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RH: Winter Birds and Field Border Width • *Conover et al.*

WINTER BIRD RESPONSE TO FIELD BORDER ESTABLISHMENT AND WIDTH

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Abstract: Transformations of agricultural practices in the southeastern US have drastically reduced pre-existing quantities of strip-cover habitat along field margins. The National Conservation Buffer Initiative has promoted the establishment of herbaceous field borders to restore wildlife benefits once provided by such habitat. This study evaluated effects of native warm-season grass field border establishment and width on winter bird response. Narrow (~8 m) field borders represented a marginal improvement to non-bordered margins that were cropped “ditch to ditch”, whereas wide (~30 m) borders significantly enhanced overall avian conservation value, abundance, species richness, and sparrow abundance compared to non- and/or narrow

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borders. Furthermore, presence of wide borders altered bird use of row-crop fields. We observed greater sparrow abundances in agricultural fields at greater distances from the border edge adjacent to wide borders, which likely enhanced foraging opportunity in the form of waste grain. Given these benefits to wintering farmland birds, we advocate the integration of herbaceous field border habitat in agricultural landscapes, particularly borders of enhanced width.

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The majority of native grassland habitat throughout the United States has been converted to agricultural land (Noss et al. 1995). Additively, the fragmented state of remaining native grasslands in North America begot the dependence of many grassland birds on these agricultural landscapes for habitat (Hunter et al. 2001). Whereas past agricultural growth was considered beneficial for some farmland birds due to geographic range expansions (Hurley and Franks 1976), recent technological advancement and agricultural intensification has largely reversed these benefits (Vickery et al. 1999, Murphy 2003) through practices such as “clean farming” and field consolidation. These changes frequently lead to a reduction of idle, weedy, grassy, and shrubby habitat (Shalaway 1979). As a result, grassland bird populations are currently more imperiled than any other avian guild in North America (Herkert 1995, Peterjohn and Sauer 1999, Brennan and Kuvlesky 2005). For example, the ratio of grassland birds with negative vs.

positive population trends from 1966 to 1979 was 3:1, but this ratio substantially worsened to 15:1 from 1980 to 2003 (Sauer et al. 2004).

The effects of this herbaceous-habitat loss in the United States are well documented for Midwestern breeding birds (Herkert 1994, Herkert et al. 1996), where over 99% of native tall grass prairie has been destroyed (Noss et al. 1995). An additional concern, though often overlooked by wildlife managers, is wintering habitat for grassland birds. During winter, birds are vulnerable to resource depletion, which can lead to population bottlenecks (Payne and Wilson 1999). In intensive agricultural systems of the southern United States, large-scale conversion of croplands to grasslands or less intensive agricultural production are unlikely (Peterjohn 2003). However, conservation buffers are easily integrated into production systems, provide multiple environmental benefits, and are more likely to be adopted by agricultural producers. Proper management of strip-cover habitat is paramount in areas where wintering avian communities are largely comprised of temperate, short-distance migrant sparrows (Family: Emberizidae) with declining populations (Sauer et al. 2004). Unfortunately, there remains a paucity of research on wintering grassland birds in the southeastern U.S. (Marcus et al. 2000, Peterjohn 2003, Smith et al. 2005), and we found none on winter bird use of herbaceous strip-cover in the Mississippi Alluvial Valley (MAV).

In the MAV physiographic region, native habitats have been degraded and/or eliminated, primarily from conversion to agricultural land (Noss et al. 1995, Rudis 2001). Such drastic habitat conversions in the MAV have likely resulted in grassland bird dependence locally on agricultural land; hence, creation of suitable habitat in this landscape may help stabilize avian population declines associated with habitat degradation. The majority of over-wintering sparrows

in the MAV have experienced negative population trends throughout North America from 1980 to 2003. Species that exhibited such declines include: Field Sparrow (*Spizella passerina*, -2.56 %/year), Vesper Sparrow (*Poecetes gramineus*, -0.86 %/year), Savannah Sparrow (*Passerculus sandwichensis*, -0.78 %/year), Song Sparrow (*Melospiza melodia*, -0.27 %/year), White-throated Sparrow (*Zonotrichia albicollis*, -0.60 %/year), Dark-eyed Junco (*Junco hyemalis*, -1.52 %/year), and Eastern Towhee (*Pipilo erythrophthalmus*, -0.98 %/year). Furthermore, most birds inhabiting agricultural field edges in the Southeast are sparrows of regional and national conservation concern (Marcus et al. 2000, Peterjohn and Sauer 1999).

