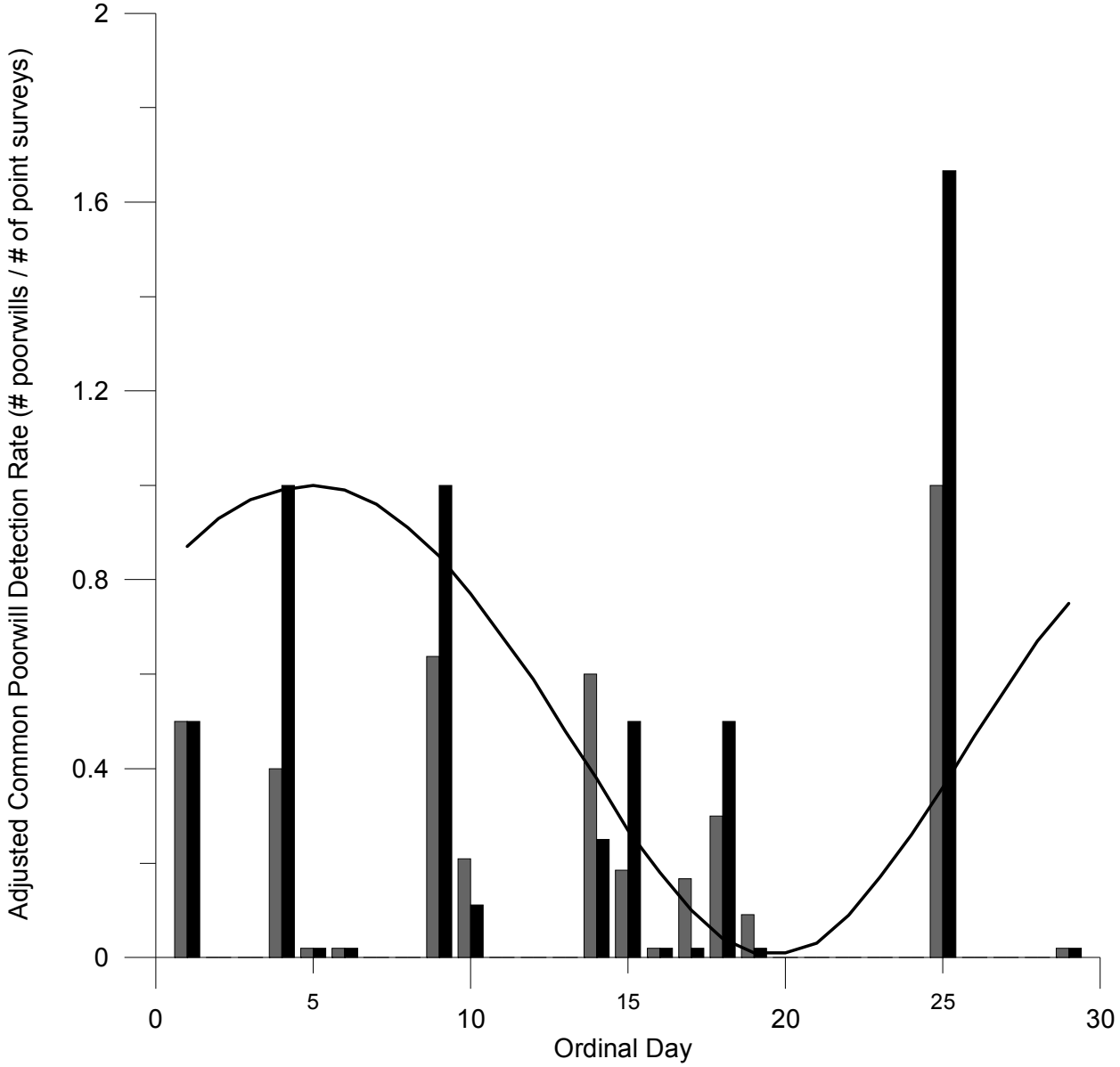

Figure 4. Standardized daily detection rates for Common Poorwill surveys (total number of Poorwills detected on a day / total number of point surveys conducted on that day) conducted in western Nebraska, between 16 May (Ordinal Day 1) and 13 June for points where call playback was not used (grey bars) and points where call playback was used (black bars). For survey days when Poorwills were not detected, detection rate was graphed as 0.02. Moon Phase (% of moon face illuminated) for this time period was shown with the black line, and ranged from 100% (full moon) to 0 % (new moon).

