FINAL PROGRAMMATIC REPORT - JOLIET ARSENAL PRAIRIE (IL) PROJECT
April 1, 1995 - September 30, 1998

The following report summarizes all programmatic activities for the Joliet Arsenal Prairie (IL) Project (#95-123) for the full project period, April 1, 1995 through September 30, 1998.

OBJECTIVES

1) Establish baseline data for grassland bird populations at the major study areas.
2) Establish baseline nest success rates for grassland bird populations at the major study areas.
3) Compare the suitability of native prairie, restored prairie, and non-prairie grasslands for grassland bird conservation efforts.
4) Evaluate impacts of common grassland management practices on grassland bird abundance and productivity (e.g., burning, mowing, grazing, idle).
5) Assess the effects of woody vegetation on grassland bird abundance and productivity.
6) Evaluate the impacts of edges on grassland bird abundance and productivity.
7) Evaluate the influence of landscape attributes on grassland bird productivity.

STUDY AREAS

Research was conducted at five major study areas which contained a wide range of grassland types including high quality native prairie, degraded native prairie, restored prairie and non-native cool-season grass fields. Grasslands in the major study areas were subjected to a variety of management regimes including prescribed burning, grazing and mowing during the study period. There was also a wide range of degree of woody encroachment on various parts of these study areas, ranging from open areas that have undergone extensive brush cutting and burning to areas that were moderately to severely overgrown with invading woody vegetation.

In addition to the five major study areas, limited censusing was conducted at three satellite areas in 1995. Nest searching was conducted at one satellite study area (Collins Station Prairie) in 1995. All satellite areas were native prairie and/or savanna habitats. A map showing the approximate location of study areas is shown in Fig. 1.

Major Study Areas

(1) Goose Lake Prairie (GLP), Grundy County; Approximate Size: 1000 ha.
(2) Des Plaines Conservation Area (DPCA), Will County; Approximate Size: 1300 ha.
(3) Midewin National Tallgrass Prairie (MIDW) (formerly the Joliet Arsenal and Ammunition Plant), Will County; Approximate Size 9500 ha (roughly 2500 ha presently in grassland habitat).
(4) Joliet Training Area (JTA), Will County; Approximate Size 1400 ha.
(5) Nachusa Grasslands (NACH), Lee County; Approximate Size 405 ha.

Satellite Study Areas

(1) Braidwood Dunes and Savanna (BDS), Approximate Size: 110 ha.
(2) Collins Station Prairie (CSP), Approximate Size: 260 ha.
(3) Sand Ridge Savanna (SRS), Approximate Size: 95 ha.

FIELD METHODS

Bird Censusing

Bird populations at all sites were censused using point counts. Counts followed nationally established point count procedures (Ralph et al. 1992, 1993). Counts were conducted at each point for five minutes, with subtotals tabulated for the first three, and second two minutes separately (Ralph et al. 1992, 1993). Point counts tabulated all birds recorded within 100 m of the point separately from birds recorded from greater distances. Points were distributed among study areas so as to sample all available

habitats. Points were not placed in areas where two or more habitats adjoined, and were at least 250 m from one another (Ralph et al. 1992, 1993). Points were usually visited twice per season. The first visit between May 10-June 10, and the second visit between June 11- July 10. Between 120 - 254 census points were established annually in the major and satellite study areas 1995-1997 (Table 1). In 1997, the effects of roads on bird distributions were assessed using 3-ha strip transects. Transects 150 m in length and 200 m in width (100 m on either side of the center line) were run perpendicular to roads. All birds encountered were plotted and summaries were calculated for each 25-m interval along the transect.

Nest Monitoring

Nest searches began in May and continued until early August. Nests were located by intensive surveys using rope-dragging, walking searches and behavioral observations. Once nests were located, the contents were checked every three days until the nest fledged, was depredated, or was abandoned. We used the Mayfield (1975) index to estimate daily predation rates for the incubation and nestling periods combined. For each species, we used all nests over all years to obtain baseline nest parasitism levels (% of nests parasitized) and daily predation rates (% of nest contents eaten by predators per day) for each site.

Vegetation Sampling

Five vegetation variables were recorded at most point count stations. The five vegetation variables were:

(1) Grass Composition: estimate of the predominant grass cover type within the 100 m radius circle centered on the census point. Major categories were Native Prairie, Restored Prairie, Non-prairie conservation grasslands, and agricultural grasslands (pastures and hayfield).

(2) Management Status: the management status recorded as either burned (burned since the end of the last breeding season), mowed (mowed within the last 12 months), grazed (grazed immediately prior to or during the current breeding season), or idle (undisturbed for at least 12 months prior to the start of the breeding season, 1 May).

(3) Vegetation Height/Density: estimates of vegetation height/density were collected by obtaining Visual Obstruction Readings (VOR) as measured with a Robel Pole (Robel et al. 1970).

(4) Litter Depth: measured in cm by meter stick at random locations surrounding the census point.

(5) Shrub Density: the density (number of stems) of woody vegetation ≥2 m in height within 100 m of the census point.

Landscape Attributes

Three measures of landscape composition were included in analyses of landscape effects on grassland bird productivity. Landscape parameters were calculated at the field level using GIS and the Illinois Land Cover data base developed by the Illinois Natural History Survey (IDNR 1996).

(1) Percent Cover of Grasslands (1, 3, and 5 km), amount of grassland habitat within one, three and five km radii of the center of the field.

(2) Percent Cover Woody Habitat (1, 3, and 5 km), amount of woody habitat (shrubland and woodland) within one, three, and five km radii of the center of the field.

(3) Percent Cover Agricultural Row Crops (1, 3, and 5 km), amount of row crops (corn, beans, and small grains) within one, three, and five km radii of the center of the field.

Analytical Methods

Analyses of census data included only data from the study areas listed in Table 1, except for the analyses focused on the effects of roads on bird distribution patterns which included data collected in 1997 at the Savanna Army Depot (Carroll and Jo Daviess counties). Only birds encountered within 100 m of the census point were included in census summaries and analysis.

Baseline nest data included data only from the study areas listed in Table 1. Analyses of edge and landscape effects include nest data collected in 1997 at Green River Conservation Area (Lee County) and the Savanna Army Depot. The edge analyses included data for grassland passerines whose nests were located either on the ground or within a half meter of the ground. All Dickcissel nests were also included in these analyses regardless of height.

RESULTS AND DISCUSSION

OBJECTIVE #1: *Establish baseline data for grassland bird populations at the major study areas*.

Ninety-nine species of birds were recorded at point counts during the study. A complete listing of birds recorded at census points within each area is included in Table 2. Red-winged blackbirds were the most widespread species occurring at 78% of all point count stations. Other commonly encountered species, in decreasing order of abundance, were Eastern Meadowlarks (74% of all point count stations), Song Sparrows (64%), Grasshopper Sparrows (62%), Field Sparrows (59%), Common Yellowthroats (52%), American Goldfinches (46%), Bobolinks (39%), Dickcissels (38%), and Eastern Kingbirds (37%). Only six species (Red-winged Blackbird, American Goldfinch, Field Sparrow, Song Sparrow, Common Yellowthroat, and Brown Thrasher) were recorded at all five major and three satellite sites. Twenty-eight species were recorded at just one site (Table 2).

Overall, bird communities at these sites differed from one another by a considerable degree. Bird community similarities among major study areas ranged from 35 - 71%. Pair wise bird community similarities among major study areas were Des Plaines Conservation Area-Goose Lake Prairie 60%, Des Plaines Conservation Area-Midewin National Tallgrass Prairie 53%, Des Plaines Conservation Area-Joliet Training Area 47%, Des Plaines Conservation Area-Nachusa Grasslands 71%, Goose Lake Prairie-Midewin National Tallgrass Prairie 50%, Goose Lake Prairie-Joliet Training Area 65%, Goose Lake Prairie-Nachusa Grasslands 51%, Midewin National Tallgrass Prairie-Joliet Training Area 35%, Midewin National Tallgrass Prairie-Nachusa Grasslands 56%, Joliet Training Area-Nachusa Grasslands 52%.

Bird species densities also differed significantly among sites (Table 3). Estimated densities of Upland Sandpipers, Bobolinks, Eastern Meadowlarks, Savannah Sparrows, Grasshopper Sparrows, and Dickcissels were highest at Midewin National Tallgrass Prairie. Des Plaines Conservation Area contained the highest estimated densities of Eastern Kingbirds, Orchard Orioles, Common Grackles, Henslow's Sparrows, Field Sparrows, Indigo Buntings, Brown Thrashers, House Wrens, and American Robins. Sedge Wrens were most abundant at Goose Lake Prairie. Nachusa Grasslands supported the highest densities of Ring-Necked Pheasants, Yellow Warblers, and Gray Catbirds. Estimated densities of Willow Flycatchers, Brown-headed Cowbirds, Red-winged Blackbirds, American Goldfinches, Song Sparrows, Common Yellowthroats, and House Wrens were greatest at the Joliet Training Area.

OBJECTIVE #2: *Establish baseline nest success rates for grassland bird populations at the major study areas*.

Predation was the leading cause of nest failure accounting for 89.5% of all nest losses. Other causes of nest loss included, abandonment 6.3%, trampling by livestock 2.1%, mowing <1%, and weather <1%. Daily predation rates were considerably higher on grassland nesting species than on shrubland nesting species within project grasslands ($F = 21.4$, 1,105 df, $P < 0.0001$; Table 4). Adjusted daily predation rates for shrubland species within project grasslands was 4.8% compared to 7.6% for grassland species.

Daily predation rates for individual species within project grasslands are shown in Table 4. Predation rates were marginally different among study areas ($F = 2.66$, 3,102 df, $P = 0.051$). Adjusted daily predation rates were highest at Goose Lake Prairie/Collins Station Prairie (7.2%), and lowest at Midewin National Tallgrass Prairie (5.1%). Des Plaines Conservation Area (6.2%) and Nachusa Grasslands (6.3%) had adjusted daily predation rates that were intermediate between Goose Lake Prairie/Collins Station Prairie and Midewin National Tallgrass Prairie.

Cowbird parasitism rates among species ranged from 0% for three species (Gray Catbird, Savannah Sparrow, Vesper Sparrow) to a high of 54% for Bell's Vireos (Table 5). Cowbird parasitism rates differed significantly among project areas ($\chi^2 = 45.98$, 3 df, $P < 0.001$). Overall nest parasitism rates were highest at Nachusa Grasslands and lowest at Midewin National Tallgrass Prairie (Table 5).