In 1997, the USDA amplified assistance to grassland and edge-associated farmland birds with the National Conservation Buffer Initiative (NCBI), which promoted establishment of conservation buffers including grassed waterways, filter strips, riparian buffers, fencerows, shelterbelts, and field borders among others. Some objectives of the NCBI were to improve soil, air and water quality, conserve biodiversity, and enhance fish and wildlife habitat (Best 2000). The NCBI encourages conservation buffer establishment through participation in a myriad of USDA Farm Bill conservation programs (i.e. Conservation Reserve Program, Continuous Conservation Reserve Program, Environmental Quality Incentives Program, Wildlife Habitat Incentives Program). Under these programs, buffer practices were restricted to down-slope field margins as water quality is the primary NCBI goal. In 2004, herbaceous upland habitat buffers (hereafter; field borders) were added as a new conservation practice (CP33 - Habitat Buffers for Upland Birds) under the continuous CRP program. Field borders are distinguished among other conservation buffer habitats as they were designed as wildlife habitat and therefore had location flexibility on field margins. Field borders are non-crop, herbaceous buffers that are typically

incorporated with a pre-existing field margin feature (Marcus et al. 2000, Smith et al. 2005).

Field borders and similar linear habitats have been shown to provide nesting habitat, foraging habitat, movement corridors, and escape cover to many avian species (Puckett et al. 1995, Marcus et al. 2000, Puckett et al. 2000, Smith et al. 2005), while substantially reducing soil erosion into riparian zones adjacent to row-crop fields (T. Cooke unpublished data).

Furthermore, Smith (2005) found the escape cover provided by field borders indirectly benefited birds by increasing their use of adjacent crop fields in close proximity, thereby allowing access to waste grain. Furthermore, field borders provide the enhanced vertical cover preferred by most sparrows (Grzybowski 1983), yet remains extremely scarce in the MAV and may enhance forage availability, which can limit winter densities of sparrows (Davis 1973, Jansson et al. 1981, Lima 1990, Watts 1990).

Field borders are increasingly popular among agricultural producers because they minimally impact crop production when located along a wooded edge (Davison 1941, Dambach 1945, Barbour 2006), reduce the incursion of invasive weeds into crop fields, harbor insects with agronomic benefits (Marshall and Moonen 2002), and may increase whole-farm profitability (Barbour 2006). In the MAV, agricultural producers are particularly inclined to establishing field borders for their potential as habitat for local populations of Northern Bobwhite (*Colinus virginianus*). The combination of conceptual popularity and financial incentives may result in future widespread establishment of field borders, heightening the need for an understanding of their proper establishment and subsequent management. Knowledge of field border value to winter avian communities are limited to Marcus et al. (2000) and Smith (2005). However, both of these studies only address avian use of relatively narrow field borders (<10 m). Research on

similar linear habitats revealed escalated avian benefits associated with increased habitat width (Rodenhouse and Best 1983, Warner 1992). Despite these potential benefits, we know of no studies evaluating the impacts of a width component for linear, herbaceous habitat to wintering birds. However, research conducted during the breeding season suggests increased habitat width provides more herbaceous habitat at greater distances from wooded field margins, which may increase the quality of habitat for edge-averse birds (Helzer and Jelinski 1999, Woodward et al. 2001). Thus, wide borders retain the edge habitat preferred by cover-dependent species (Schneider 1984) but also provide habitat for edge-averse birds by providing a transitional habitat zone from a typical abrupt wooded-farm field edge (Johnson and Temple 1986, Helzer and Jelinski 1999). Hence, a reasonable increase of border width may provide significant ecological gains and as such, evaluation should be a priority.

As the programmatic opportunities to implement field borders continue to increase, researchers must determine their conservation efficacy and provide wildlife managers with a strategy for proper border establishment and maintenance. Such information would be invaluable in developing and refining NCBI practice standards. Primary objectives of this study were to assess avian community (abundance, richness, and conservation value) and sparrow response to narrow and wide field border habitat on agricultural production farms in the MAV during winter. We hypothesized that (1) narrow-bordered field margins would receive increased bird use than non-bordered margins; (2) border width would positively relate with community response and sparrow abundances, and (3) wide borders would elicit increased spatial movement by sparrows into adjacent agricultural fields.

STUDY AREA

This study was conducted on six farms in Sunflower County, Mississippi during the winters (February) of 2003 and 2004. All farms were located in the MAV, with the two most distant farms 12 km apart. Our study farms were representative of the MAV landscape, dominated by large fields (171.14 ± 34.20 ha) of intensive agricultural production with primary crops of soybean (58%, *Glycine* sp.), cotton (16%, *Gossypium* sp.), and milo (10%, *Sorghum* sp.). Historically, this region was bottomland-hardwood forest; hence, field border establishment represents an opportunistic exploitation to indirectly restore grassland habitat lost elsewhere, specifically the Midwestern United States and Blackland Prairies of the Southeast (Smith 1981). This agricultural landscape is fragmented by wooded fencerows and drainage ditches, and has nominal topographical relief. Throughout winter, fields were void of vegetative cover except sparse, crop stubble in some fields. Soil associations on the farms were mostly Dundee silt loam or Forestdale silt loam. These are stratified alluvium soils of fine to coarse texture that were washed in by the Mississippi River and have poor to moderate drainage and vary widely in acidity levels (Powell et al. 1952).

