Bird Communities on Conservation Buffers and Mowed Field Edges of Two Agricultural Land Bases in Mississippi

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Abstract: We conducted a 13-year study to determine bird species richness and abundance in field edges maintained in conservation buffers and mowed field edges on two agricultural experiment stations in Mississippi. Both experiment stations were intensively managed for agricultural row crop and dairy production with field edges managed with frequent mowing and herbicide application. Habitat reclamation and management on 41 ha of field edges was initiated on each farm in 1988 and included selective spraying herbicides to control agronomic grasses, cessation of annual mowing, protection from livestock access, and planting legumes and shrubs. We surveyed birds from 1 May through 15 June on permanently established, fixed-width transects in three conservation buffer and three mowed field edges adjacent to row crops on each experimental farm from 1989 through 2001. We detected 25 bird species on mowed field edges and 51 species on edges maintained in conservation buffers on both farms. Mean species richness and bird abundance were higher ($P < 0.05$) on conservation buffers than on mowed field edges on both farms. We attributed higher bird species richness and abundance in conservation buffers to a more diverse habitat structure and increased food plant availability created by native plant succession and shrub plantings. These results support the concept that creation and maintenance of conservation buffers in field edges along row crops can increase bird species richness and abundance on agricultural lands.

Key words: agriculture, agricultural landscapes, avifauna, bird communities, conservation buffers, Conservation Reserve Program, CRP, field borders, field edges, Mississippi

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Agricultural lands comprise a large proportion of available habitat for birds in the United States (Burger 2005, Smith et al. 2005*a*). Effect of agricultural practices on bird populations has been examined (e.g. Heard et al. 2000, Ormerod and Watkinson 2000). Shifts in avifauna community structure and declines in bird species richness are often observed with implementation of practices that maintain field edges in low growing (<12 cm in height), monotypic cover types or convert small fields to large, intensively managed agricultural fields (Chamberlain et al. 2000).

In 1985, the Food Security Act established the Conservation Reserve Program (CRP) to conserve soil and water quality, (Heard et al. 2000, Johnson and Schwartz 1993*a*, *b*). Agricultural lands enrolled in CRP have contributed substantially to wildlife conservation and habitat enhancement on agricultural landscapes (Igl and Johnson 1995, Johnson and Igl 1995, Burger 2005). For example, Ryan et al. (1998) found 90 species of birds representing 10 orders and 19 families in CRP fields of the Midwest. Several authors reported benefits of conservation buffer practices to conservation of nongame passerines and upland gamebirds (Baudry et al. 2000, Hinsley and Bellamy 2000, Smith et al. 2005 *a*, *b*). Although field edges and borders have been reported as potential ecological traps for some nesting birds, these habitats can increase local avifauna diversity by providing forage and cover resources and habitat corridors on agricultural lands (Fagan et al. 1998, Ryan et al. 1998, Baudry et al. 2000, Hinsley and Bellamy 2000). According to Heard et al. (2000), more research is needed to ascertain long term contributions of conservation buffer practices to bird conservation on intensively-managed agricultural lands. Thus, objectives of our study were to report and compare bird species richness and abundance in two habitat management treatments, mowed field edges and field edges maintained as conservation buffers, on two agricultural experiment stations in Mississippi over a 13-year period.

Study Area

Study sites were >350-ha land bases managed for agricultural research and crop/dairy production by Mississippi State University

(MSU) and Mississippi Agricultural Experiment Station (MAES). The Black Belt Prairie Agricultural Experimental Station was near Brooksville, Mississippi, in the Blackland Prairie Land Resource Area of Mississippi with surrounding landscape dominated by agriculture, pastures, and aquaculture impoundments (Vanderford 1962). The North Mississippi Agricultural Experiment Station (NMAES) was in Holly Springs, Mississippi, within the Upper Coastal Plain Land Resource Area and was surrounded primarily by mixed pine-hardwood and bottomland hardwood forests (Vanderford 1962). When we initiated our research, all field edges of study sites were mowed at least monthly during growing seasons and were characterized by closely mowed (<12 cm in height), non-native agronomic grasses (>75% ground coverage) adjacent to row crops. Study sites were transected by intermittent watershed drainages with limited midstory cover (<10% coverage) and isolated occurrence of mature (>40 yrs) oak (*Quercus* spp.) or pine (*Pinus taeda*) trees (≤3 trees/ha).