OBJECTIVE #3: *Compare the suitability of native prairie, restored prairie, and non-prairie grasslands for grassland bird conservation efforts*.

Twenty-one of the 25 most commonly encountered species were significantly influenced by grassland cover types (Table 6). Upland Sandpipers, Bobolinks, Eastern Meadowlarks, Savannah Sparrows, Grasshopper Sparrows, and Dickcissels were all most abundant in agricultural grasslands (pastures and hayfields) within project areas. Grasslands dominated by native warm-season grasses contained the highest average densities of Ring-necked Pheasants, Willow Flycatchers, Brown-headed Cowbirds, Red-winged Blackbirds, Common Grackles, Song Sparrows, Common Yellowthroats, and Sedge Wrens. Orchard Orioles American Goldfinches, Henslow's Sparrows, Field Sparrows, Indigo Buntings, Yellow Warblers, Gray Catbirds, Brown Thrashers, House Wrens, and American Robins attained their highest average densities in field dominated by non-native cool-season grasses.

Twelve species had densities that differed significantly among native and restored warm-season grass fields (Table 7). Eastern Kingbirds, Willow Flycatchers, Bobolinks, Red-winged Blackbirds, Eastern Meadowlarks, Field Sparrows, Yellow Warblers, Gray Catbirds, and Sedge Wrens were significantly more abundant in native warm-season grasslands than in restored warm-season grass fields. Only three species (Ring-necked Pheasant, Grasshopper Sparrow and Savannah Sparrow) were significantly more abundant in restored warm-season grass plantings than they were in native warm-season grasslands.

OBJECTIVE #4: *Evaluate impacts of common grassland management practices on grassland bird abundance and productivity (e.g., burning, mowing, grazing, idle)*.

Management also had a significant effect on birds within project grasslands. Twenty of the twenty-five most commonly encountered species were significantly influenced by grassland management (Table 8). Thirteen of these 20 species were most numerous in idle grasslands (grasslands not disturbed by management within the previous 12 months). Upland Sandpipers, Eastern Kingbirds, Eastern Meadowlarks, Savannah Sparrows, and Grasshopper Sparrows were most abundant in grazed grasslands. Mowed grasslands contained the highest average densities of Bobolinks and Dickcissels. Ring-necked Pheasants and Willow Flycatchers were most abundant in grasslands that had been recently burned (Table 8).

OBJECTIVE #5: *Assess the effects of woody vegetation on grassland bird abundance and productivity.*

A. Grassland Bird Abundance

The abundance of woody vegetation (shrubs and trees ≥2 m tall) significantly affected the abundance of 17 of the 25 most commonly encountered species (Figure 2). In general estimated densities of grassland birds decreased with increasing shrub/tree density and estimated densities of shrubland and woodland birds increased. Species that increased significantly with increasing shrub/tree density included: American Goldfinch, American Robin, Brown-headed Cowbird, Brown Thrasher, Common Yellowthroat, Eastern Kingbird, Field Sparrow, Gray Catbird, Indigo Bunting, Orchard Oriole, Song Sparrow, Willow Flycatcher, and Yellow Warbler. Species that avoided trees/shrubs and whose densities were significantly greater in areas with no or few shrubs/trees included: Bobolink, Grasshopper Sparrow, Savannah Sparrow, and Sedge Wren.

B. Grassland Bird Productivity

Grassland bird nests located within 100 m of tall woody vegetation (shrubs or trees ≥ 2 m tall) tended to have higher daily predation rates than nests located farther from such features (Table 9).

Estimates of daily nest predation were higher for nests located within 100 m of tall woody vegetation for 6 of the7 species with sample sizes adequate for analyses (Table 9). Overall, predation rates were 16% higher within 100 m of a tall shrub/tree than they were for nests located greater than 100 m from tall shrubs/trees (Table 9).

Proximity to tall woody vegetation (shrubs or trees ≥ 2 m tall) also significantly influenced nest parasitism rates. Overall, nearly 80% of all nest parasitism events occurred in nests located within 50 m of a tall shrub/tree (Table 10). Six species had 100% of their nest parasitism events occur in nests located within 50 m of a tall shrub/tree (Table 10). Only three species (Dickcissel, Field Sparrow, and Red-winged Blackbird) experienced any nest parasitism in nests located more than 100 m from a tall shrub or tree (Table 9).

OBJECTIVE #6: *Evaluate the impacts of edges on grassland bird abundance and productivity.*

A. Woodland Edge

Because of the small number of nests found within 50-m of a woodland edge (N = 17) comparisons of nest predation rates for nests located near and far from a woodland edge were conducted at the 100-m range. Additionally, because of the relatively small sample of nests found even within the 100-m edge distance, nests from all species were combined for this analysis. Nests that were located within 100-m of a woodland edge were predated more frequently (daily predation rate 7.47%; N = 47 nests) than were nests which were located more than 100-m from a woodland edge and other types of woody vegetation (daily predation rate 6.48%; N = 494 nests). This difference, however, was not statistically significant (χ^2 = 0.495, 1 df, P = 0.481).

B. Road Edge

The distribution of Grasshopper Sparrows and Dickcissels were unaffected by roads (Fig. 3). Eastern Meadowlarks tended to avoid being very close (within 25 m) to roads and Bobolinks had significantly reduced densities up to 75 m from road edges (Fig. 3). Proximity to roads did not appear to influence nest success for meadowlarks (eastern and western combined), Field Sparrows, Dickcissels, Bobolinks, Grasshopper Sparrows, or Red-winged Blackbirds (Table 11).

OBJECTIVE #7: *Evaluate the influence of landscape attributes on grassland bird productivity.*

Landscape variables significantly influenced individual parasitism rates for Dickcissels, Field Sparrows, Grasshopper Sparrows, meadowlarks (eastern and western combined), and Red-winged Blackbirds (Table 12). Parasitism rates were significantly higher in areas with more row-crop agriculture for Dickcissels (within 1, 3, and 5 km) and Grasshopper Sparrows (1 and 3 km). Most other field nesting species (American Goldfinch, Field Sparrow, meadowlark, and Red-winged Blackbird) also tended to have higher nest parasitism levels in areas with high amounts of row-crops (Table 12). The amount of forest cover also significantly influenced parasitism rates for Dickcissels (1 and 3 km), Field Sparrows (3 km), Grasshopper Sparrows (1 and 3 km), and Red-winged Blackbirds (5 km) with all of these species experiencing higher rates of nest parasitism in fields with more forest in the surrounding landscape. The amount of grassland in the surrounding landscape significantly influenced nest parasitism levels for Dickcissels (1, 3, and 5 km), Grasshopper Sparrows (1, 3 and 5 km), meadowlarks (3 and 5 km), and Red-winged Blackbirds (1, 3, and 5 km) (Table 12). Nest parasitism rates for all four of these species were lowest in areas with more grassland in the surrounding landscape.

Landscape composition also significantly influenced nest predation rates (Table 12). Daily nest predation rates were higher in areas with more row-crop agriculture for meadowlarks (1 km) and Red-winged Blackbirds (1, 3, and 5 km). Nest Predation rates also increased with increasing forest cover for American Goldfinches (5 km), Brown Thrashers (1 km), and Red-winged Blackbirds (1 km). However, nest predation rates for red-winged blackbirds at 5 km were negatively correlated with forest cover. The amount of grassland in the landscape also influenced nest predation rates. Nest predation rates on Brown Thrashers (1 and 3 km), meadowlarks (5 km), and Red-winged Blackbirds (3 and 5 km) were all

significantly lower in areas with more grassland in the surrounding landscape. The tendency for nest predation rates to be lower in areas with more grassland in the surrounding landscape was a very consistent trend, with eight of the nine species showing a negative correlation between nest predation rates and grassland cover at all three landscape scales (1, 3 and 5 km).

SPECIES SPECIFIC DISCUSSION

The following section discusses species specific results for species identified as Migratory Nongame Birds of Management Concern by the U.S. Fish and Wildlife Service (USFWS 1995).

Northern Harrier

Northern Harriers were rare within project grasslands. Harriers were encountered at Goose Lake Prairie (in 1995), Joliet Training Area (1995), and Nachusa Grasslands (1995 and 1997). No harriers were encountered in 1996. No harrier nests were located during this study.

Upland Sandpiper

Among project grasslands Upland Sandpipers were nearly restricted to Midewin National Tallgrass Prairie, where they were recorded at nearly one-third of all census points (Table 2). Small numbers were detected at Nachusa Grasslands (4% of all census points) and Des Plaines Conservation Area (2%). The Des Plaines Conservation Area birds may have been vagrants from the adjacent Midewin National Tallgrass Prairie population. Upland Sandpipers preferred areas with shallow litter (< 2 cm; Fig. 4.23) and height-density between 10-30 cm (Fig. 5.23). Upland Sandpiper nest success appeared to be relatively high, with an estimated daily predation rate of 1.6%. The daily predation rate for Upland Sandpipers was substantially lower than other grassland species within these areas (Table 4). Upland Sandpiper distribution within areas was strongly influenced by both grassland cover type and management. Upland Sandpipers were essentially restricted to agricultural grasslands (Table 6), especially grazed grasslands (Table 8) and were very rare in other cover types and management regimes. Upland Sandpipers appeared to be dependent on grazing for the creation of suitable habitat. A reduction in grazing within the project grasslands would very likely result in a reduction in the present Upland Sandpiper population.

Red-headed Woodpecker

Red-headed Woodpeckers were recorded at five areas, Collins Station Prairie, Des Plaines Conservation Area, Midewin National Tallgrass Prairie, Nachusa Grasslands, and Sand Ridge Savanna. Because censusing was focused primarily on grassland habitats within these areas, our census data probably do not adequately estimate the distribution and abundance of Red-headed Woodpeckers within project grasslands. No Red-headed Woodpecker nests were found.

Sedge Wren

Sedge Wrens were encountered at most study areas. They were most frequently encountered and occurred at higher densities at Goose Lake Prairie than at any other site (Tables 2 and 3). Sedge numbers increased as the season progressed, and July densities were typically considerably higher than June numbers. Occasionally high numbers were encountered in late May (such as was the case at Joliet Training Area in 1995). Many of these late May birds appeared to be migrants, since few birds were recorded at Joliet Training Area during the June census. Too few Sedge Wren nests were found to estimate nest success for this species within project grasslands. Sedge Wren distribution within project grasslands was significantly influenced by both grassland cover type and management. Sedge Wrens were significantly more common in tall, dense grasslands (Fig. 5) with well-developed litter (Fig. 4), such as fields dominated by warm-season grasses (Table 6). Within warm-season grass fields, Sedge Wrens were significantly more common in native grasslands than in restored warm-season grass fields (Table 7). As expected due to their preference for tall, dense vegetation, Sedge Wren densities were significantly reduced by burning, mowing, and grazing (Table 8).

