Research Article

Winter Avian Community and Sparrow Response to Field Border Width

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ABSTRACT Transformations of agricultural practices in the southeastern United States have drastically reduced preexisting 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. We evaluated effects of native warm-season grass field border establishment and width on winter bird response. Narrow (approx. 8-m) field borders represented a marginal improvement to non-bordered margins that were cropped ditch to ditch, whereas wide (approx. 30-m) borders significantly enhanced total avian conservation value, abundance, species richness, and sparrow abundance compared to non- or narrow borders. Furthermore, presence of wide borders altered bird use of row-crop fields. We observed increased sparrow (Emberizidae) abundances in agricultural fields adjacent to wide borders, which likely resulted from enhanced waste grain foraging opportunities. Given these benefits to wintering farmland birds, we advocate the integration of herbaceous field border habitat in agricultural landscapes, particularly borders of enhanced width. (JOURNAL OF WILDLIFE MANAGEMENT 71(6):1917–1923; 2007)

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Large-scale conversion of native grassland habitat to agriculture in the United States (Noss et al. 1995) has increased dependence of many grassland birds on agricultural landscapes for habitat (Hunter et al. 2001). Whereas agricultural growth previously benefited farmland birds through geographic range expansions (Hurley and Franks 1976), technological advancements have intensified agricultural practices (Vickery et al. 1999, Murphy 2003) and reduced non-crop habitat on field margins (Shalaway 1979). As grassland bird populations continue to decline (Herkert 1995, Peterjohn and Sauer 1999, Brennan and Kuvlesky 2005), field margin habitat during winter is increasingly important to prevent resource depletion from causing population bottlenecks (Payne and Wilson 1999).

Intensive agricultural systems are unlikely to experience large-scale conversion of croplands to native habitat and, as such, wildlife habitat establishment must balance producer and wildlife needs (Peterjohn 2003). In 1997, the National Conservation Buffer Initiative (NCBI) was created to improve soil, air, and water quality, to conserve biodiversity, and to enhance wildlife habitat (Best 2000). Conservation buffers represent a viable habitat option because they are easily integrated into production systems, provide multiple environmental benefits, and are more likely to be adopted by agricultural producers for economic reasons (Best 2000, Barbour 2006). Initial NCBI practices focused on water quality and, as such, buffers were restricted to down-slope field margins. In 2004, Habitat Buffers for Upland Birds (hereafter field borders) represented a new buffer practice under the continuous Conservation Reserve Program, with location flexibility to enhance wildlife habitat along upland field margins. Field borders are non-crop, herbaceous buffers that are typically incorporated with a preexisting field margin feature and provide nesting and foraging habitat, movement corridors, and escape cover for many avian species (Puckett et al. 1995, 2000; Marcus et al. 2000; Smith et al. 2005). Smith et al. (2005) also noted that escape cover in field borders might increase avian use of adjacent crop fields in close proximity, thereby increasing access to waste grain. Such benefits may be particularly beneficial to defray forage resource limitations for wintering birds (Davis 1973, Jansson et al. 1981, Lima 1990, Watts 1990).

Field border establishment in the southeastern United States has specific potential to benefit temperate, short-distance migrant sparrows (Emberizidae) exhibiting declining populations (Sauer et al. 2004). The Mississippi Alluvial Valley (MAV) physiographic region has undergone large-scale conversion of native habitat to agriculture (Noss et al. 1995, Rudis 2001), which likely increased grassland bird dependence on the landscape. The majority of overwintering sparrows in the MAV had negative population trends throughout North America from 1980 to 2003, and most sparrows inhabiting agricultural field edges in the Southeast are of conservation concern (Peterjohn and Sauer 1999). Unfortunately, the current paucity of research on wintering grassland birds in the southeastern United States (Marcus et al. 2000, Peterjohn 2003, Smith et al. 2005) inhibits development of efficacious management regimes.