Methods

In 1988–1989, we randomly selected field edges at each farm and implemented management that created two habitat treatment types: conservation buffers maintained in herbaceous-shrub vegetation and mowed field edges. Selected edges were approximately 8 ha in size, rectangular in shape measuring at least 80 m in width, and adjacent to agricultural fields mowed in crop production. We used the term "conservation buffer" as described by Burger et al. (2006) to denote a combination of management actions that retained field edges in herbaceous-shrub-woody vine vegetation over the 13-year period. Reclamation and management for conservation buffers occurred on approximately 41 ha of field edges at each farm and included herbicide application for reduction of agronomic grasses, wildlife plantings, protection of remnant trees and standing snags, and restriction of annual mowing and access by livestock. Non-native grasses, including tall fescue (*Festuca arundinacea*), Bermuda grass (*Cynodon dactylon*), and Johnson grass (*Sorghum halepense*), were initially treated in June 1988 with selective application of glyphosate (Round-up, Monsanto, St. Louis, Missouri), at a rate of 1 liter of herbicide per 151 liters of water, with a tractor-mounted mist nozzle applicator. Annual lespedeza (*Kummerowia striata*), hairy vetch (*Vicia villosa*), and partridge pea (*Chamaecrista fasciculata*) were seeded at rates of ≤ 10 kg/ha on bare soil areas where agronomic grasses had been reduced by herbicide treatments. Three to four 16-m^2 patches of Chickasaw plum (*Prunus angustifolia*) and autumn olive (*Eleagnus umbellata*) were established in winters 1988–1989 at 15–20 m intervals by planting 2-year-old bare-root seedlings at spacings of 2 x 2 m in each conservation buffer. Management actions implemented to retain conservation buffers in herbaceous-shrub cover included selective herbicide at two- to three-year intervals to control resurgence of agronomic grasses and selective herbicide or manual clipping to control colonizing trees.

Mowed field edges were typified by mowed herbaceous vegetation such as fescue, Bermuda grass, Johnson grass, vasey and dallis grass (*Paspalum* spp.), and crabgrass (*Digitaria* spp.) and miscellaneous forbs such as spurges (*Euphorbia* spp.). Vegetation maintenance practices including mowing ≥1 times per month, fertilization, and selective herbicide application that had previously occurred on farms were continued on mowed field edges from 1989–2001. Mowed field edges were characterized by herbaceous vegetation dominated (>80% coverage) by agronomic grasses of ≤12 cm in height with limited occurrence (< 1% coverage) of woody plants.

We surveyed birds using fixed-width transect surveys to determine responses of bird communities within the two field edge types (Emlen 1977, Mikol 1980). Within conservation buffers and mowed edges, we identified potential transect locations based on criteria that required transects to be located at least 50 m from forested edges and a minimum of 250 m apart. From a pool of eight transects, we randomly selected three transects measuring 70 x 190 m each which were permanently established within mowed field edges and conservation buffer edges on each experimental farm (e.g., one transect in each of the six field edges on two farms). All transects were oriented parallel to the field edge. We conducted bird surveys each year from 1 May through 15 June between 0600 and 0900 hours on mornings with ≤30% cloud cover and very calm wind conditions. We repeated surveys three times each spring on each transect from 1989 through 2001 (Emlen 1977, Mikol 1980). We randomized transect order of sampling among repetitions within each year. After allowing 10 minutes, the observer surveyed transects by walking slowly down transect center for the entire length. Duration of time spent recording data in each transect was 15 minutes. Thus, total survey time was 25 minutes for each transect in mowed edges and conservation buffers. All birds seen or heard during the transect survey were recorded, and flying birds were recorded only if birds flushed from or entered the transect proper during the survey period. To reduce variation associated with observer bias, all surveys were accomplished by the same observer over the study period. Assumptions employed in our transect surveys are described by Emlen (1977), with no correction for detection probabilities encountered in different edge habitats.

We used a repeated measures mixed model ANOVA (PROC MIXED, SAS 1999) to determine differences ($P < 0.05$) in bird species richness and abundance between treatments. Year, treatment, and their interaction were fixed effects in our models, and transects were a random effect. We reported and analyzed bird community metrics separately for the two experiment stations due to locations in different physiographic regions and surrounding landscape matrices. We grouped number of bird species detected in conservation buffers and mowed field edges into guild categories based on food habits and feeding substrates as described by Best et al. (1990) to identify the primary feeding guilds in different edge types.

Results

We detected 52 bird species in conservation buffer and mowed field edges of both farms from 1989 through 2001. We recorded 25 species in mowed field edges of the two farms over the study period (Table 1). Bird species observed annually in mowed field edges included European starling (*Sturnus vulgaris*), English sparrow (*Passer domesticus*), mourning dove (*Zenaida macroura*), red-winged blackbird (*Agelaius phoeniceus*), common grackle (*Quiscalus quiscula*), brown-headed cowbird (*Molothrus ater*), killdeer (*Charadrius vociferus*), eastern meadowlark (*Sturnella magna*), and horned lark (*Eremophilia alpestris* L.; Table 1). Omnivorous and granivorous species that fed on the ground or in low-growing vegetation comprised most species (>60%) in mowed field edges.