Loggerhead Shrike

Loggerhead Shrikes were only encountered at Midewin National Tallgrass Prairie, all observations

were in grazed areas. Surveys by the IDNR indicate a population of 12-15 pairs annually at Midewin National Tallgrass Prairie. Few nests were found during this study, but data from the IDNR show daily nest predation rates for Loggerhead Shrikes at Midewin to be low (2.1%/day) based on 31 nests found and monitored between 1994-1997. This rate is comparable to other shrub nesting species at this site (Table 4).

Bell's Vireo

Bell's Vireos were encountered at five areas, Collins Station Prairie, Des Plaines Conservation Area, Goose Lake Prairie, Midewin National Tallgrass Prairie, and Nachusa Grasslands. Because censusing was focused primarily on grassland habitats within these areas, our census data (Table 2) probably underestimated the abundance of Bell's Vireos within project grasslands. Only 11 Bell's Vireo nests were found within project grasslands (Table 5). Nest success for Bell's Vireos appeared to be relatively high, with an overall 1.5% daily predation rate (Table 4). This translates into an estimated nest success rate of 66% for a 25.5 day nest cycle. Nest parasitism of Bell's Vireos within project grasslands was relatively high (Table 5).

Dickcissel

Dickcissels were the ninth most common species within project grasslands. They were most frequently encountered and occurred at higher densities at Midewin National Tallgrass Prairie and Nachusa Grasslands than other project grasslands (Tables 2 and 3). Daily predation rates for Dickcissels within project grasslands ranged from roughly 6 - 9% (Table 4). This translated into an estimated nest success rate of between 13-26% (for a 22-day nest cycle). Dickcissel nest success tended to be higher in areas with little forest cover and more grassland cover in the surrounding landscape (Table 12). Nest parasitism rates for Dickcissels were among the highest for the widely distributed grassland birds in this study (Table 5). Parasitism rates were significantly higher for nests located in landscapes with abundant row-crops and forests and little grassland (Table 12). Dickcissels were most commonly encountered in agricultural grasslands and least common in conservation areas dominated by cool-season grasses (Table 6). They were also significantly influenced by management (Table 8), being most common in mowed grasslands and least common in idle grassland areas.

Field Sparrow

Field Sparrows were the fifth most common species within project grasslands (Table 2), and were most abundant at Des Plaines Conservation Area and Nachusa Grasslands (Table 3). They were most common in areas with high shrub densities (Fig. 2.11), and high litter depth (Fig. 4.11). Daily predation rates were lowest at Nachusa Grasslands and highest at Des Plaines Conservation Area and Goose Lake Prairie/Collins Station Prairie and ranged from 6-8.5% (Table 4). Estimated nest success for Field Sparrows within project grasslands ranged from 18-30% (for a 19.5 day nest cycle). Parasitism rates were significantly higher for nests located with 50 m of a tall (≥2 m) tree/shrub (Table10) and for nests located in landscapes with abundant forest (3 km) in the surrounding landscape (Table 12). Field Sparrows were most common in conservation areas dominated by cool-season grasses and least common in agricultural grasslands (Table 6). Field Sparrows were more common in native prairie grasslands than they were in restored prairies (Table 7). Field Sparrows were most common in idle grasslands and least common in grasslands that had been mowed (Table 8).

Grasshopper Sparrow

Grasshopper Sparrows were the fourth most commonly encountered species within project grasslands (Table 2) and were most abundant at Midewin National Tallgrass Prairie and Nachusa Grasslands (Table 3). Grasshopper Sparrows were significantly more abundant in areas with no or few shrubs (Fig. 2.13), shallow litter (Fig. 4.13), and vegetation height-density less than 30 cm (Fig. 5.13). Daily predation rates for Grasshopper Sparrows were lowest at Midewin National Tallgrass Prairie and highest at Goose Lake Prairie/Collins Station Prairie and ranged from 5.4-16.4% (equivalent to 2-31% nest success based on a 21-day nest cycle). Nest success tended to be higher in areas with abundant grass in the surrounding landscape (especially within 3 and 5 km). Nest parasitism rates on Grasshopper

Sparrows were generally low (Table 5), but were significantly higher in areas with little grass (1, 3, and 5 km), more forest (1 and 3 km), and more row-crop agriculture (1 km) (Table 12). Grasshopper Sparrows were strongly influenced by grassland cover type and were nearly twice as abundant in agricultural grasslands as they were in conservation areas (Table 6). Within warm-season grass fields, Grasshopper Sparrows were significantly more common in restored grasslands than in native warm-season grass fields (Table 7). Grasshopper Sparrows were also strongly influenced by grassland management, being most common in grazed grasslands (Table 8).

Henslow's Sparrow

Henslow's Sparrows were most commonly encountered and attainted their highest average densities at Goose Lake Prairie and Des Plaines Conservation Area (Tables 2 and 3). Henslow's Sparrows were most abundant in areas with moderate to high litter depth (2-5 cm; Fig 4.14), and height-density taller than 50 cm (Fig. 5.14). Too few Henslow's Sparrow nests were found to estimate either nest success or nest parasitism rates within project grasslands. Henslow's sparrow average densities were highest in conservation areas dominated by cool-season grasses and lowest in agricultural grasslands (Table 6). Within warm-season grass fields, Henslow's Sparrows tended ($P = 0.06$) to be more common in native grasslands than in restored warm-season grass fields, but burning had a much stronger influenced on the distribution of this species within these areas (Table 7). Henslow's Sparrows were also strongly influenced by grassland management (Table 8). They were most common in idle grasslands (Table 8). Among managed grasslands, they were never encountered in grazed grasslands and were most frequently encountered in mowed grasslands where their densities were roughly one-third that of idle grasslands (Table 8).

Bobolink

Bobolinks were the eighth most commonly encountered species occurring at all five major and none of the three satellite areas (Table 2). Bobolink density was highest at Midewin National Tallgrass Prairie (Table 3). Bobolinks preferred grasslands with no or few shrubs (Fig. 2.04), intermediate (1-2 cm) litter (Fig. 4.04), and intermediate (20-40 cm) height-density (Fig. 5.04). Estimated nest predation rates on Bobolink nests was the highest for all species (Table 4). Bobolink nests were rarely parasitized by cowbirds (Table 5). The influence of landscape features on bobolink nests could not be analyzed because of the limited number of fields in which bobolinks occurred. However, Bobolinks did appear to avoid roads (Fig. 3). Bobolinks were very strongly influenced by grassland cover type (Table 6). Bobolinks were nearly six times as abundant in agricultural grasslands as they were in conservation areas dominated by either cool- or warm-season grasses. Within warm-season grass fields, Bobolinks were significantly more common in native grasslands than in restored warm-season grass fields (Table 7), and they were also significantly more common in burned than idle warm-season grass fields (Table 7). Management also strongly influenced bobolink distributions within project grasslands (Table 8). Bobolinks were most common in mowed grasslands (hayfields) and about half as common in grazed areas as they were in mowed areas (Table 8). Bobolinks were relatively rare in idle grasslands areas (Table 8).

Eastern Meadowlark

Eastern Meadowlarks were the second most commonly encountered species during this study (Table 2) with average densities being highest at Midewin National Tallgrass Prairie and Des Plaines Conservation Area (Table 3). Eastern Meadowlarks preferred areas with intermediate litter depth (1-2 cm; Fig. 4.10) and vegetation heigh-density (20-30 cm; Fig. 5.10). Eastern Meadowlark nest predation rates varied between 6.8-11.4%, being lowest at Midewin National Tallgrass Prairie (Table 4). Estimated nest success ranged from 5-17%. Meadowlark (eastern and western combined) nest success was significantly higher in areas with more grassland (within 5 km) in the surrounding landscape (Table 12). Parasitism rates on eastern meadowlarks were low (Table 5). However, meadowlark (eastern and western combined) nests located in areas with high amounts of row-crop agriculture (within 1 km) and little grassland (within 5 km) experienced significantly higher rates of nest parasitism (Table 12). Eastern

Meadowlarks were most common in agricultural grasslands and conservation areas dominated by cool-season grasses (Table 6). Within warm-season grass fields, Eastern Meadowlarks were significantly more common in native grasslands than in restored warm-season grass fields (Table 7). Management also significantly influenced meadowlark distribution within areas (Table 8). Eastern Meadowlarks were most common in grazed and least common in burned grasslands (Table 8).

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TABLE 1. DISTRIBUTION OF CENSUS POINTS AMONG STUDY AREAS, 1995-1997.

Study Area	Size (ha)	# Points 1995	# Points 1996	# Points 1997	Total # Points
Major Study Areas					
Midewin National Tallgrass Prairie	2500	93	97	28	218
Joliet Training Area	1400	31	0	0	31
Des Plaines Conservation Area	1300	37	31	17	85
Goose Lake Prairie	1000	41	38	36	115
Nachusa Grasslands	405	40	44	39	123
Satellite Study Areas					
Collins Station Prairie	260	8	0	0	8
Braidwood Dunes & Savanna	110	1	0	0	1
Sand Ridge Savanna	95	3	0	0	3

