2008 SOUTHEASTERN NATURALIST 7(1):11–18

Winter Bird Population Studies and Project Prairie Birds for Surveying Grassland Birds

Daniel J. Twedt[1,*], Paul B. Hamel[2], and Mark S. Woodrey[3]

Abstract - We compared 2 survey methods for assessing winter bird communities in temperate grasslands: Winter Bird Population Study surveys are area-searches that have long been used in a variety of habitats whereas Project Prairie Bird surveys employ active-flushing techniques on strip-transects and are intended for use in grasslands. We used both methods to survey birds on 14 herbaceous-reforested sites and 9 coastal pine savannas during winter and compared resultant estimates of species richness and relative abundance. These techniques did not yield similar estimates of avian populations. We found Winter Bird Population Studies consistently produced higher estimates of species richness, whereas Project Prairie Birds produced higher estimates of avian abundance for some species. When it is important to identify all species within the winter bird community, Winter Bird Population Studies should be the survey method of choice. If estimates of the abundance of relatively secretive grassland bird species are desired, the use of Project Prairie Birds protocols is warranted. However, we suggest that both survey techniques, as currently employed, are deficient and recommend distance-based survey methods that provide species-specific estimates of detection probabilities be incorporated into these survey methods.

Introduction

Declines in grassland bird populations (Peterjohn and Sauer 1999) have focused interest on these species, their populations, seasonal abundance, and habitats. Loss and degradation of habitat on breeding grounds has impacted grassland birds, but the contribution of winter habitats is less well understood (Vickery and Herkert 2001). Lack of understanding of grassland bird ecology during winter is due in part to their non-vocal and relatively secretive behavior during this period. These behaviors have presented difficulty in surveying some species of grassland birds during winter. As a result, various survey methods for assessing grassland bird populations during winter have been used and compared (Boano 1989, Brewer 1978, Edwards et al. 1981, Fletcher et al. 2000, Roberts and Schnell 2006).

One of the first standardized survey methods used to obtain data on bird populations during winter was an area-search method known as Winter Bird Population Studies. Inaugurated in 1948 (Anonymous, 1947), this area-search method has been used for decades in various habitats, including

[1]USGS Patuxent Wildlife Research Center, 2524 South Frontage Road, Suite C, Vicksburg, MS 39180. [2]USDA Forest Service, Center for Bottomland Hardwoods Research, PO Box 227, Stoneville, MS 38776. [3]Mississippi State University, Grand Bay National Estuarine Research Reserve, 6005 Bayou Heron Road, Moss Point, MS 39562. *Corresponding author - dtwedt@usgs.gov.

grasslands (Kolb 1965, Robbins 1972). Area searches are typically conducted during multiple visits (8 recommended; Robbins 1981) by a single observer who slowly and methodically moves throughout the search area identifying, enumerating, and recording all birds detected.

Because of the deliberate nature of area searches, secretive grassland birds may covertly move from the search path and thereby avoid detection. Therefore, an alternative method, Project Prairie Birds (Shackelford et al. 2001) was devised to survey small, secretive birds by actively flushing birds from strip transects on grasslands and herbaceous habitats during winter. To conduct a Project Prairie Birds survey, an observer walks the center line of a strip transect and records the species and number of birds observed, while two "non-observing flushers," each bearing two 4.2-m (14-ft) long poles, walk parallel to the observer and thrash the vegetation to flush birds. Transects are typically visited three times: once each during early, middle, and late winter.

We used both Project Prairie Birds and Winter Bird Population Study methods to survey herbaceous-reforested sites and coastal pine savanna sites during winter 2001–2002. Our objective was to compare data on winter bird populations obtained from these 2 survey methods.

Methods

Study areas

We surveyed 23 study sites: 9 coastal pine savanna sites in the East Gulf Coastal Plain on or near Mississippi Sandhill Crane National Wildlife Refuge, Jackson County, MS, and 14 herbaceous sites on retired agricultural lands in the early stages of reforestation in the Mississippi Alluvial Valley (Twedt 2004). Of the 14 herbaceous-reforested sites, 9 were part of a bottomland hardwood restoration experiment in Sharkey County, MS (Hamel 2003, Hamel et al. 2002), 3 were on Mahannah Wildlife Management Area (WMA) in Issaquena and Warren counties, MS, and 2 were enrolled in the USDA Wetland Reserve Program (King et al. 2006) in Madison Parish, LA. Although predominantly herbaceous, all plots had trees within or emergent from the grasses and forbs.