We recorded 51 bird species in conservation buffers on the two farms with the most common birds being red-winged blackbird, dickcissel (*Spiza americana*), northern cardinal (*Cardinalis cardinalis*), indigo bunting (*Passerina cyanea*), blue grosbeak (*Guiraca caerulea*), eastern towhee (*Pipilo erythrothalmus*), yellow-breasted chat (*Icteria virens*), eastern bluebird (*Sialia sialis*), and common yellowthroat (*Geothlypis trichas*) (Table 1). Of the 51 species observed in conservation buffers, 28 species were exclusive to these habitats. Over 80% of the species detected in conservation buffers over the study period were insectivores and omnivores that fed on the ground, on bark, or in shrub and tree cover (Best et al. 1990).

At Black Belt Prairie Agricultural Experiment Station, conservation buffers supported a greater mean species richness ($F_{1,4}$ = 54.51, P = 0.002) and abundance ($F_{1,4}$ = 8.43, P = 0.044) than mowed field edges (Figs. 1 and 2). There was a significant year effect for richness ($F_{12,48}$ = 2.33, P = 0.025) and abundance ($F_{12,48}$ = 3.15, P = 0.002), and a significant interaction effect for richness ($F_{12,48}$ = 1.98, P = 0.047). Mean species numbers detected annually in conservation buffers was 2 to 3 times that of mowed field edges with mean species richness detected ranging from 9.5 ($SE \leq .3$) in 1989 and 1998 to 14.4 (SE = 1.9) in 1997. Generally < 4 species were detected in mowed field during most study years ($SE \leq 2.0$; Fig. 1). Mean number of birds detected annually in conservation buffers ranged from 12.0 (SE = 2.5) in 1989 to 28.3 (SE = 4.8) in

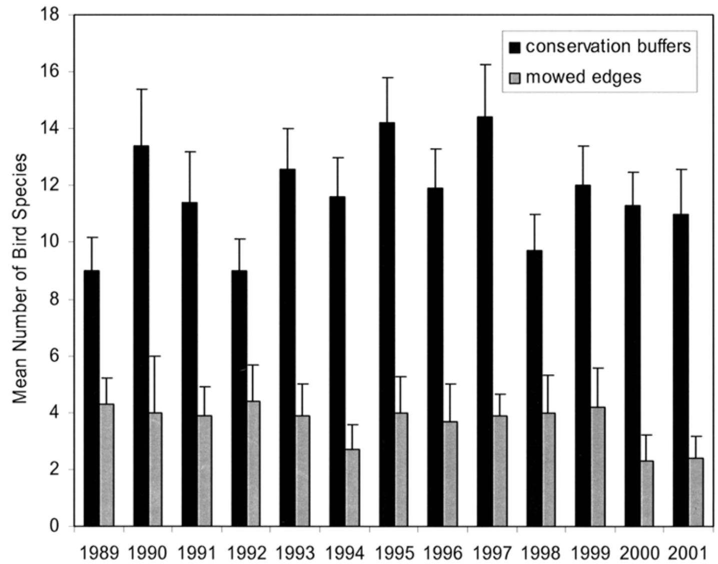

Figure 1. Mean (±SE) number of bird species in conservation buffer and mowed field edges on Black Belt Prairie Agricultural Experiment Station, Brooksville, Mississippi, in May–June 1989–2001.

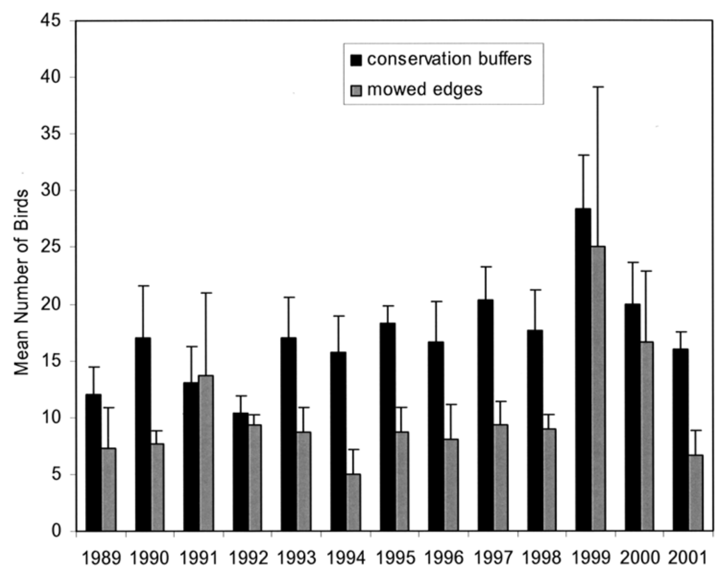

Figure 2. Mean (+ SE) number of birds in conservation buffer and mowed field edges on Black Belt Prairie Agricultural Experiment Station, Brooksville, Mississippi, in May-June 1989-2001.

Table 1. Mean abundance ($\bar{x}$), standard error (SE), and range (R) of mean bird abundance per study year on 70- x 190-m permanent fixed width transects in mowed field edges ($N = 3$ transects/station) and conservation buffers ($N = 3$ transects/station) on Black Belt Prairie Agricultural Experiment Station (BBPAES), Brooksville, Mississippi and North Mississippi Agricultural Experiment Station (NMAES), Holly Spring, Mississippi, from1989–2001. Common names of birds are listed according to the "Check List of North American Birds" of The Ornithologists' Union http://www.aou.org/checklist/index.php3.