TABLE 2. FREQUENCY[1] (%) OF BIRD OCCURRENCE AT CENSUS POINTS WITHIN STUDY AREAS, 1995-97

SPECIES	DPCA (43)[2]	GLP (43)	MIDW (111)	JTA (21)	NACH (49)	BDS (1)	CSP (8)	SRS (3)
Pied-billed Grebe	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0
Mallard	0.0	11.6	1.8	0.0	0.0	0.0	12.5	0.0
Blue-winged Teal	0.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood Duck	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0
Canada Goose	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
American Bittern	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0
Sandhill Crane	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
King Rail	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Virginia Rail	0.0	2.3	0.0	0.0	0.0	0.0	12.5	0.0
Sora	0.0	2.3	0.9	0.0	0.0	0.0	12.5	0.0
Common Snipe	2.3	4.7	0.0	0.0	0.0	0.0	0.0	0.0
Lesser Yellowlegs	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Upland Sandpiper	2.3	0.0	32.4	0.0	4.1	0.0	0.0	0.0
Killdeer	4.7	25.6	9.9	0.0	4.1	0.0	0.0	0.0
Northern Bobwhite	16.3	23.3	2.7	0.0	6.1	100.0	37.5	33.3
Ring-necked Pheasant	7.0	34.9	2.7	12.9	32.7	0.0	12.5	0.0
Mourning Dove	7.0	7.0	7.2	0.0	20.4	0.0	0.0	0.0
Cooper's Hawk	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0
Red-tailed Hawk	4.7	2.3	2.7	3.2	0.0	0.0	0.0	0.0
Yellow-billed Cuckoo	0.0	0.0	0.0	3.2	0.0	0.0	12.5	0.0
Black-billed Cuckoo	4.7	0.0	0.0	0.0	4.1	0.0	25.0	0.0
Hairy Woodpecker	0.0	0.0	0.9	0.0	4.1	0.0	0.0	0.0
Downy Woodpecker	7.0	0.0	0.0	0.0	6.1	0.0	12.5	0.0
Red-headed Woodpecker	0.0	0.0	1.8	0.0	0.0	0.0	0.0	33.3
Red-bellied Woodpecker	0.0	0.0	1.8	0.0	2.0	0.0	0.0	0.0
Northern Flicker	4.7	0.0	0.9	0.0	10.2	0.0	37.5	0.0
Eastern Kingbird	65.1	11.6	45.0	3.2	32.7	0.0	62.5	66.7
Olive-sided Flycatcher	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eastern Wood-Pewee	2.3	0.0	0.0	0.0	4.1	0.0	0.0	0.0
Willow Flycatcher	16.3	0.0	1.8	16.1	38.8	0.0	0.0	0.0
Alder Flycatcher	2.3	0.0	0.0	0.0	4.1	0.0	0.0	0.0
Least Flycatcher	0.0	0.0	0.0	0.0	0.0	0.0	37.5	0.0
Horned Lark	0.0	14.0	1.8	0.0	0.0	0.0	0.0	0.0
Blue Jay	11.6	0.0	3.6	0.0	18.4	0.0	0.0	0.0
American Crow	0.0	0.0	0.9	0.0	6.1	0.0	12.5	0.0
European Starling	11.6	2.3	20.7	6.5	2.0	0.0	37.5	0.0
Bobolink	18.6	25.6	73.0	12.9	20.4	0.0	0.0	0.0
Brown-headed Cowbird	48.8	14.0	18.9	22.6	63.3	0.0	62.5	66.7
Red-winged Blackbird	74.4	100.0	75.7	90.3	57.1	100.0	87.5	100.0
Eastern Meadowlark	81.4	88.4	85.6	41.9	55.1	0.0	87.5	0.0
Orchard Oriole	53.5	2.3	14.4	6.5	6.1	0.0	12.5	0.0
Baltimore Oriole	9.3	2.3	7.2	0.0	6.1	0.0	0.0	0.0
Northern Oriole	16.3	0.0	5.4	9.7	0.0	0.0	12.5	0.0
Common Grackle	18.6	18.6	15.3	3.2	8.2	0.0	12.5	0.0

TABLE 2. CONTINUED.

SPECIES	DPCA	GLP	MIDW	JTA	NACH	BDS	CSP	SRS
American Goldfinch	67.4	46.5	24.3	41.9	69.4	100.0	87.5	100.0
Vesper Sparrow	0.0	2.3	1.8	0.0	22.4	0.0	0.0	0.0
Savannah Sparrow	4.7	27.9	57.7	3.2	24.5	0.0	0.0	0.0
Grasshopper Sparrow	62.8	72.1	77.5	0.0	71.4	0.0	12.5	0.0
Henslow's Sparrow	37.2	53.5	7.2	0.0	4.1	0.0	0.0	0.0
Lark Sparrow	0.0	0.0	0.0	0.0	10.2	0.0	0.0	0.0
Chipping Sparrow	0.0	0.0	4.5	0.0	14.3	0.0	0.0	0.0
Field Sparrow	90.7	60.5	46.8	19.4	73.5	100.0	100.0	66.7
Song Sparrow	62.8	58.1	45.9	93.5	81.6	100.0	100.0	100.0
Lincoln's Sparrow	2.3	0.0	0.0	0.0	0.0	0.0	12.5	0.0
Swamp Sparrow	0.0	7.0	0.0	0.0	8.2	0.0	12.5	0.0
Rufous-sided Towhee	25.6	0.0	0.9	0.0	8.2	0.0	25.0	0.0
Northern Cardinal	16.3	0.0	3.6	6.5	42.9	0.0	12.5	33.3
Rose-breasted Grosbeak	9.3	0.0	1.8	3.2	6.1	0.0	0.0	0.0
Indigo Bunting	44.2	7.0	5.4	12.9	28.6	0.0	37.5	66.7
Dickcissel	20.9	23.3	55.0	22.6	46.9	0.0	0.0	0.0
Barn Swallow	0.0	4.7	0.9	0.0	0.0	0.0	0.0	0.0
Tree Swallow	2.3	2.3	6.3	0.0	6.1	0.0	0.0	0.0
Northern Rough-winged Swallow	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
Cedar Waxwing	18.6	0.0	8.1	0.0	10.2	0.0	0.0	0.0
Loggerhead Shrike	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0
Red-eyed Vireo	2.3	0.0	0.0	0.0	2.0	0.0	0.0	33.3
Philadelphia Vireo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3
Warbling Vireo	23.3	0.0	4.5	3.2	6.1	0.0	12.5	0.0
Yellow-throated Vireo	2.3	0.0	0.9	0.0	2.0	0.0	0.0	0.0
Bell's Vireo	7.0	0.0	0.9	0.0	14.3	0.0	25.0	0.0
Golden-winged Warbler	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0
Nashville Warbler	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0
Yellow Warbler	30.2	0.0	9.0	19.4	42.9	0.0	25.0	66.7
Magnolia Warbler	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3
Bay-breasted Warbler	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0
Blackpoll Warbler	0.0	0.0	0.0	0.0	0.0	0.0	12.5	66.7
Blackburnian Warbler	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0
Northern Waterthrush	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0
Connecticut Warbler	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
Mourning Warbler	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
Common Yellowthroat	76.7	81.4	9.9	77.4	69.4	100.0	100.0	100.0
Yellow-breasted Chat	2.3	0.0	0.0	0.0	4.1	0.0	0.0	0.0
Wilson's Warbler	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0
Canada Warbler	0.0	0.0	0.0	0.0	0.0	100.0	12.5	33.3
American Redstart	0.0	0.0	0.0	0.0	0.0	0.0	37.5	33.3
House Sparrow	0.0	0.0	1.8	0.0	4.1	0.0	0.0	0.0
Northern Mockingbird	2.3	0.0	12.6	0.0	0.0	0.0	0.0	0.0

TABLE 2. CONTINUED.

SPECIES	DPCA	GLP	MIDW	JTA	NACH	BDS	CSP	SRS
Gray Catbird	48.8	4.7	4.5	0.0	42.9	0.0	25.0	66.7
Brown Thrasher	37.2	4.7	18.9	3.2	38.8	100.0	37.5	66.7
House Wren	25.6	4.7	8.1	22.6	22.4	100.0	62.5	0.0
Sedge Wren	37.2	51.2	19.8	41.9	12.2	0.0	25.0	66.7
Marsh Wren	0.0	16.3	0.0	0.0	0.0	0.0	0.0	0.0
White-breasted Nuthatch	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0
Black-capped Chickadee	18.6	0.0	1.8	3.2	10.2	0.0	12.5	33.3
Blue-gray Gnatcatcher	4.7	0.0	0.0	0.0	2.0	0.0	0.0	0.0
Wood Thrush	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0
Gray-cheeked Thrush	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0
American Robin	58.1	23.3	25.2	6.5	42.9	0.0	50.0	0.0
Eastern Bluebird	2.3	0.0	3.6	0.0	10.2	0.0	12.5	0.0

[1] Frequency = Percent of Census Points at Which the Species Was Encountered at Least Once Within 100 M, 1995-1997

[2] Number of Point Count Stations at Each Site

TABLE 3. COMPARISON OF DENSITY (MEAN NUMBER OF BIRDS/CENSUS POINT) AMONG MAJOR STUDY SITES FOR THE 25 MOST COMMONLY ENCOUNTERED SPECIES, 1995-1997.

SPECIES	DPCA	GLP	MIDW	NACH	JTA
upland sandpiper	0.01	0.00	0.20	0.02	0.00
ring-necked pheasant	0.02	0.08	0.01	0.17	0.14
eastern kingbird	0.30	0.03	0.26	0.11	0.05
willow flycatcher	0.06	0.00	0.01	0.23	0.33
bobolink	0.11	0.06	1.60	0.08	0.57
brown-headed cowbird	0.27	0.08	0.10	0.52	0.64
red-winged blackbird	1.03	2.90	1.48	1.17	4.83
eastern meadowlark	1.02	0.89	1.41	0.36	0.57
orchard oriole	0.28	0.00	0.04	0.02	0.07
common grackle	0.15	0.08	0.06	0.06	0.05
American goldfinch	0.52	0.32	0.13	0.56	0.59
savannah sparrow	0.01	0.10	0.56	0.17	0.02
grasshopper sparrow	0.67	0.77	1.66	1.29	0.00
Henslow's sparrow	0.35	0.34	0.04	0.01	0.00
field sparrow	0.96	0.22	0.35	0.71	0.16
song sparrow	0.46	0.22	0.28	0.83	3.14
indigo bunting	0.17	0.01	0.04	0.10	0.14
dickcissel	0.07	0.08	0.63	0.36	0.24
common yellowthroat	0.50	0.61	0.05	0.47	1.35
yellow warbler	0.16	0.00	0.04	0.26	0.26
gray catbird	0.18	0.01	0.02	0.19	0.00
brown thrasher	0.15	0.01	0.06	0.11	0.02
house wren	0.10	0.01	0.04	0.07	0.30
sedge wren	0.17	0.50	0.13	0.10	0.25
American robin	0.25	0.07	0.13	0.17	0.07

TABLE 4. ESTIMATES[1] OF DAILY PREDATION RATES (%) WITHIN PROJECT GRASSLANDS[2], 1995-1997.