Survey methods

The area searched during Winter Bird Population Studies varied by location: 6–8 ha on Sharkey County sites (n = 9), 15–19 ha on Louisiana and Mahannah WMA sites (n = 5), and 25 ha on coastal savanna sites (n = 9). We made 8 area-search visits to herbaceous-reforested sites, but only 3 area-search visits to coastal savanna sites in conjunction with Winter Bird Population Surveys.

Within the same areas used for Winter Bird Population Surveys, strip-transects associated with Project Prairie Bird surveys were visited 3 times. Strip-transect area varied among sites: we surveyed two 100- x 20-m transects on each of the 9 herbaceous-reforested sites in Sharkey County, two

100- x 30-m transects on each of the other 5 herbaceous-reforested sites, and one 500- x 20-m transect on each coastal savanna site. Birds observed outside of area-search and strip-transect boundaries were not recorded.

Observed species richness was the total number of species identified on a study site during all area-search or strip-transect surveys. We were unable to identify a few birds to species, only to species group, and these birds were not included in analyses. Because coastal pine savanna sites had fewer area-search visits, employed a larger area for strip-transects, and had a different habitat structure, these data were analyzed separate from data obtained from herbaceous-reforested sites, but both data sets were analyzed using the same methods.

Analytical methods

We used the program SPECRICH2 to estimate the total number of species on all study sites based on the observed species richness within each study site (http://www.mbr-pwrc.usgs.gov/software/specrich2.html). This program uses species presence-absence data from multiple sample sites to estimate species richness based on the model M(h)—closed model capture-recapture analysis: model with heterogeneous capture probabilities—from program CAPTURE (White et al. 1982).

The number of birds (all birds and selected species) detected during area-search and strip-transect surveys was expressed as detections per visit per unit area surveyed, standardized to 100 ha (km^2), and referred to as relative abundances because we did not determine detection probabilities (MacKenzie and Kendall 2002). We compared relative abundances of 8 frequently observed species (5 species on coastal savanna sites and 6 species on herbaceous-reforested sites) using Wilcoxon paired-sample tests (Wilcoxon 1945, Zar 1984). Means are presented with their standard error (SE) and differences between survey methods were deemed significant only if they met our criteria for false discovery ($P = 0.1$) used to adjust probability levels for multiple paired-sample tests (Benjamini and Hochberg 1995).

Results

With more visits and/or greater areas searched (Connor and McCoy 1979, Engstrom 1981, Kilburn 1966), we detected far more individuals with a greater estimated species richness during area searches associated with Winter Bird Population Studies than on strip-transects associated with Project Prairie Birds. During Winter Bird Population Studies, we detected 1797 individuals representing 56 ± 5.1 species on coastal savannas and 4166 individuals of 49 ± 7.6 species on herbaceous-reforested sites. During Project Prairie Birds surveys, we detected only 57 individuals representing 11 ± 2.3 species on coastal savannas and 278 individuals of 7 ± 1.4 species on herbaceous-reforested sites.

Even with vastly different numbers of detections, relative avian abundance on the 9 coastal savanna sites estimated from Project Prairie Birds

surveys (211 ± 32 birds / km^2) did not differ ($T_9 = 15.5$, $P = 0.45$) from that estimated from Winter Bird Population Study surveys (265 ± 46 birds / km^2). Conversely, on 14 herbaceous-reforested sites, mean relative abundance detected during Project Prairie Birds surveys (1254 ± 354 birds / km^2) was greater ($T_{14} = 0$, $P < 0.01$) than that detected during Winter Bird Population Studies (291 ± 58 birds / km^2).

On coastal savanna sites and on herbaceous-reforested sites, ≤6 species constituted >90% of all detections on Project Prairie Birds surveys (Table 1). On herbaceous-reforested sites, the same 6 species accounted for >92% of all detections during Winter Bird Population Studies–the only other species frequently detected were *Circus cyaneus* L. (Northern Harrier, n = 94) and *Buteo jamaicensis* Gmelin (Red-tailed Hawk, n = 57). In contrast, the 5 most common species encountered during Project Prairie Bird surveys on pine savanna sites accounted for only 21% of detections during Winter Bird Population Study area searches. This result was due to the presence of flocks of *Turdus migratorius* L. (American Robin, n = 688), *Dendroica coronata* L. (Yellow-rumped Warbler, n = 206), and *Bombycilla cedrorum* Vieillot (Cedar Waxwing, n = 111) as well as common detections of *Dendroica pinus* Wilson (Pine Warbler, n = 66), *Agelaius phoeniceus* L. (Red-winged Blackbird, n = 65), and *Sitta pusilla* Latham (Brown-headed Nuthatch, n = 50) during area searches that were rarely observed during strip-transect surveys.