	Mean bird numbers ($\bar{x}$)[a], Standard Error (SE)[a], and Range of mean abundance per study year (R)[b]											
	BBPAES Mowed field edges ($N = 39$)[c]			BBPAES Conservation buffers ($N = 39$)[c]			NMAES Mowed field edges ($N = 39$)[c]			NMAES Conservation buffers ($N = 39$)[c]		
Bird species	$\bar{x}$	SE	R	$\bar{x}$	SE	R	$\bar{x}$	SE	R	$\bar{x}$	SE	R
Blackbird, Red-winged	2.08	0.46	0.0–7.67	1.77	0.18	0.33–2.65	2.67	0.37	0.33–7.67	1.88	0.21	0.67–3.00
Bluebird, Eastern	0.08	0.60	0.0–0.33	0.45	0.10	0.33–0.67	0.10	0.07	0.0–1.33	1.33	0.30	0.67–2.0
Blue jay	0.0	0.0	0.0	0.13	0.07	0.0–0.67	0.08	0.08	0.0–1.00	0.08	0.04	0.0–0.67
Bobwhite, Northern	0.0	0.0	0.0	0.62	0.10	0.0–1.67	0.05	0.04	0.0–0.33	0.54	0.10	0.0–1.67
Bunting, Indigo	0.0	0.0	0.0	0.62	0.11	0.33–1.33	0.08	0.06	0.0–0.67	0.85	0.11	0.67–1.5
Cardinal, Northern	0.0	0.0	0.0	0.87	0.10	0.33–1.33	0.0	0.0	0.0	0.62	0.09	0.33–1.0
Chat, Yellow-breasted	0.0	0.0	0.0	0.44	0.10	0.0–1.0	0.0	0.0	0.0	0.59	0.12	0.0–1.33
Chickadee, Carolina	0.0	0.0	0.0	0.10	0.05	0–0.33	0.0	0.0	0.0	0.0	0.0	0.0
Cowbird, Brown-headed	0.46	0.13	0.0–1.67	0.26	0.09	0.0–1.0	0.44	0.12	0.0–1.33	0.21	0.07	0.0–0.33
Crow, American	0.0	0.0	0.0	0.11	0.06	0–0.67	0.03	0.03	0.0–0.33	0.13	0.08	0–0.33
Cuckoo, Yellow-billed	0.0	0.0	0.0	0.10	0.05	0–0.33	0.0	0.0	0.0	0.45	0.08	0–0.67
Dickcissel	0.54	0.22	0.33–3.67	1.50	0.16	0.33–2.33	0.28	0.08	0.0–0.67	1.0	0.11	0.33–2.00
Dove, Mourning	2.54	0.58	0.33–6.00	1.64	0.58	0.33–8.67	1.90	0.41	0.67–15.00	3.10	0.46	0.33–6.67
Egret, Cattle	0.05	0.04	0.0–0.33	0.05	0.04	0.0–0.33	0.0	0.0	0.0	0.10	0.04	0.0–0.67
Flicker, Northern	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.08	0.04	0.0–0.33
Goldfinch, American	0.0	0.0	0.0	0.23	0.08	0.33–0.67	0.26	0.26	0.0–3.33	0.31	0.10	0.0–2.0
Grackle, Common	1.36	0.32	0.0–5.00	0.26	0.09	0.0–1.0	0.85	0.24	0.0–2.67	0.44	0.13	0.0–1.0
Grosbeak, Blue	0.08	0.06	0.0–0.67	1.23	0.09	0.67–1.67	0.28	0.11	0.0–1.67	1.03	0.09	0.67–1.33
Harrier, Northern	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.05	0.04	0.0–0.33
Hawk, Red-shouldered	0.0	0.0	0.0	0.03	0.04	0.0–0.33	0.0	0.0	0.0	0.08	0.04	0.0–0.33
Hawk, Red-tailed	0.03	0.03	0.0–0.33	0.31	0.08	0.0–0.67	0.03	0.03	0.0–0.33	0.23	0.07	0.0–0.67
Heron, Great blue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.08	0.04	0.0–0.33
Heron, Green-backed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.26	0.07	0.0–0.67