Species	DPCA	GLP/CSP	MIDW	NACH	OVERALL
Shrubland Species					
American Goldfinch	3.2 (63)[3]	4.7 (322)	2.7 (447)	3.6 (365)	3.5 (1197)
American Robin	3.6 (252)	2.6 (189)	2.6 (189)	-	3.0 (630)
Bell's Vireo	3.3 (61)	0.0 (26)	0.0 (27)	0.0 (14)	1.6 (127)
Brown Thrasher	14.9 (34)	5.0 (80)	1.5 (532)	9.2 (87)	3.4 (732)
Eastern Kingbird	2.2 (314)	3.9 (102)	2.1 (329)	2.4 (123)	2.4 (866)
Field Sparrow	8.5 (401)	8.5 (260)	7.0 (999)	6.1 (361)	7.3 (2021)
Gray Catbird	0.0 (32)	6.3 (48)	0.0 (61)	2.9 (103)	2.5 (244)
Orchard Oriole	1.7 (180)	0.0 (11)	0.0 (37)	0.0 (6)	1.3 (233)
Song Sparrow	7.4 (14)	6.3 (48)	4.9 (245)	3.2 (63)	4.9 (369)
Willow Flycatcher	0.0 (16)	10.5 (10)	1.2 (82)	2.5 (158)	2.3 (265)
Yellow Warbler	13.3 (45)	7.7 (26)	7.7 (118)	1.7 (61)	7.2 (249)
Grassland Species					
Bobolink	-	-	9.8 (325)	-	9.8 (325)
Dickcissel	6.1 (17)	8.9 (124)	6.6 (807)	7.3 (616)	7.0 (1563)
Eastern Meadowlark	8.5 (260)	11.4 (149)	6.8 (1325)	9.7 (73)	7.5 (1806)
Grasshopper Sparrow	7.0 (29)	16.4 (37)	5.4 (442)	7.2 (418)	6.7 (925)
Mallard	0.0 (13)	6.8 (30)	2.3 (43)	66.7 (2)	4.6 (87)
Red-winged Blackbird	5.9 (323)	6.8 (206)	6.2 (580)	9.2 (584)	7.3 (1693)
Savannah Sparrow	-	13.8 (15)	6.3 (63)	12.1 (17)	8.5 (94)
Vesper Sparrow	18.2 (6)	-	-	7.6 (119)	8.0 (125)

[1] Estimates Were Obtained Using the Mayfield (1975) Method.
[2] DPCA = Des Plaines Conservation Area, GLP = Goose Lake Prairie/Collins Station Prairie, MIDW = Midewin National Tallgrass Prairie, NACH = Nachusa Grasslands.
[3] Number of Exposure Days Are Given in Parentheses.

TABLE 5. ESTIMATES OF NEST PARASITISM RATES (% OF ALL NESTS PARASITZED) WITHIN PROJECT GRASSLANDS[1], 1995-1997.

Species	DPCA		GLP/CSP		MIDW		NACH		OVERALL	
Shrubland Species										
American Goldfinch	0.0	(4)[2]	0.0	(23)	3.0	(33)	11.1	(27)	4.6	(87)
American Robin	0.0	(19)	0.0	(15)	0.0	(15)	-		0.0	(49)
Bell's Vireo	60.0	(5)	0.0	(1)	0.0	(2)	100.0	(3)	54.5	(11)
Brown Thrasher	0.0	(6)	0.0	(8)	5.1	(39)	0.0	(11)	3.1	(64)
Eastern Kingbird	0.0	(15)	0.0	(15)	10.0	(20)	0.0	(6)	4.2	(48)
Field Sparrow	10.9	(55)	10.3	(39)	8.3	(121)	17.0	(47)	10.7	(262)
Gray Catbird	0.0	(3)	0.0	(5)	0.0	(4)	0.0	(7)	0.0	(19)
Orchard Oriole	45.5	(11)	0.0	(1)	25.0	(4)	100.0	(1)	41.2	(17)
Song Sparrow	0.0	(1)	50.0	(4)	30.4	(23)	10.0	(10)	26.3	(38)
Willow Flycatcher	100.0	(1)	0.0	(1)	25.0	(4)	16.7	(12)	22.2	(18)
Yellow Warbler	33.3	(6)	0.0	(2)	7.1	(14)	50.0	(6)	21.4	(28)
Grassland Species										
Bobolink	-		-		1.9	(53)	-		1.9	(53)
Dickcissel	0.0	(3)	0.0	(3)	3.2	(93)	24.6	(69)	11.1	(180)
Eastern Meadowlark	0.0	(28)	4.5	(22)	1.5	(137)	11.1	(9)	2.0	(196)
Grasshopper Sparrow	0.0	(4)	0.0	(11)	0.0	(62)	5.0	(60)	2.2	(137)
Red-winged Blackbird	3.1	(32)	16.0	(25)	0.0	(55)	15.9	(69)	8.8	(181)
Savannah Sparrow	-		0.0	(2)	0.0	(10)	0.0	(2)	0.0	(14)
Vesper Sparrow	-		0.0	(2)	-		0.0	(12)	0.0	(14)

[1] DPCA = Des Plaines Conservation Area, GLP/CSP = Goose Lake Prairie/Collins Station Prairie, MIDW = Midewin National Tallgrass Prairie, NACH = Nachusa Grasslands.

[2] Number of Nests.

TABLE 6. COMPARISON OF BIRD ABUNDANCE (MEAN NUMBER OF BIRDS/CENSUS POINT) WITHIN GRASSLAND COVER TYPES[1].

SPECIES	cs-ag	cs-cons	ws-cons	F(anova)[2]	P(anova)[3]
upland sandpiper[4]	0.20^{a}	0.01^{b}	0.01^{b}	24.32	<0.0001
ring-necked pheasant	0.01^{b}	0.04^{b}	0.11^{a}	16.52	<0.0001
eastern kingbird	0.26^{a}	0.26^{a}	0.11^{b}	9.04	0.0002
willow flycatcher	0.01^{b}	0.07^{ab}	0.11^{a}	9.93	0.0001
bobolink	1.60^{a}	0.27^{b}	0.06^{b}	79.24	<0.0001
brown-headed cowbird	0.10^{b}	0.16^{b}	0.38^{a}	13.91	<0.0001
red-winged blackbird	1.48^{b}	0.74^{b}	2.06^{a}	10.38	0.0010
eastern meadowlark	1.41^{a}	1.10^{a}	0.63^{b}	36.78	<0.0001
orchard oriole	0.04^{b}	0.29^{a}	0.02^{b}	43.37	<0.0001
common grackle	0.06	0.03	0.11	1.03	0.3582
American goldfinch	0.13^{b}	0.51^{a}	0.48^{a}	16.16	<0.0001
savannah sparrow	0.56^{a}	0.05^{b}	0.12^{b}	55.00	<0.0001
grasshopper sparrow	1.66^{a}	0.82^{b}	0.93^{b}	25.59	<0.0001
Henslow's sparrow	0.04^{c}	0.39^{a}	0.16^{b}	20.19	<0.0001
field sparrow	0.35^{c}	0.82^{a}	0.58^{b}	14.57	<0.0001
song sparrow	0.28^{b}	0.43^{ab}	0.58^{a}	12.34	<0.0001
indigo bunting	0.04^{b}	0.16^{a}	0.08^{b}	6.19	0.0024
dickcissel	0.63^{a}	0.05^{b}	0.21^{b}	25.92	<0.0001
common yellowthroat	0.05^{b}	0.48^{a}	0.59^{a}	50.81	<0.0001
yellow warbler	0.04^{b}	0.16^{a}	0.14^{a}	6.04	0.0027
gray catbird	0.02^{b}	0.16^{a}	0.12^{a}	11.04	<0.0001
brown thrasher	0.06	0.11	0.09	1.32	0.2661
house wren	0.04	0.10	0.05	2.19	0.1104
sedge wren	0.13^{b}	0.17^{ab}	0.31^{a}	5.76	0.0035
American robin	0.13	0.19	0.15	0.89	0.4157

[1] cs-ag = Agricultural Grasslands; cs-cons = Cool-Season Conservation Grasslands; ws-cons = Warm-Season Conservation Grasslands.

[2] F-statistic from a One-way ANOVA Comparing Densities among Cover Types.

[3] Significance Based on One-way ANOVA.

[4] Means with the Same Superscript Are Not Significantly ($P > 0.05$) Different from One Another.

TABLE 7. COMPARISON OF BIRD POPULATIONS (MEAN NUMBER OF BIRDS/CENSUS POINT) AMONG NATIVE AND RESTORED PRAIRIE SITES, 1995-1997.

	Restored		Native					
	idle[1]	burned[2]	idle	burned	F[3] (overall)	P[4] (overall)	P[5] (type)	P[6] (burn)
upland sandpiper	0.00	0.02	0.00	0.02	1.41	0.2460	0.7365	0.0950
ring-necked pheasant	0.16	0.20	0.03	0.09	8.77	0.0003	0.0004	0.1461
eastern kingbird	0.07	0.05	0.12	0.19	2.87	0.0570	0.0178	0.5010
willow flycatcher	0.03	0.09	0.07	0.33	8.89	0.0002	0.0030	0.0006
bobolink	0.02	0.05	0.02	0.23	8.75	0.0003	0.0134	0.0002
brown-headed cowbird	0.30	0.31	0.36	0.52	1.04	0.3563	0.1951	0.3866
red-winged blackbird	1.51	1.72	2.82	1.64	5.47	0.0049	0.0124	0.1084
eastern meadowlark	0.60	0.35	0.75	0.85	4.08	0.0177	0.0106	0.4786
orchard oriole	0.01	0.01	0.03	0.03	1.20	0.3030	0.1241	0.2650
common grackle	0.09	0.09	0.17	0.07	0.34	0.7201	0.6359	0.5745
American goldfinch	0.42	0.34	0.52	0.57	1.02	0.3626	0.1720	0.8935
savannah sparrow	0.15	0.24	0.04	0.06	9.50	0.0001	0.0003	0.1293
grasshopper sparrow	1.29	1.30	0.42	1.02	12.78	0.0000	0.0000	0.0500
Henslow's sparrow	0.18	0.00	0.33	0.02	14.97	0.0000	0.0653	0.0000
field sparrow	0.58	0.23	0.70	0.74	7.29	0.0010	0.0025	0.0994
song sparrow	0.64	0.56	0.45	0.60	0.54	0.5884	0.3722	0.7291
indigo bunting	0.07	0.03	0.07	0.12	1.11	0.3362	0.1445	0.9760
dickcissel	0.17	0.40	0.06	0.31	8.46	0.0004	0.1453	0.0006
common yellowthroat	0.61	0.34	0.66	0.55	3.84	0.0224	0.1996	0.0322
yellow warbler	0.07	0.05	0.17	0.24	4.45	0.0125	0.0031	0.6286
gray catbird	0.07	0.04	0.14	0.19	3.58	0.0287	0.0087	0.8969
brown thrasher	0.03	0.08	0.07	0.16	3.40	0.0304	0.0552	0.0365
house wren	0.08	0.02	0.03	0.12	0.24	0.7860	0.5533	0.6335
sedge wren	0.28	0.00	0.60	0.07	19.93	0.0000	0.0062	0.0000
American robin	0.07	0.16	0.19	0.16	1.41	0.2440	0.1111	0.4116

[1] Idle at Least 12 Months

[2] Burned Within the Last 12 Months

[3] Overall F-statistic from a Two-way ANOVA Comparing Densities among Cover Type (Native vs. Restored) and Management (Idle vs. Burned).