Experimental field borders were established in the spring of 2002 and were located between a wooded field margin (typically fencerow) that enclosed a drainage ditch and an agricultural field. The field border population was randomly selected from a pre-determined sample population of all potential habitats on selected farms. Control (non-bordered) field margins were located in similar conditions, but represented “ditch to ditch” row-cropping techniques typical of the area and contained no herbaceous buffer. All borders were approximately 400 m in length and were planted with a mixture of indian grass (*Sorghastrum*

nutans), little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), partridge pea (*Chamaecrista fasciculata*), and kobe lespedeza (*Lespedeza striata*). Despite plantings, the primary floral composition of field borders also included horsetail (*Conyza canadensis*), seashore vervain (*Verbena litoralis*), bermuda grass (*Cynodon dactylon*), johnson grass (*Sorghum halepense*), goldenrod (*Solidago* spp.), common ragweed (*Ambrosia artemisiifolia*), giant ragweed (*Ambrosia trifida*), poison ivy (*Toxicodendron radicans*), curly dock (*Rumex crispus*) and *Rubus* spp. Farm operators were requested not to disturb (mow, burn, apply chemicals, drive on, or disk) field borders during the study. However, this failed to prevent some border destruction, which resulted in a reduced sample size from 2003 to 2004. Hence, border treatments on field margins were non-bordered (2003: n = 19; 2004: n = 17), narrow-bordered (2003: mean = 8.5 ± 1.8 m, n = 38; 2004: mean = 7.3 ± 2.2 m, n=26), and wide-bordered (2003: mean = 32.7 ± 9.0 m, n = 5; 2004: mean = 29.7 ± 10.2 m, n = 5). Field border width was determined by using the average measurement of distances between the fencerow and crop field at 50 m intervals per border. The influence of field borders on birds was evaluated in three field margin regions (field border zone (FBZ) and adjacent agricultural field and wooded edge). The FBZ was a 10 m area adjacent to the wooded edge and represented either experimental border vegetation or, for non-bordered margins, “ditch to ditch” row-crop practices. The agricultural field region encompassed the area extending 30 m into the adjacent row-crop field. The wooded edge region extended 20 m into fencerows adjacent to the FBZ.

METHODS

Community Assessment

Avian communities were surveyed during February of 2003 and 2004 using line-transect survey techniques (Buckland et al. 2001). Each transect was surveyed over 200 m with ≥ 100 m buffer between transects to minimize counting individuals multiple times. Transect lines were located on the agricultural field-FBZ edge. Transects were evenly paced for 10 minutes to ensure the entire transect received equal observation effort and one person surveyed $>90\%$ of transects to minimize observer bias (Diefenbach et al. 2003). Surveys were conducted from 0700 to 1000 (three hours post-sunrise, Central Standard Time) on days with no precipitation and wind <12 km/hr. Flyover observations were not included, as their presence was not likely associated with field border presence. We recorded all bird observations within 10 m perpendicular bands relative to each local field margin region and field border treatment.

Statistical Analyses

Avian response metrics included species richness, abundance, total avian conservation value (TACV; Nuttle et al. 2003), and sparrow abundance. These metrics were analyzed with a repeated measures analysis of variance (ANOVA) using PROC MIXED (SAS Institute, Inc. 2003). Fixed main effects were field border treatments with year as the repeated effect and line transects as the random effect. Year effects were detected ($P < 0.05$) for sparrow abundance in the FBZ and wooded edge regions. Sparrow abundance estimates within adjacent distance bands were analyzed for combined years using an ANOVA, as no year effects existed within distance bands for any treatment. We also calculated species-specific abundances per treatment for common sparrows (Song Sparrow, Swamp Sparrow, and White-throated Sparrow). Species-specific abundances were combined across years; however we did detect a year effect on Swamp Sparrows. The nature of these survey conditions (birds counted <30 m of observer with no

visual obstruction) permits the reasonable assumption of a 100% detection probability in the agricultural field, thereby eliminating the need to calculate detection functions (Diefenbach et al. 2003). Diversity indices were not used to avoid potentially ambiguous interpretations of community comparisons amongst treatments (Hurlbert 1971, Gotelli and Entsminger 2001).

TACV is a community metric that calculates the relative conservation value of experimental field borders by multiplying species' abundances by their Partners in Flight (PIF) conservation priority ranks (Carter et al. 2000, Nuttle et al. 2003). We applied PIF ranks for wintering birds in the MAV physiographic region (<http://www.rmbo.org/pif/scores/scores.html>). PIF ranks were calculated based upon breeding and wintering distributions, relative abundance, potential threats to breeding and wintering habitats, population trend, and physiographic-specific area importance value (Carter et al. 2000). Unidentified birds were not assigned a PIF rank, however, unidentified sparrows were assigned a conservative rank of two, as all sparrows besides Chipping Sparrow (*Spizella passerina*), which were rarely observed, had a rank ≥ 2 . Species-specific TACV scores were summed within treatments to produce cumulative conservation scores for each field margin region per border treatment.