Lark, Horned	0.0	0.0	0.0	0.0	0.0	0.0	0.40	0.19	0.0–2.67	0.0	0.0	0.0
Kestrel, American	0.0	0.0	0.0	0.10	0.05	0.0–0.67	0.08	0.04	0.0–0.33	0.10	0.05	0.0–1.0
Killdeer	0.49	0.15	0.0–2.00	0.15	0.06	0.0–0.33	0.41	0.10	0.0–1.00	0.50	0.13	0.33–1/0
Kingbird, Eastern	0.0	0.0	0.0	0.10	0.05	0.0–0.33	0.05	0.04	0.0–0.33	0.36	0.10	0.0–0.67
Meadowlark, Eastern	0.87	0.18	0.0–3.0	0.92	0.12	0.33–2.0	0.64	0.13	0.33–1.67	0.74	0.12	0.67–2.0
Mockingbird, Eastern	0.03	0.03	0.0–0.33	0.62	0.09	0.0–1.33	0.0	0.0	0.0	0.31	0.08	0.0–1.0
Oriole, Orchard	0.0	0.0	0.0	0.13	0.05	0.0–0.67	0.0	0.0	0.0	0.54	0.12	0.33–1.0
Owl, Barred	0.0	0.0	0.0	0.03	0.03	0.0–0.33	0.0	0.0	0.0	0.0	0.0	0.0
Phoebe, Eastern	0.0	0.0	0.0	0.05	0.04	0.0–0.33	0.0	0.0	0.0	0.21	0.06	0.0–0.33
Robin, American	0.15	0.06	0.0–0.67	0.23	0.07	0.0–0.67	0.0	0.0	0.0	0.36	0.11	0.0–1.67
Sparrow, Chipping	0.0	0.0	0.0	0.05	0.04	0.0–0.33	0.0	0.0	0.0	0.0	0.0	0.0
Sparrow, English	0.08	0.06	0.0–0.67	0.03	0.03	0.0–0.67	0.0	0.0	0.0	0.0	0.0	0.0
Starling, European	0.92	0.37	0.0–5.33	0.15	0.07	0.0–0.67	1.31	0.42	0.0–5.0	0.15	0.06	0.0–0.67
Swallow, Barn	0.08	0.08	0.0–1.0	0.21	0.07	0.0–0.67	0.13	0.08	0.0–1.0	0.80	0.21	0.0–2.0
Swallow, Rough-winged	0.10	0.07	0.0–0.33	0.18	0.09	0.0–1.33	0.21	0.13	0.0–1.33	0.85	0.02	0.00–2.0
Swift, Chimney	0.0	0.0	0.0	0.05	0.07	0.0–0.67	0.0	0.0	0.0	0.41	0.12	0.0–1.67
Tanager, Summer	0.0	0.0	0.0	0.05	0.04	0.0–0.33	0.0	0.0	0.0	0.27	0.7	0.0–1.0
Thrasher, Brown	0.0	0.0	0.0	0.39	0.08	0.0–1.0	0.0	0.0	0.0	0.41	0.08	0.0–1.0
Titmouse, Tufted	0.0	0.0	0.0	0.28	0.07	0.0–0.67	0.0	0.0	0.0	0.39	0.08	0.0–0.67
Towhee, Eastern	0.0	0.0	0.0	0.80	0.04	0.33–1.67	0.0	0.0	0.0	0.70	0.10	0.33–1.67
Vireo, Red-eyed	0.0	0.0	0.0	0.28	0.07	0.0–1.0	0.0	0.0	0.0	0.46	0.08	0.0–1.0
Vireo, White-eyed	0.0	0.0	0.0	0.08	0.04	0.0–0.67	0.0	0.0	0.0	0.41	0.08	0.0–0.67
Woodpecker, Downy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.05	0.04	0.0–0.33
Woodpecker, Pileated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.03	0.0–0.33
Woodpecker, Red-bellied	0.0	0.0	0.0	0.03	0.03	0.0–0.33	0.0	0.0	0.0	0.05	0.04	0.0–0.33
Woodpecker, Red-headed	0.0	0.0	0.0	0.05	0.02	0.0–0.33	0.0	0.0	0.0	0.13	0.05	0.0–0.33
Wood-peewee, Eastern	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.39	0.10	0.0–0.67
Wren, Carolina	0.0	0.0	0.0	0.33	0.06	0.0–1.0	0.0	0.0	0.0	0.46	0.08	0.0–1.0
Yellowthroat, Common	0.0	0.0	0.0	0.57	0.11	0.0–1.0	0.0	0.0	0.0	1.3	0.20	0.0–2.0