Field borders are increasingly popular among agricultural producers for their minimal impact on crop production (Davison 1941, Barbour 2006), attractiveness for northern bobwhite (*Colinus virginianus*), and potential to increase whole-farm profitability (Barbour 2006). The conceptual

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allure and financial incentives of field borders may result in future widespread establishment, heightening the need to understand wildlife response. Current understanding of field border interactions with winter birds is limited to narrow field borders (<10 m; Marcus et al. 2000, Smith et al. 2005). Although escalated avian benefits have been associated with increased linear habitat width (Rodenhouse and Best 1983, Warner 1992), no such assessment has been conducted on field borders. Wider field borders provide habitat farther from wooded field margins and, as such, have the potential to provide habitat for wooded edge-averse (i.e., species that avoid wooded habitat edges; Helzer and Jelinski 1999, Woodward et al. 2001) and wooded cover–dependent birds (Schneider 1984). Hence, a reasonable increase of border width may provide significant ecological gains and, as such, evaluation should be a priority.

As programmatic opportunities to implement field borders increase, researchers must provide wildlife managers with effective establishment and maintenance regimes. Our primary objectives were differentiating avian benefits between non-, narrow-, and wide-bordered agricultural field margins during winter. We hypothesized that 1) narrow-bordered field margins would receive increased bird use compared to non-bordered margins, 2) border width would positively relate with avian community metrics and sparrow abundance, and 3) wide borders would facilitate increased spatial movement into adjacent agricultural fields.

STUDY AREA

We conducted our study on 6 farms in Sunflower County, Mississippi, USA, during February of 2003 and 2004. All farms were located in the MAV, with the 2 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 (*Glycine* sp.; 58%), cotton (*Gossypium* sp.; 58%), and milo (*Sorghum* sp.; 10%). Historically, this region was bottomland-hardwood forest; hence, field border establishment represented an opportunistic exploitation to indirectly restore grassland habitat lost elsewhere, specifically the midwestern United States and Blackland Prairies of the southeastern United States (Smith 1981). Nominal topographical relief defined the landscape along with large row-crop fields fragmented by wooded fencerows and drainage ditches. Fields were largely void of vegetative cover except sparse crop stubble in some fields. Soil associations on the farms were primarily Dundee silt loam or Forestdale silt loam. These are stratified alluvial soils of fine to coarse texture that were washed in by the Mississippi River, have poor to moderate drainage, and vary widely in acidity levels (Powell et al. 1952).

In the spring of 2002 we established experimental field borders, which were located between a wooded field margin (e.g., fencerow), which enclosed a drainage ditch and a row-crop field. We randomly selected the field border population from a predetermined sample population of all potential habitats on selected farms. Control (non-bordered) field margins were located in comparable environmental contexts but represented ditch-to-ditch row-cropping techniques typical of the area and therefore 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*). The floral composition of field borders also included horsetail (*Conyza canadensis*), seashore vervain (*Verbena litoralis*), Bermuda grass (*Cynodon dactylon*), johnsongrass (*Sorghum halepense*), goldenrod (*Solidago* spp.), common ragweed (*Ambrosia artemisiifolia*), giant ragweed (*Ambrosia trifida*), poison ivy (*Toxicodendron radicans*), curly dock (*Rumex crispus*), and *Rubus* spp.

METHODS

We requested farm operators not to disturb (e.g., mow, burn, apply chemicals to, drive on, or disk) field borders during our 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: $\bar{x}$ width $= 8.5 \pm 1.8$ m, $n = 38$; 2004: $\bar{x}$ width $= 7.3 \pm 2.2$ m, $n = 26$), and wide-bordered (2003: $\bar{x}$ width $= 32.7 \pm 9.0$ m, $n = 5$; 2004: $\bar{x}$ width $= 29.7 \pm 10.2$ m, $n = 5$). We determined field border width by using the average measurement of distances between the fencerow and crop field at 50-m intervals per border. We evaluated the influence of field borders on birds in 3 adjacent field margin regions (1: wooded edge, 2: field border zone [FBZ], 3: agricultural field; Fig. 1). The FBZ was a 10-m area between the wooded edge and agricultural field, and it 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.