[4] Overall Significance Based on Two-way ANOVA

[5] Significance of the Cover Type Effect

[6] Significance of the Management Effect

TABLE 8. EFFECTS OF MANAGEMENT ON BIRD ABUNDANCE (MEAN NUMBER OF BIRDS/CENSUS POINT) WITHIN STUDY AREAS, 1995-1997.

Species	burned[1]	grazed[2]	idle[3]	mowed[4]	F(anova)[5]	P(anova)[6]
upland sandpiper[7]	0.02[b]	0.29[a]	0.00[b]	0.02[b]	32.23	<0.0001
ring-necked pheasant	0.13[a]	0.01[b]	0.08[a]	0.00[b]	10.65	<0.0001
eastern kingbird	0.12[b]	0.33[a]	0.15[b]	0.14[b]	8.21	<0.0001
willow flycatcher	0.15[a]	0.00[c]	0.09[ab]	0.01	7.49	0.0001
bobolink	0.11[c]	1.29[b]	0.06[c]	2.24[a]	73.06	<0.0001
brown-headed cowbird	0.34[a]	0.07[b]	0.34[a]	0.16[ab]	6.54	0.0003
red-winged blackbird	1.48[ab]	1.22[b]	2.22[a]	1.92	5.59	0.0010
eastern meadowlark	0.55[c]	1.61[a]	0.81	1.06[b]	29.79	<0.0001
orchard oriole	0.06	0.04	0.10	0.05	2.02	0.1083
common grackle	0.07	0.07	0.11	0.05	0.41	0.7491
American goldfinch	0.42[a]	0.15[b]	0.52[a]	0.10[b]	11.51	<0.0001
savannah sparrow	0.14[b]	0.58[a]	0.07[b]	0.51[a]	38.15	<0.0001
grasshopper sparrow	1.17[b]	1.98[a]	0.70[c]	1.05	34.63	<0.0001
Henslow's sparrow	0.01[b]	0.00[b]	0.31[a]	0.10[b]	23.10	<0.0001
field sparrow	0.52[ab]	0.41[bc]	0.65[a]	0.23[c]	8.29	<0.0001
song sparrow	0.56[ab]	0.26[c]	0.76[a]	0.31	11.90	<0.0001
indigo bunting	0.07[ab]	0.00[b]	0.11[a]	0.10[ab]	5.01	0.0021
dickcissel	0.31[bc]	0.40[b]	0.11[c]	1.05[a]	32.75	<0.0001
common yellowthroat	0.40[b]	0.04[c]	0.70[a]	0.07[c]	46.89	<0.0001
yellow warbler	0.11[ab]	0.03[b]	0.17[a]	0.05[ab]	4.96	0.0023
gray catbird	0.08[ab]	0.01[b]	0.13[a]	0.05[ab]	7.41	0.0001
brown thrasher	0.10	0.08	0.07	0.03	1.92	0.1235
house wren	0.06	0.03	0.10	0.06	2.40	0.0658
sedge wren	0.02[b]	0.13[b]	0.47[a]	0.11[b]	19.51	<0.0001
American robin	0.17	0.15	0.15	0.09	0.94	0.4244

[1] Burned since the End of the Last Breeding Season

[2] Grazed Immediately Prior to or During the Current Breeding Season

[3] Undisturbed for at Least 12 Months Prior to the Start of the Breeding Season, 1 May

[4] Mowed within the last 12 months

[5] F-statistic from a One-way ANOVA Comparing Densities among Management Categories

[6] Statistical Significance Based on One-way ANOVA

[7] Means with the Same Superscript Are Not Significantly ($P > 0.05$) Different from One Another

TABLE 9. DAILY PREDATION RATE (%) IN RELATION TO DISTANCE TO WOODY VEGETATION (2 ≥M TALL).

Species	Far (>100 m)	Near (<100 m)	N[1]	Prob.[2]
Meadowlarks[3]	4.11	6.79	264	0.0175
Dickcissel	6.47	7.18	192	0.6317
Bobolink	8.11	9.69	56	0.6622
Grasshopper Sparrow	6.80	7.09	222	0.8467
Henslow's Sparrow	0.00	28.57	4	0.0404
Field Sparrow	5.00	7.50	279	0.1684
Red-winged Blackbird	6.11	6.73	123	0.7015
Savannah Sparrow	13.79	6.59	11	0.3294
OVERALL	6.17	7.18	1239	0.1248

[1] Number of Nests

[2] Significance Based on Statistical Comparison Using the Program CONSTRAST

[3] Eastern and Western Meadowlarks Combined

TABLE 10. BREAKDOWN OF PARASITIZED NESTS WITHIN PROJECT GRASSLANDS IN RELATION TO DISTANCE FROM TALL (≥ 2M) WOODY VEGETATION.

Species	Total # Nests	# Parasitized Nests	# Parasitized Nests[1]		
			<50 m	50-100 m	>100 m
Bobolink	56	1	1	0	0
Common Yellowthroat	4	3	2	1	0
Dickcissel	192	28	16	4	8
Eastern Meadowlark	207	4	4	0	0
Field Sparrow	279	35	33	1	1
Grasshopper Sparrow	222	6	4	2	0
Henslow's Sparrow	4	0	0	0	0
Lark Sparrow	29	7	7	0	0
Red-winged Blackbird	123	7	3	3	1
Savannah Sparrow	11	2	2	0	0
Song Sparrow	33	9	9	0	0
Vesper Sparrow	37	2	1	1	0
Western Meadowlark	27	1	1	0	0
Meadowlark[2]	8	0	0	0	0
TOTAL	1232	105	83	12	10

[1] The Number of Parasitized Nests among Various Distance Categories. Distance Categories Are Nests Located More than 100 M from All Tall Woody Vegetation (> 100 M), Nests Located 50 to 100 M from Tall Woody Vegetation (50-100 M), and Nests Located Within 50 M of Tall Woody Vegetation (< 50 M).

[2] Unknown species of meadowlark

TABLE 11. DAILY PREDATION RATE (%) IN RELATION TO DISTANCE TO ROAD EDGE.

Species	Far (>50 m)	Near (<50 m)	N[1]	Prob.[2]
Meadowlarks[3]	6.22	5.39	128/56	0.472
Dickcissel	7.46	6.89	104/37	0.727
Bobolink	10.07	4.00	39/3	0.159
Grasshopper Sparrow	7.89	6.89	101/76	0.488
Field Sparrow	5.79	7.31	79/65	0.284
Red-winged Blackbird	6.64	7.01	65/32	0.827
OVERALL	7.02	6.65	566/313	0.532

[1] Number of Nests, Number of Nests Far/Number of Nests Near

[2] Significance Based on Statistical Comparison Using the Program CONSTRAST

[3] Eastern and Western Meadowlarks Combined

TABLE 12. CORRELATIONS BETWEEN LANDSCAPE ATTRIBUTES AND NEST PARASITISM AND DAILY NEST PREDATION RATES WITHIN ILLINOIS GRASSLANDS

Landscape Attribute[1]	American Goldfinch	Brown Thrasher	Dickcissel	Eastern Kingbird	Field Sparrow	Grasshopper Sparrow	Meadowlark	Red-winged Blackbird	Song Sparrow
Nest Parasitism[2]									
AGRC-1K	0.311	-0.248	0.842***	-0.069	0.078	0.399*	0.160	0.268	-0.312
AGRC-3K	0.234	-0.159	0.902***	-0.070	0.090	0.386*	0.316	0.216	-0.128
AGRC-5K	0.235	-0.119	0.864***	-0.028	0.037	0.178	0.320	0.204	-0.086
FOREST-1K	0.230	-0.063	0.907***	-0.290	0.265	0.412*	0.085	0.244	-0.324
FOREST-3K	0.276	-0.027	0.641**	0.162	0.370*	0.649***	-0.249	0.222	-0.371
FOREST-5K	-0.258	0.060	-0.464	-0.220	0.242	0.271	0.067	0.369*	0.073
GRASS-1K	-0.284	0.255	-0.887***	0.306	-0.196	-0.395*	-0.285	-0.387*	0.192
GRASS-3K	-0.175	0.275	-0.862***	0.242	-0.286	-0.654***	-0.448***	-0.510**	0.172
GRASS-5K	-0.061	0.148	-0.849***	0.280	-0.225	-0.604***	-0.521***	-0.422*	0.137
Nest Predation[3]									
AGRC-1K	0.173	0.298	0.035	-0.053	0.036	0.100	0.372*	0.639***	-0.035
AGRC-3K	-0.080	0.360	-0.067	-0.146	0.002	0.046	0.195	0.487**	0.001
AGRC-5K	-0.054	0.352	-0.029	-0.181	-0.052	-0.017	0.195	0.534**	0.040
FOREST-1K	0.082	0.677***	-0.059	-0.210	-0.035	0.072	0.100	0.487**	-0.049
FOREST-3K	0.233	0.092	-0.232	-0.297	0.059	0.185	-0.271	0.308	0.027
FOREST-5K	0.537*	-0.322	0.147	0.230	0.026	0.104	-0.129	-0.434**	0.000
GRASS-1K	-0.078	-0.415*	-0.158	-0.004	-0.058	-0.090	-0.255	-0.201	0.019
GRASS-3K	-0.318	-0.428*	-0.125	0.112	-0.082	-0.336	-0.140	-0.381*	-0.097
GRASS-5K	-0.357	-0.323	-0.025	-0.002	0.035	-0.289	-0.349*	-0.466**	-0.143
N[4]	12	18	12	14	26	22	24	22	15

* = P < 0.10, ** = P < 0.05, *** = P 0.01

[1] AGRC = Agricultural Row-crops (corn, beans, small grains); Forest = Woodlands; Grass = Grasslands.

[2] Pearson correlations between field-level nest parasitism rates (percent of nests with at least one cowbird egg) and landscape attributes of the field, weighted by the number of nests per field.

[3] Pearson correlations between field-level estimates of daily nest predation and landscape attributes of the field, weighted by the number of exposure days for all nests combined in each field.