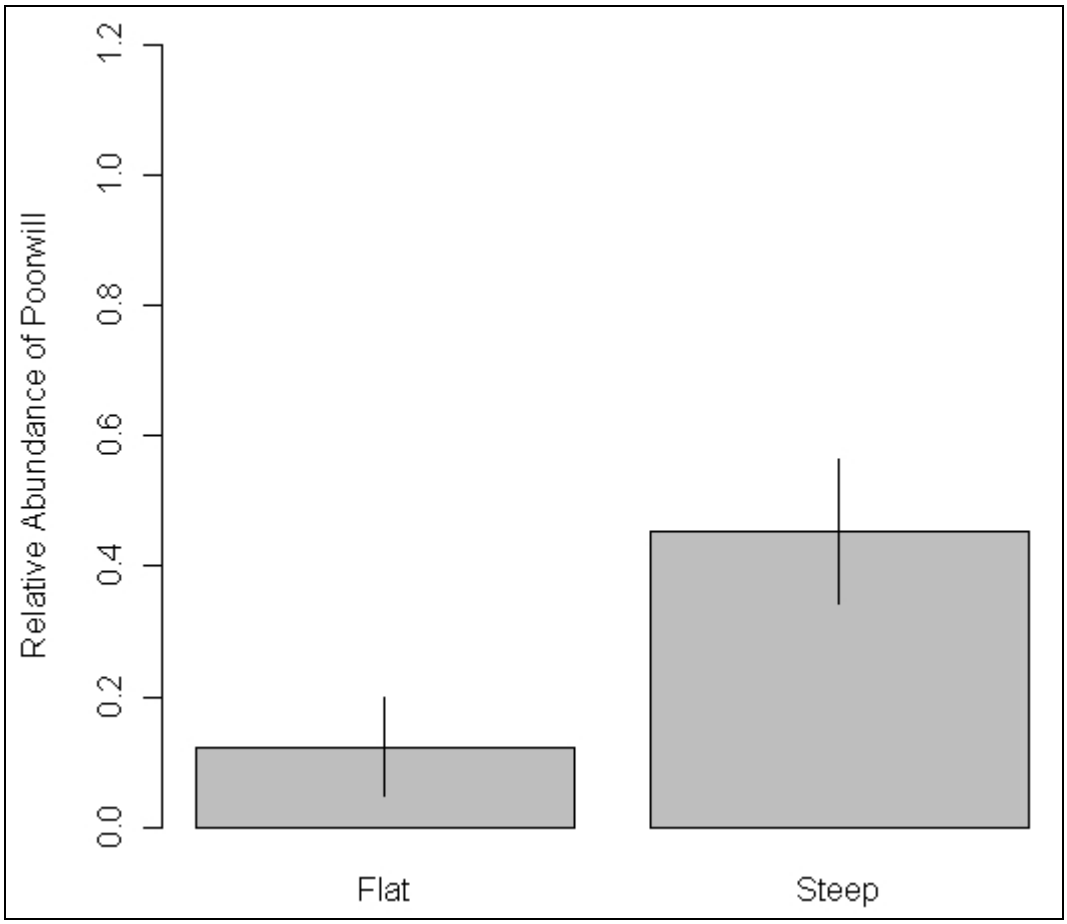

Figure 5. Relative abundances of Common Poorwills (Common Poorwills / 6 minute point count) and associated 95% confidence intervals (95% C.I. = 1.96 * SE) with respect to topography for surveys conducted in western Nebraska in the spring of 2008.