Community Assessment

We surveyed the avian community during February of 2003 and 2004 using distance sampling, line-transect survey techniques (Buckland et al. 2001). We surveyed transects >200 m with ≥100-m buffer between transects to minimize counting individuals multiple times. Transects were located on the agricultural field–FBZ edge (Fig. 1), and we evenly paced them for 10 minutes to ensure equal observation effort. One person surveyed >90% of transects to minimize observer bias, and the other observer had comparable avian identification skills (Diefenbach et al. 2003). We conducted surveys from 0700 hours to 1000 hours (3 hr after sunrise, Central Standard Time) on days with no precipitation and wind <12 km/hour. We excluded flyover observations from analyses because their presence was not likely associated with field borders. We recorded all bird observations within 6 10-m perpendicular distance bands relative to each local field margin region and field border treatment. We pooled

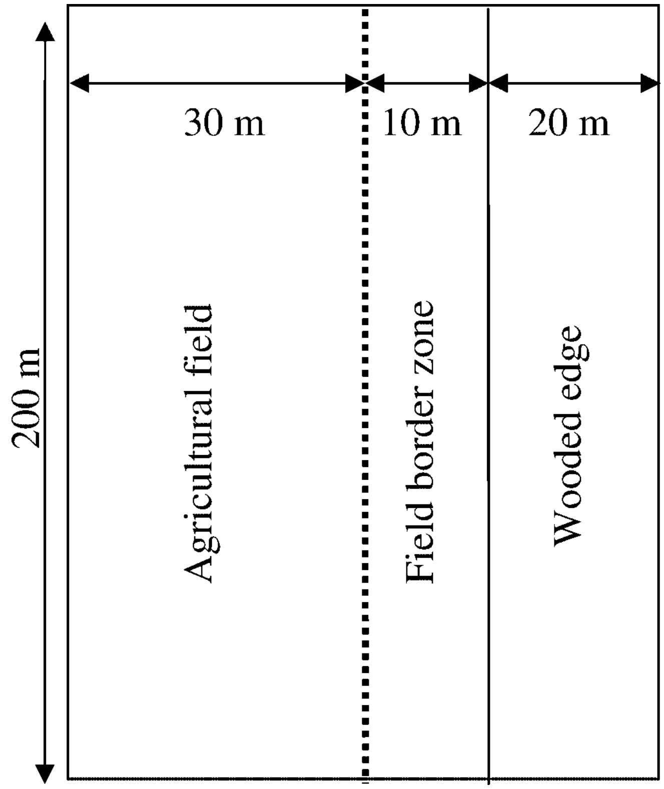

Figure 1. Bird observations were in the agricultural field, field border zone, and wooded edge regions of a field margin in the Mississippi Alluvial Valley, USA, during winters of 2003 and 2004. The dashed line denotes line-transect location.

distance bands for region-specific analyses of the agricultural field and wooded edge.

Statistical Analyses

Avian response metrics included species richness, total bird abundance, total avian conservation value (TACV; Nuttle et al. 2003), and sparrow abundance. We analyzed these metrics with a repeated measures analysis of variance using PROC MIXED in SAS (SAS Institute, Cary, NC). We evaluated both compound symmetry and first-order auto-regressive (AR1) variance–covariance structures and selected AR1 based on lowest Akaike's Information Criterion model estimates. Fixed main effects included field border treatments (non-, narrow, and wide-bordered) with year as the repeated effect and line transects as the random subject effect. We also calculated species-specific abundances per treatment for frequently detected sparrows (song sparrow [*Melospiza melodia*], swamp sparrow [*Melospiza georgiana*], white-throated sparrow [*Zonotrichia leucophrys*]). We combined species-specific abundances across years; however, we did detect a year effect on swamp sparrows. We avoided the need for detection functions by using abundance estimates (birds/200-m $\times$ 10-m strip) rather than calculating density. As all bird observations were made $\leq$30 m of the observer, 100% detection probability is a reasonable assumption for herbaceous habitats (Diefenbach et al. 2003). We concede that slightly different detection rates may exist among field margin regions; however, they remain comparable because detectability should remain consistent within regions across treatments. To avoid potentially ambiguous interpretations of community comparisons among treatments, we did not use diversity indices (Hurlbert 1971, Gotelli and Entsminger 2001).