RESULTS

We recorded 59 bird species and 4,083 individuals over 22.4 km of line-transects during 2003 and 2004 winters. The five most abundant birds were Mourning Dove (*Zenaida macroura*; 17.5%), European Starling (*Sturnis vulgaris*; 15.5%), Red-winged Blackbird (*Agelaius phoeniceus*; 6.7%), Common Grackle (*Quiscalus quiscula*; 6.4%), and Northern Cardinal (*Cardinalis cardinalis*; 5.9%). The most abundant sparrows were Song Sparrow (*Melospiza melodia*; 5.0%), White-throated Sparrow (*Zonotrichia albicollis*; 4.4%), and Swamp Sparrow

(*Melospiza georgiana*; 3.1%). The most abundant species in the FBZ were Song Sparrow (19.0%), Swamp Sparrow (13.9%), Northern Cardinal (11.4%), Mourning Dove (10.5%), and White-throated Sparrow (9.1%).

Border treatment exerted significant influence on the cumulative avian response (abundance, richness, TACV, and sparrow abundance) to agricultural field margins within the field border zone (Table 1). This influence proliferated into the agricultural field, which experienced enhanced sparrow abundance and TACV when adjacent to a bordered margin (Table 1). A direct comparison of border treatments revealed small differences between non- and narrow-bordered field margins and a large influence of border width (Table 2). Narrow-bordered field margins had consistently greater abundance, richness, TACV, and sparrow abundance than non-bordered in the FBZ and agricultural field regions, albeit not statistically significant. However, wide-bordered margins had considerable influence on the avian community compared to non- and narrow-bordered margins. Wide borders supported significantly greater abundance, richness, TACV, and sparrow abundance within the FBZ than either non- or narrow-bordered margins. We also documented substantially greater TACV and sparrow abundance in the agricultural field adjacent to wide borders than non- or narrow treatments (Table 2). Negligible differences were detected among border treatments for any response metric within the wooded edge (Tables 1 and 2), likely because this region was predominantly inhabited by forest species that were largely uninfluenced by field border presence. TACV was considerably greater for wide borders than either non- or narrow (Figure 1).

Species-specific abundances generally experienced significant enhancement from non- to narrow and narrow to wide treatments (Figure 2). Song ($F_{2,105}=5.130$, $P = 0.009$) and Swamp

($F_{2,105} = 3.400$, $P = 0.040$) Sparrows had substantially higher densities within the FBZ for both narrow and wide-bordered margins than non-bordered. White-throated Sparrows were uninfluenced ($F_{2,105} = 0.110$, $P = 0.900$) by field border presence and remained more wooded-cover dependent (Figure 2).

Field border width positively correlated with sparrow abundances per distance band into adjacent agricultural fields (Figure 3). We observed considerably greater numbers at farther distances adjacent to wide borders than non- or narrow; however, few birds ventured farther than 20 m beyond the border edge regardless of treatment (Figure 3).

DISCUSSION

Alterations in agricultural practices commonly proceed in apathy of their impacts on wintering birds. The aftermath of these alterations generally include habitat loss or degradation (Best 1983) and have been found to coincide with declining grassland bird populations throughout North America (Peterjohn and Sauer 1999). The USDA has promoted integration of field borders to enhance quantity and complexity of early successional habitat in farm landscapes, which provides habitat for birds of conservation concern. Field borders represented the majority of otherwise scarce early-successional habitat on the agricultural farms we investigated and provided foraging and escape habitat for many wintering sparrows. Seed resources provided by vegetation in field borders are an important source of energy for many ground-foraging, over-wintering sparrows (Falls and Kopachena 1994, Mowbray 1997, Arcese et al. 2002). Our results reflected these avian benefits provided by field borders. Based on this research, we advocate the establishment of field borders on production farms as valuable habitat

for foraging, roosting, escape cover, and maintenance activities of wintering grassland birds in the MAV.

This study supported our prediction that narrow field borders positively influence overwintering sparrows in the southeast (Marcus et al. 2000, Smith et al. 2005), although we failed to observe overwhelming evidence for narrow field borders. However, we did document consistent and slightly greater avian abundance, richness, TACV, and sparrow abundance for narrow-bordered margins compared with non-bordered. This study also revealed the augmented benefits for wintering birds through increased field border width. Wide-bordered field margins represented a considerable enhancement over “ditch to ditch” cropping techniques as well as narrow-bordered margins for edge-associated and habitat generalist birds during winter. Wide borders strongly influenced overall abundance, species richness, sparrow abundance, and TACV, thus verifying their potential benefits for avian conservation. Higher TACV scores may partially reflect avian abundance, however, as this influence predominated from priority sparrows, we feel it maintains an accurate indication of field border conservation value.

We did not document attraction of edge-averse species to field borders regardless of width, however, the benefits provided by wide borders were likely positively influenced by the existence of habitat farther from the wooded edge. We suspect that field border location, on wooded edges in a matrix of vast, un-vegetated fields precluded their appeal to edge-averse birds. As such, field borders are mostly exploited by edge-associated and habitat generalist species. Such species-specific responses to field border presence corresponded with the cover-dependency of each species. Song, Swamp, and White-throated Sparrows were all common on field edges and are somewhat dependent on brushy and/or woody cover (Falls and Kopachena

1994, Mowbray 1997, Arcese et al. 2002). White-throated Sparrows were unresponsive to field borders, largely remaining within the wooded edge regardless of border treatment. This was expected, as the hesitancy of White-throated Sparrows to venture from cover has been previously documented (Schneider 1984). Song and Swamp Sparrows occurred in bordered margins at significantly greater abundances than non-bordered, and both species had substantially increased abundances in wide than narrow field borders. This result is encouraging from a conservation standpoint as Swamp Sparrows are classified by Partner's in Flight as a species of high regional concern in the MAV physiographic region (<http://www.rmbo.org/pif/pifdb.html>).