[4] Number of fields included in the analyses for each species.

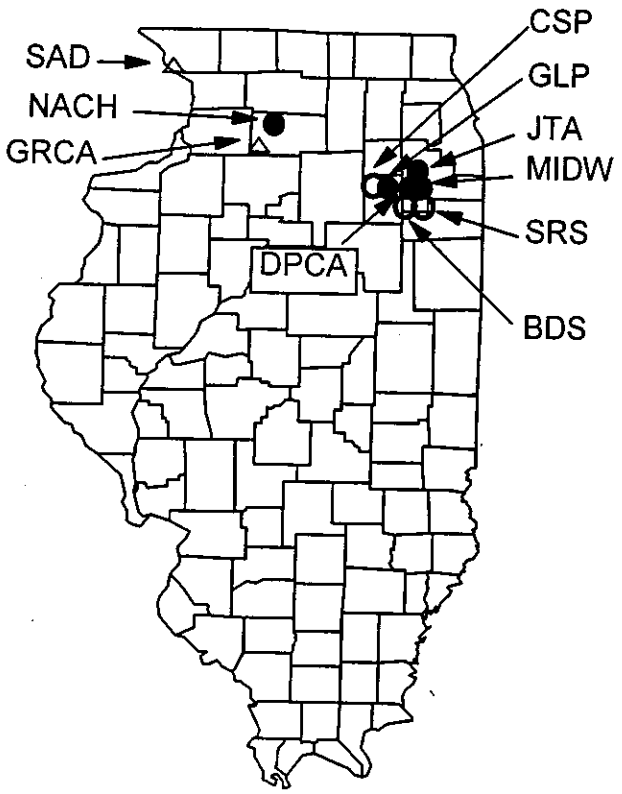


FIGURE 1. LOCATION OF STUDY AREAS. SOLID CIRCLES REPRESENT MAJOR STUDY AREAS. HOLLOW CIRCLES REPRESENT SATELLITE STUDY AREAS. TRIANGLES REPRESENT STUDY AREAS USED TO GAIN SUPPLEMENTARY NESTING DATA. CSP = COLLINS STATION PRAIRIE, GLP = GOOSE LAKE PRAIRIE, JTA = JOLIET TRAINING AREA, MIDW = MIDEWIN NATIONAL TALLGRASS PRAIRIE (FORMERLY THE JOLIET ARMY AMMUNITION PLANT), SRS = SAND RIDGE SAVANNA, BDS = BRAIDWOOD DUNES AND SAVANNA, SAD = SAVANNA ARMY DEPOT, NACH = NACHUSA GRASSLANDS, GRCA = GREEN RIVER CONSERVATION AREA.

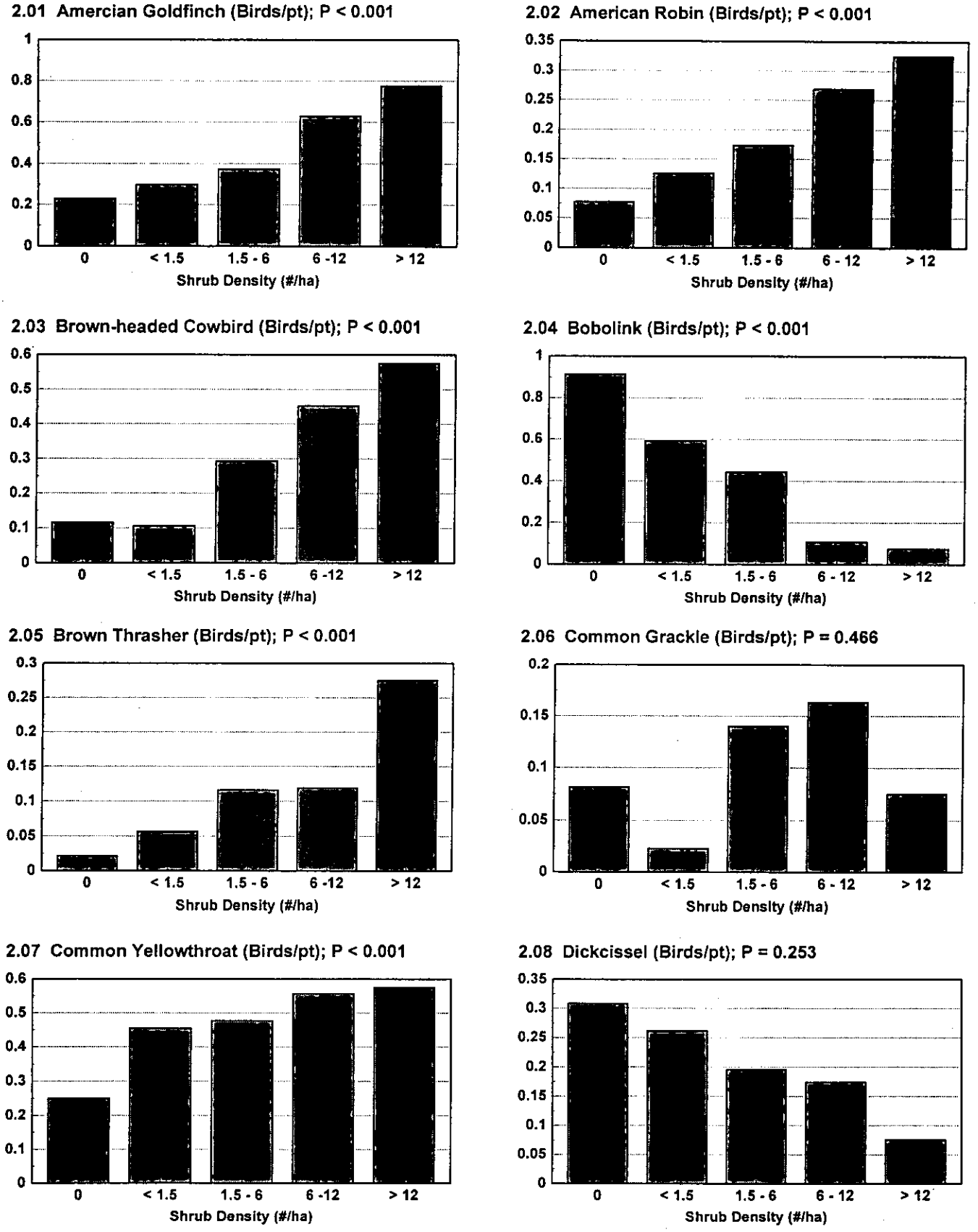
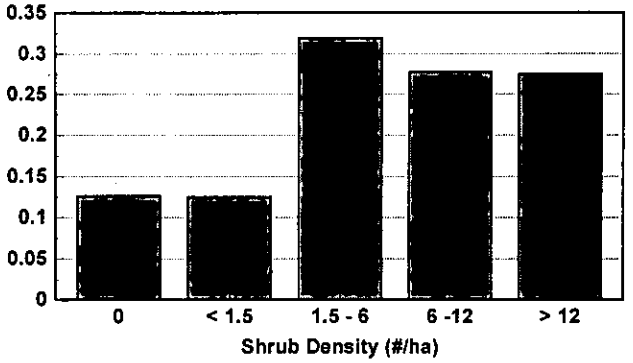
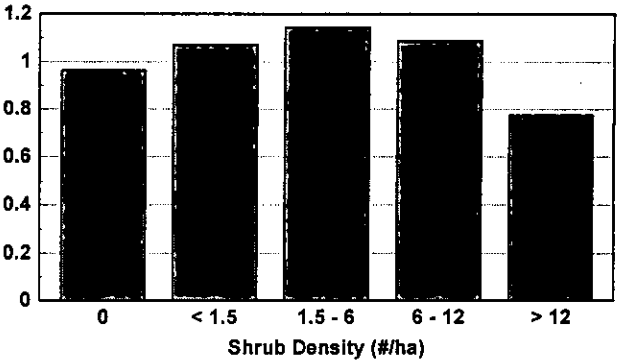


FIGURE 2. INFLUENCE OF TALL (≥ 2 M) SHRUBS/TREES ON BIRD ABUNDANCE (MEAN NUMBER OF BIRDS/POINT) WITHIN PROJECT GRASSLANDS. P-VALUES RESULTING FROM A ONE-WAY ANOVA COMPARING BIRD DENSITIES AMONG SHRUB CLASSES ARE ALSO SHOWN FOR EACH SPECIES.

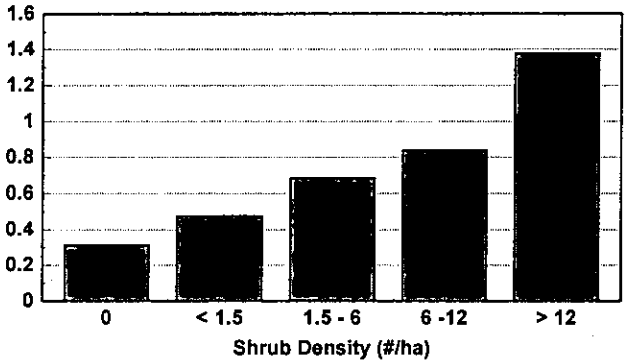
2.09 Eastern Kingbird (Birds/pt); P < 0.001



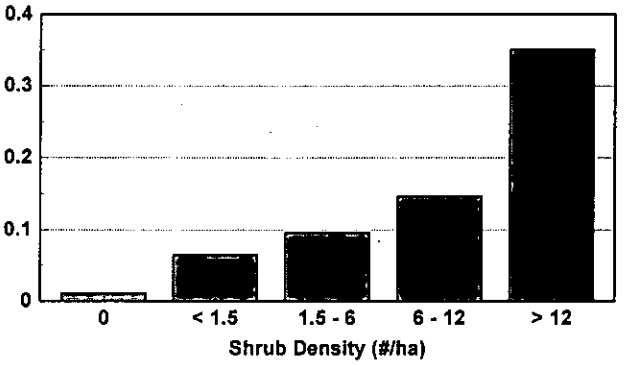
2.10 Eastern Meadowlark (Birds/pt); P = .499



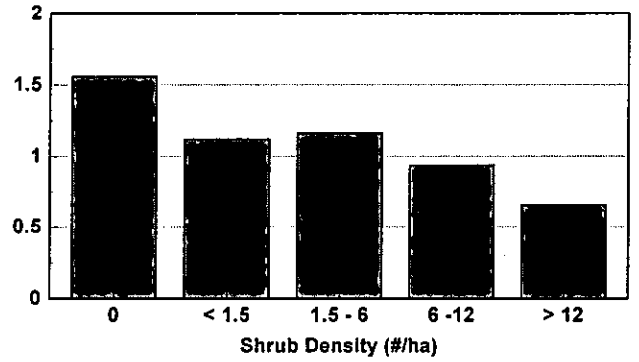
2.11 Field Sparrow (Birds/pt); P < 0.001