Total avian conservation value is a community metric we used to calculate the relative conservation value of 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>), which was 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). We did not assign unidentified birds a PIF rank; however, we assigned unidentified sparrows a conservative rank of 2 because all sparrows besides chipping sparrow (*Spizella passerina*), which was rarely observed, had a rank $\geq$2. We summed species-specific TACV scores 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 winters of 2003 and 2004. The 5 most commonly detected birds included 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 common sparrows were song sparrow (5.0%), white-throated sparrow (4.4%), and swamp sparrow (3.1%). The most frequently encountered birds 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%).

We detected year effects ($P < 0.05$) for sparrow abundance in the FBZ and wooded edge regions. We analyzed sparrow abundance estimates within adjacent distance bands for combined years because no year effects existed within distance bands for any treatment. Experimental border treatment effects revealed a beneficial influence on the cumulative avian response (abundance, richness, TACV, and sparrow abundance) to agricultural field margins, particularly within the FBZ (Table 1). This influence proliferated into the agricultural field, which had 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 field borders reliably, albeit nonsignificantly, enhanced avian abundance, TACV, and sparrow abundance over non-bordered field margins in the FBZ and agricultural field regions (Table 2). In contrast, the FBZ for wide-bordered margins supported significantly (P

Table 1. Avian richness, abundance, total avian conservation value (TACV), and total sparrow abundance (Sparrow) 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, USA, during winters of 2003 and 2004.

Community measure	Yr	Border treatment	Field border zone				Agricultural field				Wooded edge			
			$\bar{x}$	SE	$F_{2,105}$[a]	P	$\bar{x}$	SE	$F_{2,105}$	P	$\bar{x}$	SE	$F_{2,105}$	P
Abundance	2003	Non-	2.21	1.78			2.00	9.66			20.53	6.69		
		Narrow	4.90	1.26			17.63	6.83			24.26	4.73		
		Wide	17.40	3.48			19.40	18.82			15.00	11.90		
	2004	Non-	3.24	1.89			10.00	10.21			14.65	7.07		
		Narrow	4.62	1.53			4.42	8.26			17.58	5.72		
		Wide	10.33	3.17	6.63	<0.01	22.33	17.18	0.46	0.63	38.80	13.03	0.40	0.67
Richness	2003	Non-	1.68	0.44			1.05	0.33			5.58	0.61		
		Narrow	1.92	0.31			1.71	0.23			5.79	0.43		
		Wide	5.40	0.86			2.00	0.63			4.33	1.08		
	2004	Non-	2.47	0.46			0.88	0.34			5.18	0.64		
		Narrow	2.96	0.38			0.65	0.28			6.00	0.52		
		Wide	3.50	0.78	4.73	0.01	2.17	0.58	2.41	0.09	3.60	1.19	2.34	0.10
TACV	2003	Non-	4.37	3.17			8.47	9.10			48.53	16.35		
		Narrow	7.76	2.24			26.66	6.44			58.87	11.56		
		Wide	24.60	6.18			43.40	17.74			23.33	29.09		
	2004	Non-	6.47	3.35			20.18	9.62			37.29	17.28		
		Narrow	7.92	2.71			17.77	7.78			41.92	13.97		
		Wide	19.83	5.64	4.83	<0.01	64.67	16.20	3.18	<0.05	93.20	31.86	0.22	0.80
Sparrow	2003	Non-	1.16	1.17			0.11	1.88			2.53	1.10		
		Narrow	3.05	0.83			1.32	1.33			2.29	0.78		
		Wide	16.60	2.29			16.40	3.66			9.33	1.97		
	2004	Non-	1.47	1.24			2.41	1.98			3.18	1.17		
		Narrow	3.50	1.00			1.73	1.60			2.39	0.94		
		Wide	3.17	2.09	8.53[b]	<0.01	3.83	3.34	4.63	0.01	1.20	2.15	2.01[b]	0.14