Sparrow abundances in agricultural fields were greater adjacent to wide-bordered margins than narrow or non-bordered. This enhanced spatial utilization suggests wider borders provided higher quality escape cover and subsequently allowed birds to forage more in agricultural fields. This trend is also likely related to increased distance of agricultural fields from wooded edges, which provide perch sites for avian predators, when adjacent to wide field borders. If wide borders allow birds to safely venture farther from the border edge, there may be substantially increased foraging benefits as agricultural fields provide a large amount of food in the form of waste grain (Warner et al. 1989). The ability of birds to safely access waste grain within 20 m adjacent to a 400 m long field border would provide an additional 0.8 ha of forage space per border. Such supplemental forage resources may differentiate between survival and death for many sparrows during late-winter months when food supply is a primary limiting factor (Jansson et al. 1981). We suggest future investigations identify a minimal field border width to elicit this effect, forage resource quality in these areas, and the associated risk of predation.

Proper management of field borders is crucial to maintain the integrity of herbaceous vegetation and resultant avian benefits. Maintenance of borders should occur through periodic disturbance regimes (e.g., fire, mowing, and disking) approximately every 3–5 years, dependent on vegetative density and avian community composition (Vogl 1974). Additionally, we recommend application of disturbance regimes to occur in a rotational pattern to prevent widespread simultaneous elimination of herbaceous habitat on a farm. This is especially important if executed during late winter or early-spring months, when reduced food supply and added forage demands of the impending migration may reduce bird survival. Another consideration for adequate maintenance of these borders relates to row crop orientation during the growing season. We noticed that field borders adjacent to perpendicularly oriented rows were frequently damaged when used as a turn row and therefore, recommend that immediately adjacent crop rows be oriented parallel with borders to both prevent turn row damage and provide a herbicide lane should border vegetation disperse into crop fields. Another issue requiring confrontation is the seemingly inevitable degradation of border integrity caused from farm vehicle travel on field margins. It may prove useful to explore potential advantages of field border establishment off the wooded edge (3-5 m) as a means to reduce border destruction by farm vehicles and increase distance from the wooded edge while maintaining proximity for cover-dependent species.

MANAGEMENT IMPLICATIONS

With the growing popularity of field borders and similar strip-cover habitat in agricultural systems, an understanding of wildlife response is increasingly important. Although there remains a paucity of literature on over-winter farmland bird conservation, this research gap is

slowly becoming recognized and addressed (Herkert et al. 1996, Marcus et al. 2000, Peterjohn 2003, Smith et al. 2005). This study demonstrated that field borders (e.g. CP33, Habitat Buffers for Upland Birds) are extremely valuable wintering avian habitat in an agricultural landscape. Furthermore, avian benefits were soundly enhanced with increased border width. Although the value of strip-cover habitat is becoming well known, this study highlights the advantages of increased strip-cover width. Our findings document the wildlife benefits of managing conservation buffer habitat for wildlife over water quality. We therefore recommend that field border establishment proceed in favor of the width component. Field borders are a new (2004) buffer practice under the CRP, and can be established in widths of 30-120 feet. Based on these findings, we recommend establishment between 90-120 feet to maximize avian benefit.

Subsequent wildlife-related goals for conservation buffers should place equal emphasis on area and hence, width, as they do length. Future research on field borders should focus on the identification of an optimal width threshold for maximization of both wildlife habitat and economic benefits of agricultural producers. Resultant management regimes would efficiently enhance the value of such habitat for wintering avian communities without impeding landowner economic profit (Barbour 2006). The incorporation of herbaceous field borders into agricultural systems may have large environmental and sociological impacts. Their potential to balance the needs of agricultural producers and wildlife is reassuring as this connection is increasingly urgent with the continued expansion of human populations and food requirements worldwide (Robertson and Swinton 2005).