We compared relative abundance estimates between survey methods for 5 species commonly detected on pine savanna sites. Estimates of *Ammodramus henslowii* Audubon (Henslow's Sparrow) and *Cistothorus platensis* Latham (Sedge Wren) abundance from Project Prairie Birds surveys were

Table 1. Species, number of individuals detected (n), and relative abundance (mean ± standard error; birds / km^2) of birds commonly detected on 14 herbaceous-reforested sites in the Mississippi Alluvial Valley and 9 coastal pine savanna sites in the East Gulf Coastal Plain surveyed during winter 2001–2002 using Winter Bird Population Studies and Project Prairie Birds protocols.

	Winter Bird Population Studies		Project Prairie Birds		
Common name	n	Abundance	n	Abundance	P[1]
Coastal pine savanna sites (n = 9)					
Sedge Wren	132	19.6 ± 3.7	14	51.9 ± 14.8	0.05
Eastern Bluebird	62	9.2 ± 1.3	5	18.5 ± 12.6	0.65
Henslow's Sparrow	93	13.8 ± 4.3	26	96.3 ± 22.5	0.01
Swamp Sparrow	43	6.4 ± 2.3	4	14.8 ± 8.1	0.65
Eastern Meadowlark	62	9.2 ± 3.1	2	7.4 ± 4.9	0.50
Herbaceous-reforested sites (n = 14)					
Sedge Wren	49	5.3 ± 1.5	3	17.9 ± 12.9	0.16
Savannah Sparrow	902	56.6 ± 15.9	45	192.5 ± 61.7	0.04
Song Sparrow	266	25.6 ± 5.0	17	97.2 ± 22.9	<0.01
Swamp Sparrow	1525	96.8 ± 26.5	177	785.7 ± 303.5	0.03
Red-winged Blackbird	875	57.6 ± 22.1	9	35.7 ± 24.4	0.12
Eastern Meadowlark	226	21.0 ± 5.7	26	125.0 ± 53.7	0.16

[1]Mean abundance compared between survey methods using Wilcoxon paired-sample tests (Wilcoxon 1945).

greater than estimates from Winter Bird Population Studies (Table 1). Abundance estimates for *Sialia sialis* L. (Eastern Bluebird), *Melospiza georgiana* Latham (Swamp Sparrow), and *Sturnella magna* L. (Eastern Meadowlark) did not differ between methods (Table 1).

We compared abundance estimates of 6 common species on herbaceous-reforested sites. Abundance estimates that resulted from Project Prairie Bird surveys were greater than estimates resulting from Winter Bird Population Studies for Swamp Sparrow, *Passerculus sandwichensis* Gmelin (Savannah Sparrow), and *Melospiza melodia* Wilson (Song Sparrow), whereas abundances of Eastern Meadowlark, Red-winged Blackbird, and Sedge Wren did not differ between survey methods (Table 1).

Discussion

Clearly, large differences in area surveyed between Winter Bird Population Studies and Project Prairie Birds surveys resulted in vast differences in the number of species and total number of bird detections. For a few species—Henslow's Sparrow and Sedge Wren on coastal savanna sites and Swamp Sparrow, Savannah Sparrow, and Song Sparrow on herbaceous-reforested sites—Project Prairie Bird surveys yielded greater estimates of abundance than did Winter Bird Population Study surveys, suggesting that active flushing associated with Project Prairie Bird surveys results in the detection of some birds that are missed during area searches.

In Oklahoma grasslands, Roberts and Schnell (2006) found higher density estimates for Savannah Sparrow resulted from area-search surveys than from 20-m wide strip transects (similar to Project Prairie Birds transects but with a single non-flushing observer). However, the area searched (1 ha) was much smaller than any of the plots we surveyed (range 6–25 ha) and was intensively searched with an observer walking within 10 m of all points on a plot during a 20-min observation period (Roberts and Schnell 2006). In contrast, our plots were less intensively searched, with our largest plots (25 ha) surveyed for only 60 min (<2.5 min/ha) during which the observer was ≥25 m from many points. The largest plots we used for area searches during Winter Bird Population Studies were less than the 60-ha area-search size recommended for use in grasslands (Cornell Laboratory of Ornithology 1989), but equaled the 20- to 25-ha area recommended by Engstrom and James (1981) for use in open pine habitat.