[a] F-test and P-values are associated with field border treatment as main effect in repeated-measures analysis of variance, not individual $\bar{x}$/yr.
[b] We detected yr effects for Sparrow in the field border zone ($F_{1,105} = 11.33$, $P = 0.001$) and wooded edge ($F_{1,105} = 4.43$, $P = 0.040$).

≤ 0.01) greater overall abundance, richness, TACV, and sparrow abundance than either non- or narrow-bordered margins (Table 2). Wide field borders had 2.8 times greater mean TACV than either non- or narrow borders (Fig. 2).

Species-specific abundances generally increased from non- to narrow and narrow to wide treatments (Table 3; Fig. 3). Song ($F_{2,105} = 9.36$, $P < 0.01$) and swamp ($F_{2,105} = 7.15$, $P < 0.01$) sparrows had substantially higher densities within the FBZ for both narrow and wide-bordered margins than non-bordered. White-throated sparrows were uninfluenced ($F_{2,105} = 0.03$, $P = 0.97$) by field border presence and remained more wooded-cover dependent (Fig. 3).

Field border width also influenced sparrow presence in adjacent agricultural fields (Fig. 4). We observed 7.8 times more sparrows within 20 m adjacent to wide border edges than to non- or narrow; however, few birds ventured beyond 20 m regardless of treatment (Fig. 4).

DISCUSSION

Our results consistently supported the prediction that narrow field borders benefit overwintering sparrows (Marcus

Table 2. The least-squares mean difference ($\bar{x}$) for each metric denotes effect size between field border treatments per field margin region (non-, narrow, and wide borders) during winter in the Mississippi Alluvial Valley, USA, from 2003 to 2004.

Field margin region	Metric[a]	Narrow vs. non-			Wide vs. narrow			Wide vs. non-		
		$\bar{x}$	SE	t	$\bar{x}$	SE	t	$\bar{x}$	SE	t
Field border zone	Abu	2.03	1.69	1.20	7.66	2.52	3.04**	9.69	2.67	3.63***
	Rich	0.36	0.40	0.92	1.59	0.60	2.63**	1.95	0.64	3.06**
	TACV	2.43	3.01	0.81	12.14	4.48	2.71**	14.57	4.74	3.07**
	Sparrow[b]	1.97	1.08	1.82	5.18	1.64	3.16**	7.15	1.73	4.13***
Agricultural field	Abu	5.00	8.89	0.56	8.25	13.32	0.62	13.25	14.08	0.94
	Rich	0.22	0.30	0.72	0.82	0.45	1.83	1.03	0.47	2.19*
	TACV	8.28	8.82	0.94	26.42	12.98	2.04*	34.70	13.76	2.90*
	Sparrow	0.28	1.67	0.17	7.40	2.55	2.91**	7.68	2.69	2.86**
Wooded edge	Abu	3.17	6.25	0.51	5.76	9.71	0.59	8.93	10.24	0.87
	Rich	0.54	0.63	0.85	2.02	0.95	2.13*	1.48	1.01	1.47
	TACV	7.38	15.07	0.49	7.68	23.52	0.33	15.06	24.77	0.61
	Sparrow[b]	0.55	0.94	0.59	3.01	1.51	2.00*	2.46	1.58	1.56

[a] Abbreviations: Abu, abundance; Rich, richness; TACV, total avian conservation value; Sparrow, total sparrow abundance.
[b] Denotes presence of yr effect.
* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