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Table 1. Richness, abundance, and total avian conservation value in the field border zone, agricultural field, and wooded edge habitat regions associated with non-, narrow, and wide-bordered field margins in the Mississippi Alluvial Valley during winters of 2003 and 2004.

| Community Measure | Year | Border Treatment | Field Border Zone | | | | Agricultural Field | | | | Wooded Edge | | | |
|-------------------|------|------------------|-------------------|-------|---------------------------------|--------|--------------------|--------|--------------------|-------|-------------|--------|--------------------|-------|
| | | | mean | SE | F _{2,105} ^a | P | mean | SE | F _{2,105} | P | mean | SE | F _{2,105} | P |
| Abundance | 2003 | Non | 2.211 | 1.784 | | | 2.000 | 9.657 | | | 20.526 | 6.686 | | |
| | | Narrow | 4.895 | 1.261 | | | 17.632 | 6.828 | | | 24.263 | 4.727 | | |
| | | Wide | 17.400 | 3.477 | | | 19.400 | 18.824 | | | 15.000 | 11.897 | | |
| | 2004 | Non | 3.235 | 1.886 | | | 10.000 | 10.209 | | | 14.647 | 7.068 | | |
| | | Narrow | 4.615 | 1.525 | | | 4.423 | 8.255 | | | 17.577 | 5.715 | | |
| | | Wide | 10.333 | 3.174 | 8.660 | <0.001 | 22.333 | 17.184 | 0.540 | 0.584 | 38.800 | 13.032 | 0.450 | 0.640 |
| Richness | 2003 | Non | 1.684 | 0.439 | | | 1.053 | 0.325 | | | 5.579 | 0.608 | | |
| | | Narrow | 1.921 | 0.311 | | | 1.711 | 0.230 | | | 5.789 | 0.430 | | |
| | | Wide | 5.400 | 0.856 | | | 2.000 | 0.634 | | | 4.333 | 1.082 | | |
| | 2004 | Non | 2.471 | 0.464 | | | 0.882 | 0.344 | | | 5.177 | 0.643 | | |
| | | Narrow | 2.962 | 0.375 | | | 0.654 | 0.278 | | | 6.000 | 0.520 | | |
| | | Wide | 3.500 | 0.782 | 6.560 | 0.002 | 2.167 | 0.579 | 2.600 | 0.079 | 3.600 | 1.186 | 2.540 | 0.084 |
| TACV | 2003 | Non | 4.368 | 3.168 | | | 8.474 | 9.102 | | | 48.526 | 16.345 | | |
| | | Narrow | 7.763 | 2.240 | | | 26.658 | 6.436 | | | 58.868 | 11.558 | | |
| | | Wide | 24.600 | 6.176 | | | 43.400 | 17.742 | | | 23.333 | 29.087 | | |
| | 2004 | Non | 6.471 | 3.349 | | | 20.177 | 9.622 | | | 37.294 | 17.280 | | |
| | | Narrow | 7.923 | 2.708 | | | 17.769 | 7.780 | | | 41.923 | 13.973 | | |
| | | Wide | 19.833 | 5.638 | 6.340 | 0.003 | 64.667 | 16.196 | 4.210 | 0.018 | 93.200 | 31.863 | 0.230 | 0.792 |
| Sparrows | 2003 | Non | 1.158 | 1.172 | | | 0.105 | 1.876 | | | 2.526 | 1.104 | | |
| | | Narrow | 3.053 | 0.829 | | | 1.316 | 1.327 | | | 2.290 | 0.781 | | |
| | | Wide | 16.600 | 2.285 | | | 16.400 | 3.658 | | | 9.333 | 1.965 | | |
| | 2004 | Non | 1.471 | 1.239 | | | 2.412 | 1.984 | | | 3.177 | 1.168 | | |
| | | Narrow | 3.500 | 1.002 | | | 1.731 | 1.604 | | | 2.385 | 0.944 | | |
| | | Wide | 3.167 | 2.086 | 11.770 ^b | <0.001 | 3.833 | 3.339 | 5.550 | 0.005 | 1.200 | 2.153 | 1.720 ^b | 0.184 |

^a F-test and *P* values are associated with field border treatment as main effect in repeated measures ANOVA, not individual means per year

^b Year effects were detected for Sparrows in the field border zone ($F_{1,105} = 11.33$, $P = 0.001$) and wooded edge ($F_{1,105} = 4.43$, $P = 0.040$).

Table 2. The mean difference for each community metric denote effect size between border treatments per location of field margins during winter in the Mississippi Alluvial Valley from 2003-2004.

| Field Margin Region | Metric | Narrow vs. Non | | | Wide vs. Narrow | | | Wide vs. Non | | |
|------------------------|----------------------|----------------|--------|---------|-----------------|--------|----------|--------------|--------|----------|
| | | mean | SE | t-value | mean | SE | t-value | mean | SE | t-value |
| Field Border Zone | Abu | 2.032 | 1.632 | 1.250 | 9.112 | 2.554 | 3.570*** | 11.144 | 2.688 | 4.150*** |
| | Rich | 0.364 | 0.402 | 0.910 | 2.009 | 0.629 | 3.200** | 2.373 | 0.662 | 3.580*** |
| | TACV | 2.424 | 2.899 | 0.840 | 14.374 | 4.536 | 3.17** | 16.797 | 4.775 | 3.520*** |
| | Sparrow ^a | 1.962 | 1.073 | 1.830 | 6.607 | 1.678 | 3.940*** | 8.569 | 1.767 | 4.850*** |
| Agricultural Field | Abu | 5.027 | 8.835 | 0.570 | 9.840 | 13.824 | 0.710 | 14.867 | 14.552 | 1.020 |
| | Rich | 0.215 | 0.298 | 0.720 | 0.901 | 0.466 | 1.930 | 1.116 | 0.490 | 2.280* |
| | TACV | 7.889 | 8.327 | 0.950 | 31.820 | 13.029 | 2.440* | 39.708 | 13.716 | 2.900** |
| | Sparrow | 0.265 | 1.717 | 0.150 | 8.593 | 2.686 | 3.200** | 8.858 | 2.828 | 3.130** |
| Wooded Edge | Abu | 3.333 | 6.117 | 0.54 | 5.980 | 9.571 | 0.620 | 9.313 | 10.075 | 0.920 |
| | Rich | 0.517 | 0.557 | 0.930 | -1.928 | 0.871 | 2.210 | -1.411 | 0.917 | -1.540 |
| | TACV | 7.486 | 14.955 | 0.500 | 7.871 | 23.399 | 0.340 | 15.356 | 24.633 | 0.620 |
| | Sparrow ^a | -0.514 | 1.011 | -0.510 | 2.930 | 1.581 | 1.850 | 2.415 | 1.664 | 1.450 |