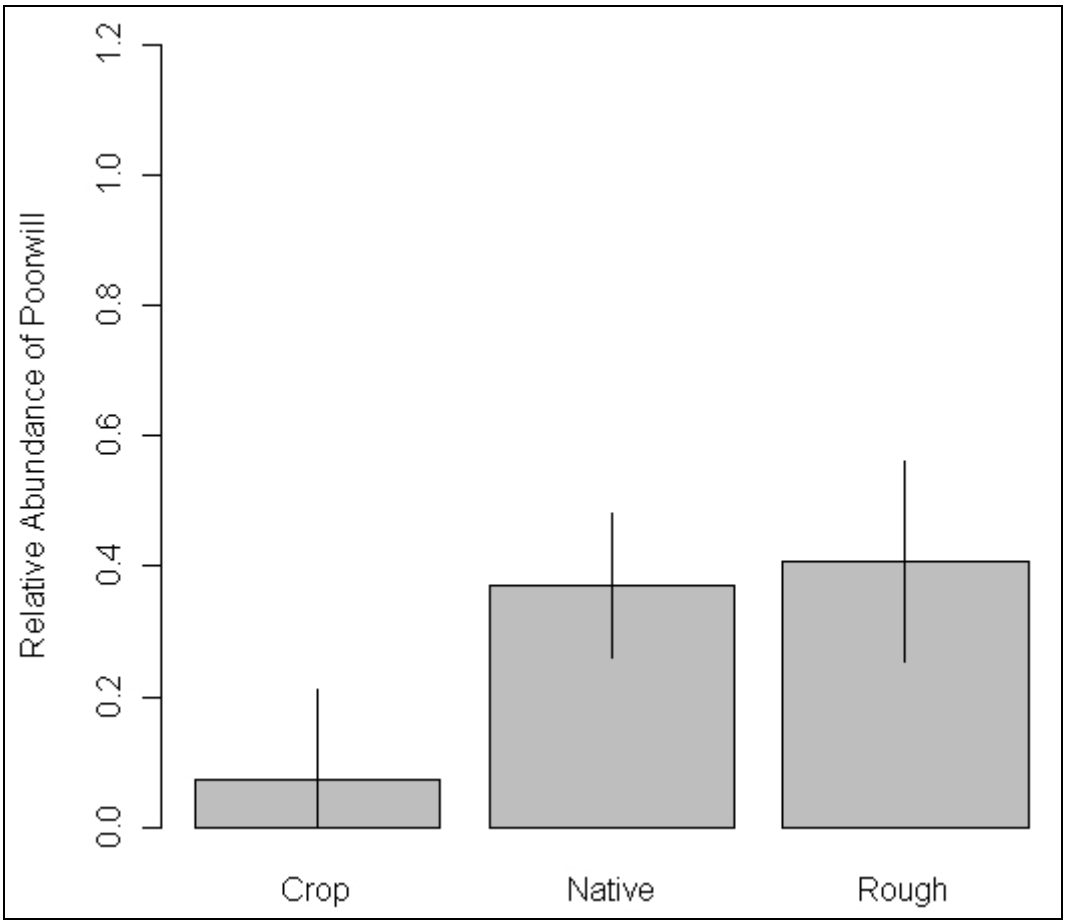

Figure 6. Relative abundances of Common Poorwills (Common Poorwills / 6 minute point count) and associated 95% confidence intervals (95% C.I. = 1.96 * SE) with respect to landscape composition for surveys conducted in western Nebraska in the spring of 2008.

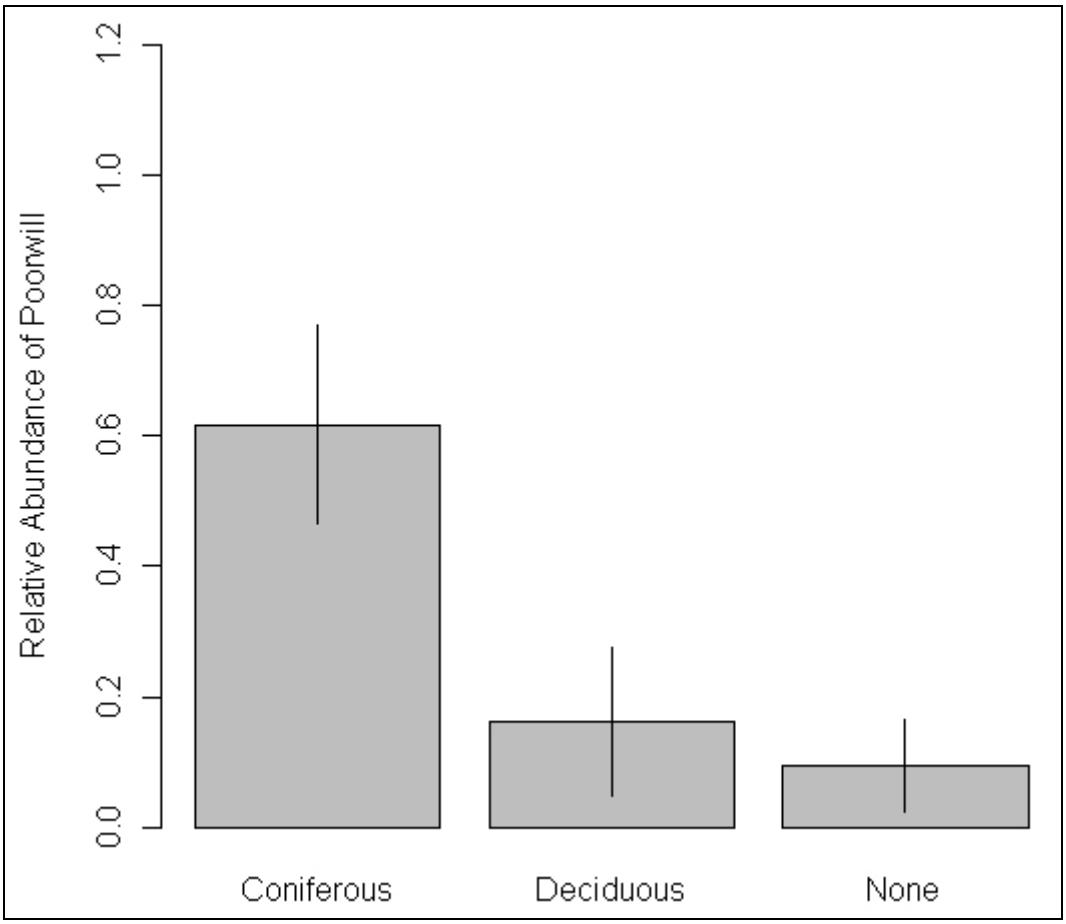

Figure 7. Relative abundances of Common Poorwills (Common Poorwills / 6 minute point count) and associated 95% confidence intervals (95% C.I. = 1.96 * SE) with respect to tree cover / type for surveys conducted in western Nebraska in the spring of 2008.