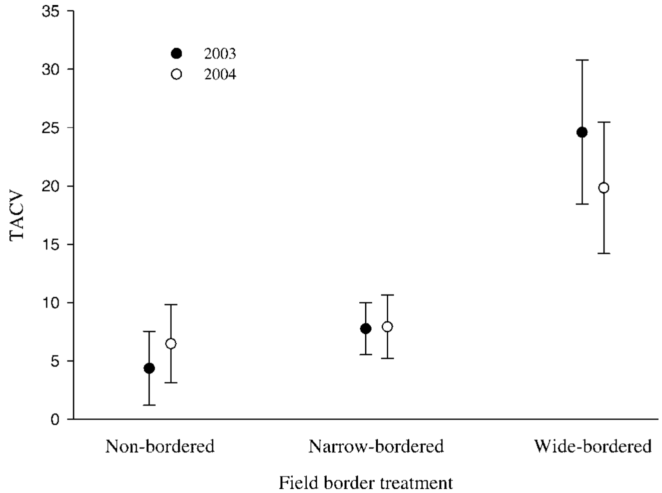

Figure 2. Total avian conservation value (TACV) within the field border zone of non-, narrow, and wide-bordered field margins in the Mississippi Alluvial Valley, USA, during winters of 2003 and 2004.

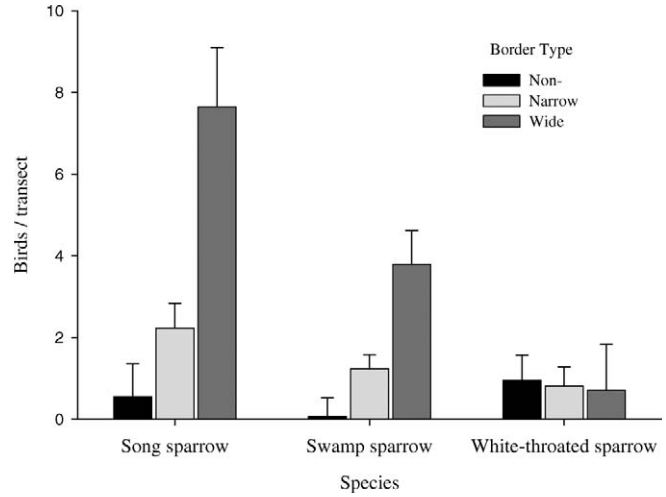

Figure 3. Species-specific abundances within the field border zone and agricultural field of non-, narrow, and wide-bordered field margins in the Mississippi Alluvial Valley, USA, during winters of 2003 and 2004.

et al. 2000, Smith et al. 2005); however, increases in overall abundance, richness, TACV, and sparrow abundance for narrow-bordered over non-bordered margins were relatively slight. Wide-bordered field margins represented a considerable enhancement of overall abundance, richness, TACV, and sparrow abundance over non- and narrow-bordered margins, thus verifying their efficacy for avian conservation. Higher TACV scores may partially reflect avian abundance; however, this influence predominated from priority sparrows and thus maintains an accurate indication of field border avian conservation value. We detected negligible treatment effects within the wooded edge (Tables 1, 2), likely because this region was predominantly inhabited by forest species that were less influenced by field border presence.

We failed to document edge-averse species (e.g., grasshopper sparrow [*Ammodramus savannarum*]) using field borders irrespective of border width. We propose 2 reasons for this: 1) 30 m is not an adequate distance from a wooded edge and 2) the vast open-field context of the MAV landscape precluded the appeal of field borders to edge-averse birds. As previous research has related edge-aversion behavior in wintering birds with increased predation risk and flock size (Rodriguez et al. 2001), future research should focus on the potential of enhanced border width to attract edge-averse birds.