^a Denotes presence of year effect.

* P < 0.05, ** P < 0.01, *** P < 0.001

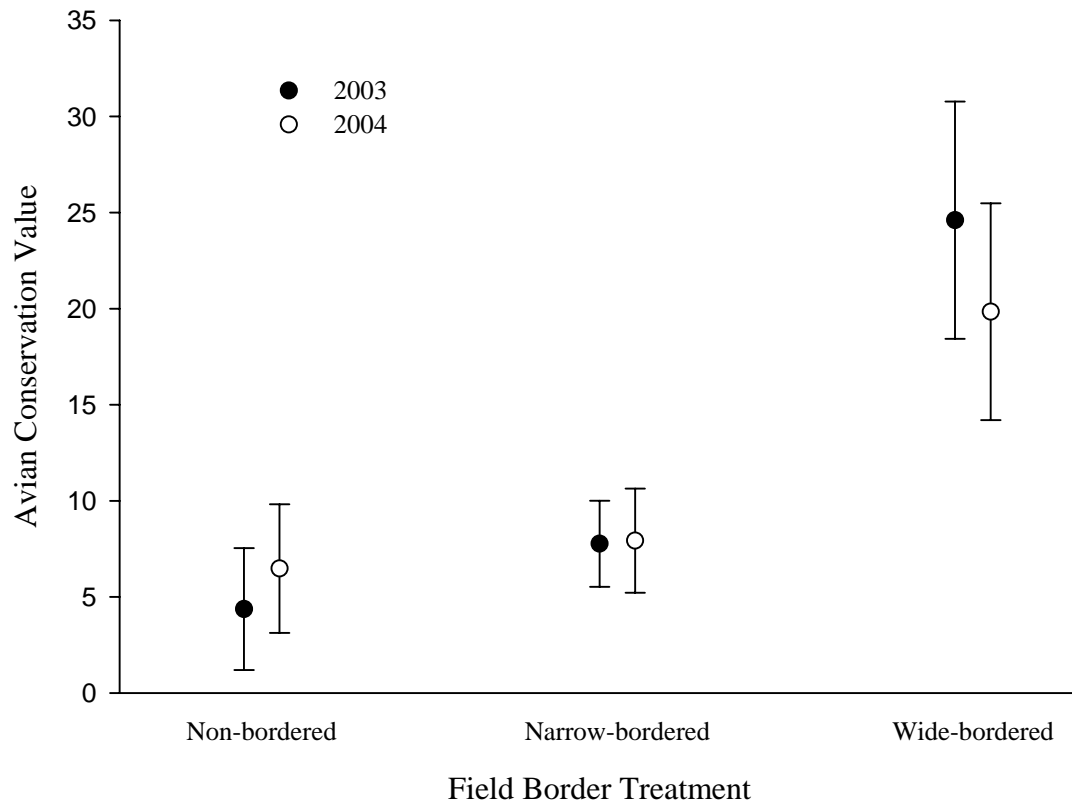


Figure 1.