a Mean number and standard error of each species detected pooled over the 13-year study period.

b R = Range in mean number of birds/species detected on three fixed-width transects in each study year over 13 years.

c $N = 39$: Represented by three transects on each treatment type on each study site over 13 years.

1999. In mowed field edges, mean numbers of birds ranged from 5.0 (*SE* = 3.2) in 1995 to 25 (*SE* = 14.1) in 1999 (Fig. 2). Similar results were found at North Mississippi Agricultural Experiment Station where conservation buffers also supported a greater mean species richness ($F_{1,4}$ = 27.97, P = 0.006) and abundance ($F_{1,4}$ = 17.66, P = 0.014) than mowed field edges, and there was a significant year effect for richness ($F_{12,48}$ = 2.11, P = 0.034) and abundance ($F_{12,48}$ = 2.21, P = 0.026; Figs. 3 and 4). No interaction effect (P >0.05), between year and treatment was found for response variables at North Mississippi Agricultural Experiment Station. At this farm, mean species richness in conservation buffers ranged from 10.7 (*SE* = 1.5) in 1992 to 19.33 (*SE* = 3.30) in 1997 whereas species numbers in mowed edges ranged from 3.33 (*SE* = 0.80) in 1989 to 7.70 (*SE* = 0.90) in 1990 (Fig. 3). Mean number of birds in conservation buffers ranged from 12 (*SE* = 1.5) in 1992 to 29.0 (*SE* = 3.6) in 1995 whereas mean numbers in mowed edges ranged from 5.7 (*SE* = 1.2 in 1992 to 13.0 (*SE* = 1.7) in 1999 (Fig. 4).

Discussion

We detected greater bird species richness on conservation buffer edges than mowed field edges on both agricultural land bases over the 13-year period. Studies conducted in the midwestern United States on CRP fields report similar findings in bird species richness and abundance of featured bird species on CRP fields and fallow field edges (Igl and Johnson 1995, Ryan et al. 1998). Johnson and Schwartz (1993*b*) reported 15 bird species that were unique to fallow CRP fields; Johnson and Igl (1995) reported 12 species to be unique or substantially more abundant in CRP fields. In cornfields of Iowa and Kansas, Best et al. (1990) reported 50 species using wooded field edges and 23 bird species using herbaceous field edges. Although specific species detected in our study differed from those reported by Best et al. (1990), we recorded similar levels of richness and abundance in conservation buffers and mowed field edges in Mississippi. Over the study period, number of species inhabiting field edges retained in conservation buffers was almost twice that of mowed field edges. Most birds species (≥80%) unique to conservation buffers in our study were insectivores or omnivores that fed on the ground, in shrubs, and small trees and nested in shrub-vine midstory. Of the species unique to conservation buffers in our study, 10 species had Partners-in-Flight concern scores of 19 or greater, indicating a need for conservation due to regional population declines (Carter et al. 2000). These species included dickcissel, American kestrel (*Falco sparverius*), orchard oriole (*Icterus spurious*), yellow-billed cuckoo, blue grosbeak, white-eyed vireo, indigo bunting, eastern wood peewee (*Contopus virens*), summer tanager (*Piranga rubra*), and northern bobwhite. Selected carnivorous and insectivorous species that used snags

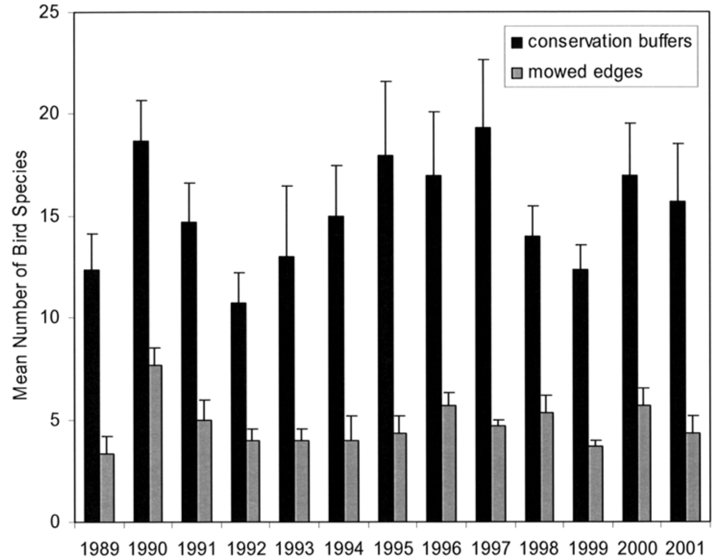

Figure 3. Mean (+ SE) number of bird species in conservation buffer and mowed field edges on North Mississippi Agricultural Experiment Station, Holly Springs, Mississippi, in May–June 1989–2001.

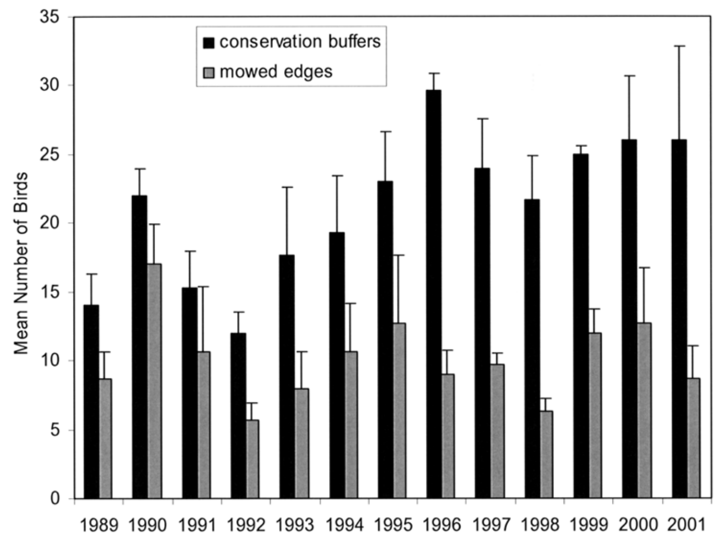

Figure 4. Mean (+ SE) number of birds in conservation buffer and mowed field edges on North Mississippi Agricultural Experiment Station, Holly Springs, Mississippi, in May-June 1989-2001.