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 were somewhat dependent on brushy or woody cover (Falls and Kopachena 1994, Mowbray 1997, Arcese et al. 2002). White-throated sparrows remained within the wooded edge regardless of border treatment, as predicted based on previous research (Schneider 1984). Song and swamp sparrows occurred in bordered margins at significantly greater abundances than in non-bordered, and both species were more abundant in wide compared to narrow field borders. This is encouraging for conservationists because the swamp sparrow is recognized by PIF as a species in need of continental stewardship.

Sparrow abundances were greater in agricultural fields adjacent to wide-bordered margins than to non- or narrow borders, suggesting that wide borders either maintain increased escape-cover quality or reduce predation pressure by increasing distance to avian predator perch sites in the wooded edge. This increased spatial utilization of agricultural fields may have substantial impacts on the forage resource pool for wintering birds (Warner et al. 1989). 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). Future investigations of waste grain forage quality may elucidate avian benefits associated with enhanced spatial movement and subsequent recommendations for field border location and width relative to row-crop plantings.

Table 3. The least-squares mean difference ($\bar{x}$) denotes effect size between field border treatments (non-, narrow, and wide borders) per sparrow species during winter in the Mississippi Alluvial Valley, USA, from 2003 to 2004.

	Narrow vs. non-			Wide vs. narrow			Wide vs. non-		
Species	$\bar{x}$	**SE**	t	$\bar{x}$	**SE**	t	$\bar{x}$	**SE**	t
Song sparrow	1.68	0.98	1.71	5.37	1.55	3.46***	7.04	1.63	4.33***
Swamp sparrow	1.16	0.60	1.94	2.49	0.92	2.70**	3.65	0.97	3.75***
White-throated sparrow	0.14	0.76	0.19	0.11	1.20	0.09	0.26	1.26	0.20

** $P < 0.01$, *** $P < 0.001$.

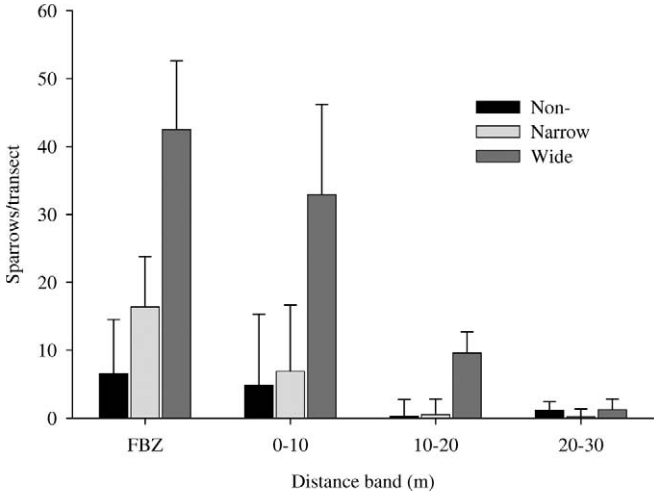

Figure 4. Sparrow abundance in the field border zone (FBZ) and agricultural field region for non-, narrow, and wide field border treatments in the Mississippi Alluvial Valley, USA, during winters of 2003 and 2004.

Overall, field borders performed well as winter bird habitat in the MAV. The substantial habitat improvements provided by increased border width should be further investigated to determine differential effects based on geographic location. Furthermore, researchers must identify an optimal width threshold to ensure field border management protocols strive to maintain a working balance between wildlife and producer needs. The potential of field borders to balance these needs is reassuring, with the continued expansion of human populations and food requirements worldwide (Robertson and Swinton 2005).

MANAGEMENT IMPLICATIONS

Based on this research, we advocate the establishment of field borders (e.g., Habitat Buffers for Upland Birds) on production farms as valuable habitat for foraging, roosting, escape cover, and maintenance activities of wintering grassland birds in the MAV. Although the value of strip-cover habitat is becoming well known, our study highlights the advantages of increased strip-cover width. Whereas field borders can be established as a Conservation Reserve Program buffer practice in widths of 10–40 m, our results infer optimal avian benefits at widths $\geq$30 m.

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