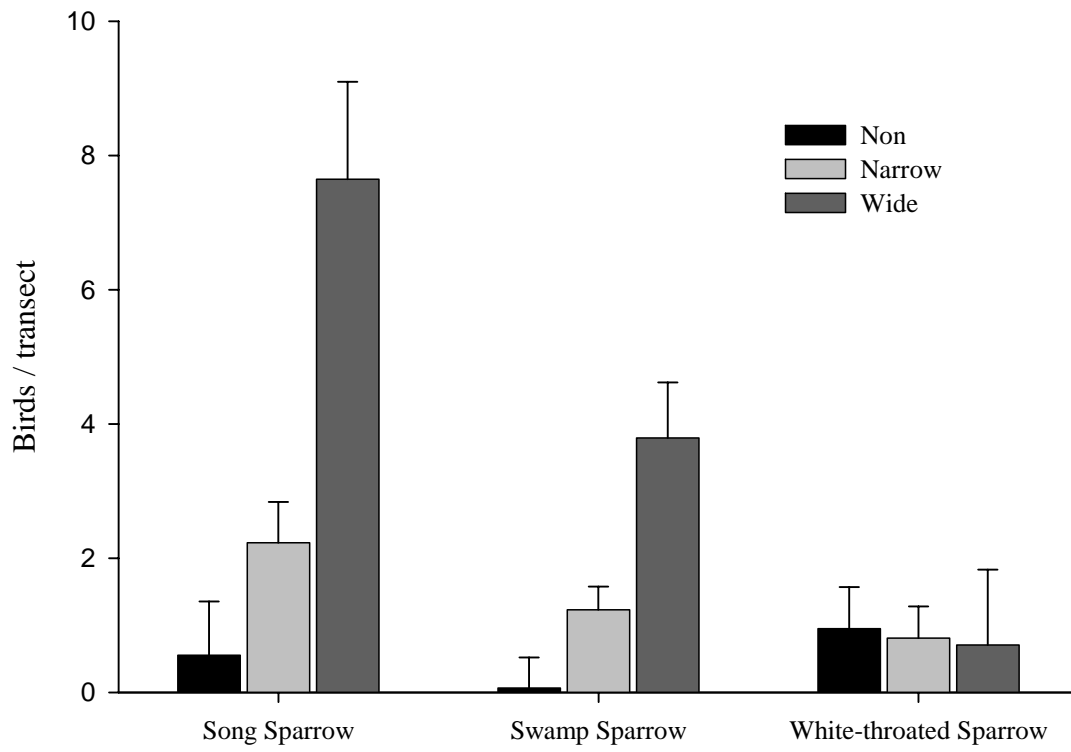


Figure 2.

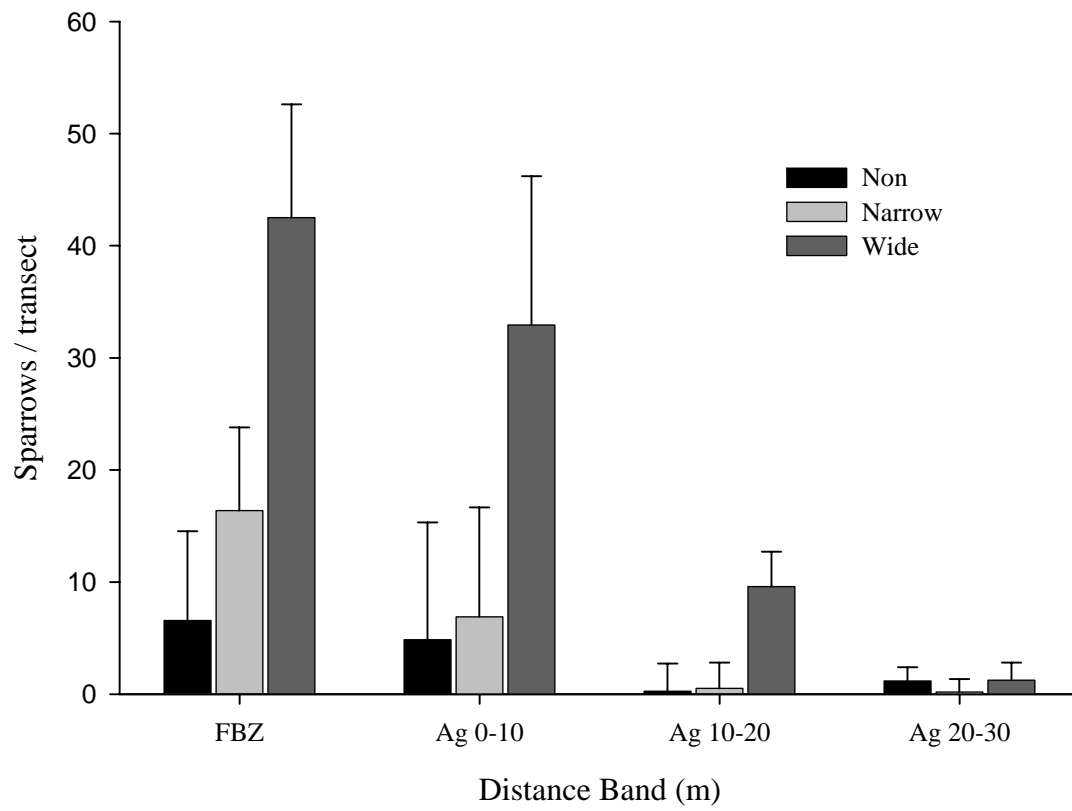


Figure 3.

Figure 1. Total avian conservation value within the field border zone of non-, narrow and wide-bordered field margins in the MAV during 2003 and 2004.

Figure 2. Species-specific abundances within the field border zone and agricultural field of non-, narrow, and wide-bordered field margin treatments during 2003 and 2004.

Figure 3. Sparrow abundance in the field border zone (FBZ; 10 m region adjacent to the wooded edge), and 3-10 m distance bands into the agricultural field region for non-, narrow, and wide-bordered field margin treatments during 2003 and 2004.