Differences in effort between survey methods are noteworthy. For example, 100-m long strip transects required only 2 min (recommended maximum, Shackelford et al. 2001) to complete, in contrast to the 20–60 min for each area-search visit. However, the 3 "observers" required to undertake Project Prairie Bird surveys can be burdensome when personnel are limited or when travel time among sites is lengthy. Therefore, when undertaking Project Prairie Bird surveys, we recommend establishing multiple strip-transects at each site to increase the area surveyed relative to the total time expended by personnel.

Thompson et al. (1998) point out additional considerations involving plot size and shape as these affect density estimates. Long, narrow plots, like those used for Project Prairie Birds, are considered more efficient at detecting individuals than are plots of other shapes. Additionally, the active flushing during Project Prairie Bird surveys appeared to improve detection of birds.

Doster (2004), using 2-observer line transects (150 m wide), estimated that avian density on 69 reforested sites was between 610 and 1970 birds/km^2, with estimated species richness from 58 to 69 species. Notably, Doster (2004) and Roberts and Schnell (2006) exploited distance sampling along their line transects to estimate detection probabilities of birds. Because a detection probability provides an estimate of birds that are present, but not detected, an estimated avian density (not relative abundance) can be obtained. As currently implemented, neither Winter Bird Population Studies nor Project Prairie Birds provides a mechanism for estimating detection probabilities.

A breeding season analog of Winter Bird Population Studies is the Breeding Bird Census (i.e., spot-mapping; IBCC 1970): an assumption of which is that with repeated visits ($\geq$8) all territorial individuals will be detected, thereby resulting in 100% detection. However, during winter, birds are markedly less territorial and may in fact be quite vagile. Thus, during winter, the assumption of 100% detection, even with multiple visits, is doubtful. We recommend distance estimation, or another method of estimating detection probability, be incorporated into both of these survey methods and that investigations be conducted to assess the ability of refined survey methods to estimate avian densities.

Our results indicate that Project Prairie Bird surveys in herbaceous-reforested habitats provided greater estimates of total avian abundance and the abundance of 3 frequently observed species than did area searches associated with Winter Bird Population Studies. Similarly, in pine savanna habitats, relative abundance of 2 common savanna species estimated from Project Prairie Birds was greater than those derived from Winter Bird Population Studies. Project Prairie Birds produced higher abundance estimates for species that were associated with herbaceous grasslands, precisely the species Project Prairie Birds was designed to survey. Thus, in our opinion, the technique provided abundance estimates that are likely closer to actual densities than those derived from Winter Bird Population Study area-search surveys. During these area searches, relatively secretive birds were able to escape detection when a single, walking observer was not actively flushing birds. The active flushing technique employed by Project Prairie Birds rendered these species more visible. Thus, if estimates are desired of the abundance of relatively secretive grassland birds, such as Henslow's Sparrow, Sedge Wren, or *Ammodramus leconteii* Audubon (Le Conte's Sparrow), the use of Project Prairie Birds protocols is warranted. However, when it is more important to identify all species within the winter bird population, Winter Bird Population Studies should be the survey method of choice. Regardless of survey

method used, we recommend incorporating distance-sampling techniques from which detection probabilities may be estimated.

Acknowledgments

We thank Carl Smith, Stephanie Allison, Kevin Corbin, Michelle Hunt, Blaine Elliott, Bruce Reid, Randy Wilson, Kevin Hartke, and Jeff Buler for assistance with avian surveys. The Mississippi Museum of Natural Science provided facilities for collaboration on analysis. We appreciate the inspiration of the Southeastern Management Working Group of Partners in Flight and Gulf Coast Bird Observatory in conducting this experiment. Cecilia Riley, Tom Dell, Glen McMaster, John Probst, Jean-Pierre Savard, Cliff Shackelford, Scott Somershoe, and Gary Schnell reviewed and commented on earlier drafts of this manuscript.

Literature Cited

Anonymous. 1947. Announcement of the Winter Bird-Population Study. Audubon Field Notes 1:165-166.

Benjamini, Y., and Y. Hochberg. 1995. Controlling the false discovery rate: A practical and powerful approach to multiple testing. Journal of the Royal Statistical Society B 57:289–300.

Boano, G. 1989. Censusing bird communities in winter: A comparison of some relative methods. Ricerche Biologia Selvaggina 16:275–280.

Brewer, R. 1978. A comparison of three methods of estimating winter bird populations. Bird Banding 49:252–261.