for perching, nesting, or feeding were observed infrequently over the study's duration. These species included red-shouldered hawk (*Buteo lineatus*), Carolina chickadee (*Poecele caroliniensis*), and four woodpecker species (*Drycopus pileatus*, *Melanerpes carolinus, M. erythrocephalus*, *Colaptes auratus*; Table 1). Limited abundance of standing snags (<1/ha) probably influenced use of our study sites by raptors and woodpeckers.

Mowed field edges supported lowest species richness and highest number of flocking bird species. Tendency of these species to occur in flocks influenced abundance of birds and variability in bird numbers in mowed field edges over the study period. Similar findings were reported by Ryan et al. (1998) who found that seven species including mourning dove, barn swallow, horned lark, and killdeer (*Pooecetes gramineus* Gm.) occurred at higher abundance levels in croplands and adjacent mowed habitats in the midwestern United States. Because most were omnivores or granivores that fed on the ground or in low-growing vegetation, habitat conditions created by frequent mowing adjacent to grain row crops probably created quality foraging sites for flocks and individuals (Best et al. 1990).

Differences in bird abundance detected during our study were similar to the findings of Johnson and Schwartz (1993*b*) who found that abundance of individual bird species vary as CRP fields mature. Several authors also reported that crop rotations, field size and shape, migratory patterns, proximity and availability of surface water, and climate patterns influenced bird communities on agricultural lands (Best et al. 1990, Millenbah et al. 1996, Smith et al. 2005*a*,*b*). Best et al. (1990) reported that bird species such as mourning doves, red-winged blackbirds, and common grackles frequently used cornfield interiors and cornfield edges in Iowa and Kansas. Although our study did not evaluate these factors, we hypothesized that these factors, especially specific crop planted in an adjacent field and crop rotations, may have influenced bird use in our field border sites. We recommend that future studies be designed to investigate potential influences of these factors on bird communities of field borders. We submit that our study could have been strengthened by evaluation of year-round bird use as described by Smith et al. (2005 *a, b*). Also, an increased number of study sites and replications on each study site could have produced a more rigorous experimental design and possibly more conclusive findings.

Management Implications

Our study supports findings of studies conducted on CRP fields and conservation buffers in the midwestern and southeastern United States (Burger 2005, Smith et al. 2005*a*). We observed responses in bird species richness in the first year following habitat reclamation and conservation buffers continued to support more species over the 13-year period on both study sites. Thus the long-term nature of our study provides additional evidence that field edges retained in conservation buffers can provide important habitats for birds over the long term, as suggested by Heard et al. (2000). Long term studies are needed to formulate prudent management and restoration plans that effectively integrate bird conservation into agricultural systems. Conservation buffers in our study exhibited successional changes in vegetation communities over time that ranged from grassland-forb cover types during the first two study years to communities dominated by woody vines and shrubs interspersed with herbaceous vegetation thereafter. Although we did not report specific relationships between vegetation and bird communities in this paper, these relationships are measurable and important, especially when monitoring contribution of buffers to bird conservation over the long term. Evaluation of bird use and nesting success over time within field edges maintained in different cover types, (e.g., herbaceous versus shrub-vine cover types) could provide important information on plant successional stages that provide nesting and foraging habitats for different bird species. We also suggest studies should be undertaken to evaluate field edges of different cover types in terms of habitat enhancement for specific species experiencing global and regional population declines, especially species with Partners-in-Flight scores of >19 (Carter et al. 2000).

Although field borders and edges may serve as ecological traps due to nest parasitism and depredation, these areas serve as travel corridors and resting sites for birds and may be especially important during migration or wintering (Burger 2005). However, to address this concern, we recommend that studies be designed to assess nesting success and depredation rates within different field edge habitats in both short- and long term-studies.

Conservation buffers can have multiple environmental benefits in agricultural systems, including erosion control, water quality protection, and wildlife habitat enhancement. Research has shown that retention of conservation buffers can also produce cost-effective and sustainable farming practices (Burger et al. 2006). In our study, at least 26 species found in conservation buffers were insectivores which could improve integrated pest management in adjacent row crops. Also, increases in game and nongame bird use on agricultural lands can provide recreational benefits to land owners and lease holders through enhancement of hunting and bird watching opportunities. After initial cost of restoration and wildlife plantings, conservation buffers can reduce vegetation maintenance costs due to less frequent mowing and herbicide use. For example, one farm manager on our study sites reported savings in mowing costs of ≥ US$19,000.00 annually (≥ $35/ha;

J. Johnson, MAFES-NMAES manager, personal communication). Today, current mowing costs can exceed $50/ha due to increases in fuel and equipment maintenance costs and personnel wages and represent substantial expenditures for farmers and managers (MAFES, unpublished data). Therefore, reclamation and retention of conservation buffers in field edges can have economic and ecological benefits through reduction of mowing costs, control of soil erosion, enhancement of recreational opportunities, and conservation of bird habitat in Mississippi's croplands.

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Literature Cited

Baudry, J., R. G. H. Bunce, and F. Burel. 2000. Hedgerows: An international perspective on their origin, function and management. Journal of Environmental Management 60:7–22.

Best, L. B., R. C. Whitmore, and G. M. Booth. 1990. Use of cornfields by birds during the breeding season: the importance of edge habitat. American Midland Naturalist 123:84–99.

Burger, L. W. 2005. The conservation reserve program in the Southeast: Issues affecting wildlife habitat value. Fish and Wildlife Benefits of Farm Bill Programs: 2000–2005. Update 63–92.

———, P.J Barbour, R. Hamrick, and M. Smith. 2006. Conservation buffers: wildlife benefits in southern agricultural systems. Forest and Wildlife Research Center, Mississippi State University. Research Advances 9:2.

Carter, M.F., W. C. Hunter, D. N. Pashley, and K. V. Rosenberg. 2000. Setting conservation priorities for landbirds in the United States: the Partners in Flight Approach. Auk 117: 541–548.

Chamberlain, D. E., R. J. Fuller, R. G. H. Bunce, J. C. Duckworth, and M. Shrubb. 2000. Changes in the abundance of farmland birds in relation to the timing of agricultural intensification in England and Wales. Journal of Applied Ecology 37:771–788.

Emlen, J. T. 1977. Estimating breeding season bird densities from transect counts. Auk 94:323–342.

Fagan, W. F., R. S. Cantrell, and C. Cosner. 1998. How habitat edges change species interactions. American Naturalist 153:165–182.

Heard, L. P., A. W. Allen, L. B. Best, S. J. Brady, W. Burger, A. H. Esser, E. Hackett, D. H. Johnson, R. L. Pederson, R. E. Reynolds, C. Rewa, M. R. Ryan, R. T. Molleur, and P. Buck. 2000. A comprehensive review of Farm Bill contributions to wildlife conservation, 1985–2000. *In* W. L. Hohman and D. J. Halloum, editors. U.S. Department of Agriculture, Natural Resource Conservation Service, Wildlife Management Institute, Technical Report. USDA/NRCS/SHMI-2000.

Hinsley, S. A. and P. E. Bellamy. 2000. The influence of hedge structure, management and landscape context on the value of hedgerows to birds: a review. Journal of Environmental Management 60:33–49.

Igl, L. D. and D. H. Johnson. 1995. Dramatic increase of Le Conte's sparrow in conservation reserve program fields in the northern great plains. Prairie Naturalist 27:89–94.

Johnson, D. H. and L. D. Igl. 1995. Contribution of the conservation reserve program to populations of breeding birds in North Dakota. Wilson Bulletin 107:709–718.

——— and M. D. Schwartz. 1993*a*. The conservation reserve program: habitat for grassland birds. Great Plains Research 3:273–295.

——— and ———. 1993*b*. The conservation reserve program and grassland birds. Conservation Biology 7:934–937.

Mikol, S. A. 1980. Field guidelines for using transects to sample nongame bird populations. U.S. Fish and Wildlife Service FWS/OBS-80–85. 26.

Millenbah, K. F., S. R. Winterstein, H. Campa, III, L. T. Furrow, and R. B. Minnis. 1996. Effects of conservation reserve program field age on avian relative abundance, diversity, and productivity. Wilson Bulletin 108:760–770.

Ormerod, S.J. and A. R. Watkinson. 2000. Editors' introduction: birds and agriculture. Journal of Applied Ecology 37:699–705.

Ryan, M. R., L. W. Burger, and E. W. Kurzejeski. 1998. The Impact of CRP on avian wildlife: a review. Journal of Production Agriculture 11:61–66.

SAS. 1999. SAS/STAT User's Guide. Version 8. SAS Institute, Cary, North Carolina.

Smith, M. D., P. J. Barbour, L. W. Burger, and S. J. Dinsmore. 2005*a*. Breeding bird abundance and diversity in agricultural field edges in the Black Belt Prairie of Mississippi. Proceedings Annual Conference Southeastern Association of Fish and Wildlife Agencies 59: 43–56.

———, ———, ———, and ———. 2005*b*. Density and diversity of overwintering birds in managed field edges in Mississippi. Wilson Bulletin 117 (3): 258–69.

Vanderford, H. B. 1962. Soils of Mississippi. Mississippi State University, Mississippi Agricultural Experiment Station, Starkville.