Cornell Laboratory of Ornithology. 1989. An Introduction to the Winter Bird Population Study. Unpubl. memorandum. Ithaca, NY.

Connor, E.F., and E.D. McCoy. 1979. The statistics and biology of the species-area relationship. American Naturalist 113:791–833.

Doster, R.H. 2004. Ecology and conservation of wintering migratory birds in early successional habitats of the Lower Mississippi River Alluvial Valley. Ph.D. Dissertation. University of Arkansas, Fayetteville, AR. 122 pp.

Edwards D.K., G.L. Dorsey, and J.A. Crawford. 1981. A comparison of three avian-census methods. Studies in Avian Biology 6:170–176.

Engstrom, R.T. 1981. The species-area relationship in spot-map censusing. Studies in Avian Biology 6:421–425.

Engstrom, R.T., and F.C. James. 1981. Plot size as a factor in Winter Bird-Populations Studies. Condor 83:34–41.

Fletcher, Jr., R.J., J.A. Dhundale, and T.F. Dean. 2000. Estimating nonbreeding season bird abundance in prairies: A comparison of two survey techniques. Journal of Field Ornithology 71:321–329.

Hamel, P.B. 2003. Winter bird community differences among methods of bottomland hardwood forest restoration: Results after seven growing seasons. Forestry 76: 189–197.

Hamel, P.B., D.J. Twedt, T.J. Nuttle, C.A. Woodson, F. Broerman, and J.M. Wahome. 2002. Forest restoration as ecological succession: Should we speed it up or slow it down? Pp. 98–108, *In* M.M. Holland, M.L. Warren, Jr., and J.A. Stanturf (Eds.). Proceedings of a conference on sustainability of wetlands and water resources, Oxford, Mississippi, 21–23 May 2000. USDA Forest Service General Technical Report SRS-50, Southern Research Station, Asheville, NC.

International Bird Census Committee (IBCC). 1970. An international standard for a mapping method in bird-census work recommended by the International Bird Census Committee. Audubon Field Notes 24:722–726.

Kilburn, P.D. 1966. Analysis of the species-area relation. Ecology 47:831–843.

King, S.L., D.J. Twedt, and R.R. Wilson. 2006. The role of the Wetland Reserve Program in conservation efforts in the Mississippi Alluvial Valley. Wildlife Society Bulletin 34:914–920.

Kolb, H. 1965. The Audubon Winter Bird-Population Study. Audubon Field Notes 19:432–434.

MacKenzie, D.L., and W.L. Kendall. 2002. How should detection probability be incorporated into estimates of relative abundance? Ecology 83:2387–2393.

Peterjohn, B.G., and J.R. Sauer. 1999. Population status of North American grassland birds from the North American Breeding Bird Survey, 1966–1996. Studies in Avian Biology 19:27–44.

Robbins, C.S. 1972. An appraisal of the Winter Bird-Population Study technique. American Birds 26:688–692.

Robbins, C.S. 1981. Reappraisal of the Winter Bird-Population Study technique. Studies in Avian Biology 6:52–57.

Roberts, J.P., and G.D. Schnell. 2006. Comparison of survey methods for wintering grassland birds. Journal of Field Ornithology 77:46–60.

Shackelford, C.E., N.R. Carrie, C.M. Riley, and D.K. Carrie. 2001. Project Prairie Birds: A citizen science project for wintering grassland birds. Texas Parks and Wildlife Department Publication, PWD BK W7000-485 (1/01), Austin, TX. 24 pp. Available online at http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_0485.pdf. Accessed 13 September 2006.

Thompson, W.L., G.C. White, and C. Gowan. 1998. Monitoring Vertebrate Populations. Academic Press, New York, NY.

Twedt, D.J. 2004. Tree and shrub colonization and development on reforested bottomlands. Plant Ecology 172:251–263

Vickery, P.D., and J.R. Herkert. 2001. Recent advances in grassland bird research: Where do we go from here? Auk 118:11–15.

White, G.C., D.R. Anderson, K.P. Burnham, and D.L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory LA-8787-NERP, Los Alamos, NM. 235 pp. Available online at http://www.warnercnr.colostate.edu/class_info/fw663/White1982/WhiteList.html. Accessed 16 January 2007.

Wilcoxon, F. 1945. Individual comparison by ranking methods. Biometrics 1: 80–83.

Zar, J.H. 1984. Biostatistical Analysis. Prentice-Hall, Inc., Englewood Cliffs, NJ. 718 pp.