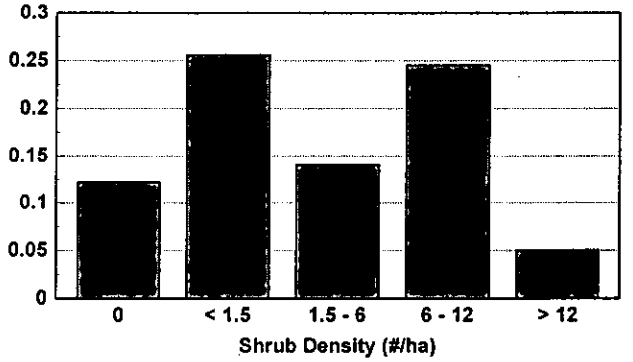
2.12 Gray Catbird (Birds/pt); P < 0.001



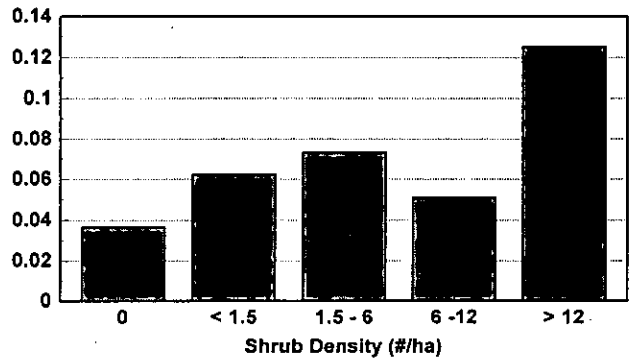
2.13 Grasshopper Sparrow (Birds/pt); P < 0.001



2.14 Henslow's Sparrow (Birds/pt); P = 0.077



2.15 House Wren (Birds/pt); P = 0.243



2.16 Indigo Bunting (Birds/pt); P = 0.001

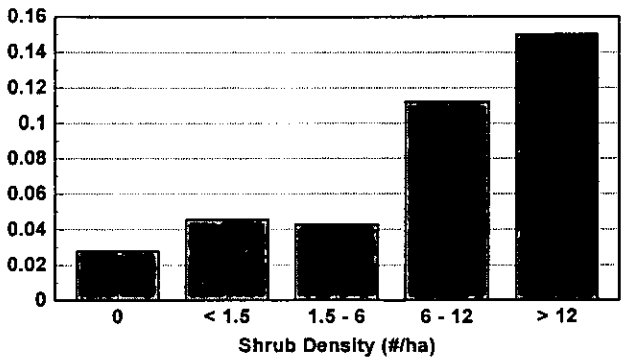
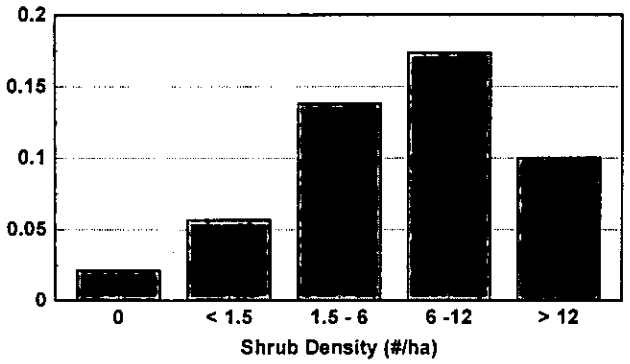
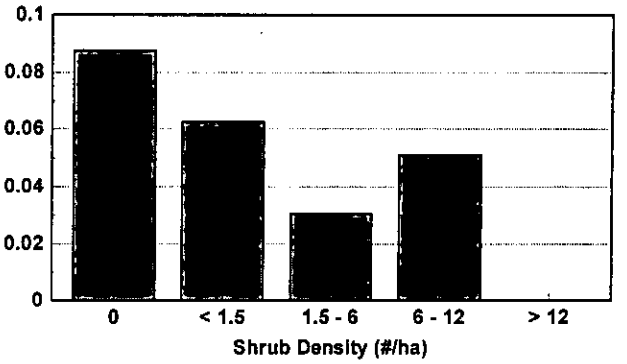


FIGURE 2. CONTINUED.

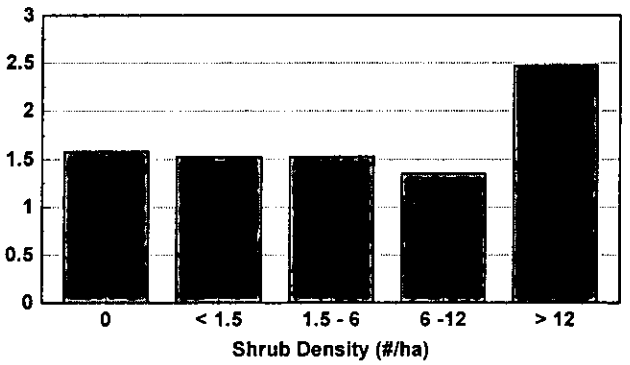
2.17 Orchard Oriole (Birds/pt); P < .001



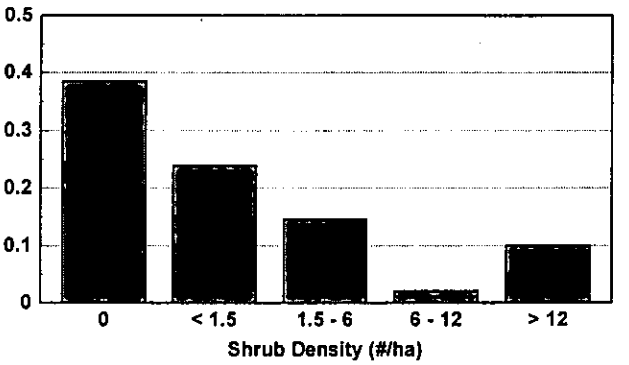
2.18 Ring-necked Pheasant (Birds/pt); P = 0.1510



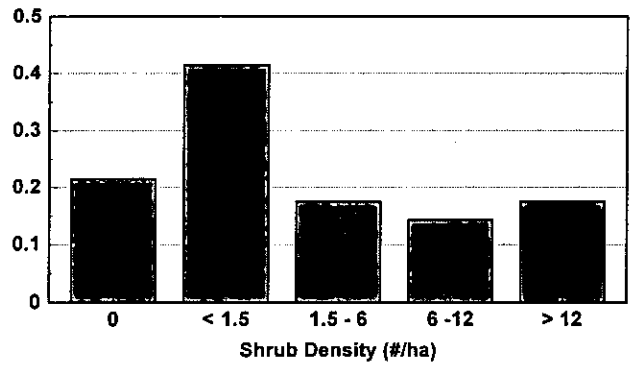
2.19 Red-winged Blackbird (Birds/pt); P = 0.472



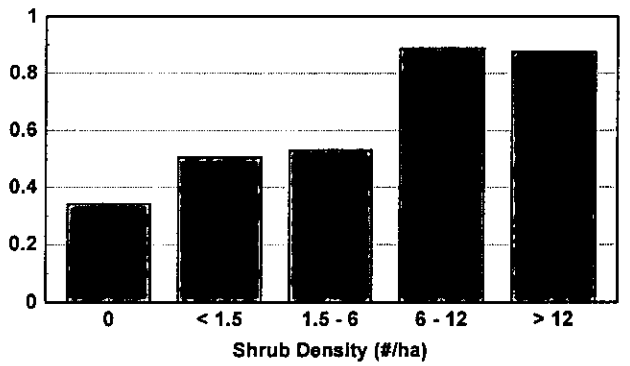
2.20 Savannah Sparrow (Birds/pt); P < 0.001



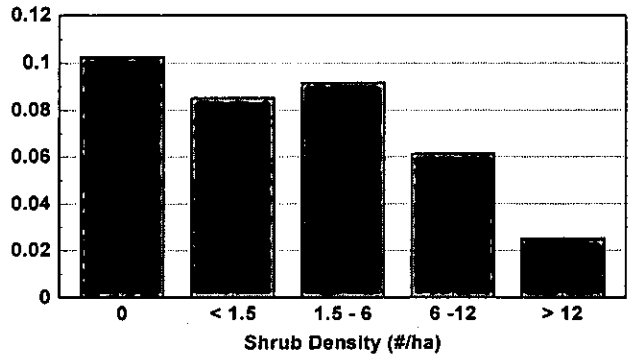
2.21 Sedge Wren (Birds/pt); P = 0.041



2.22 Song Sparrow (Birds/pt); P < 0.001



2.23 Upland Sandpiper (Birds/pt); P = 0.849



2.24 Willow Flycatcher (Birds/pt); P < 0.001

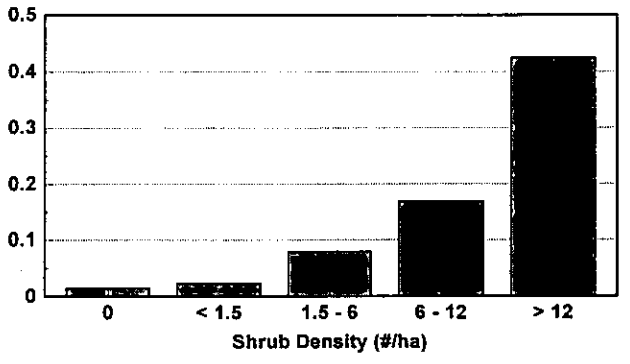


FIGURE 2. CONTINUED.

2.25 Yellow Warbler (Birds/pt); p < 0.001

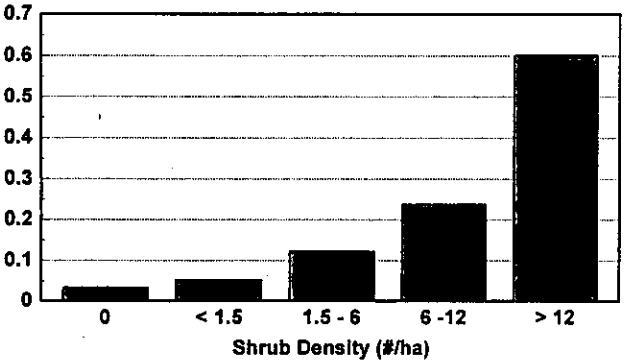


FIGURE 2. CONTINUED.

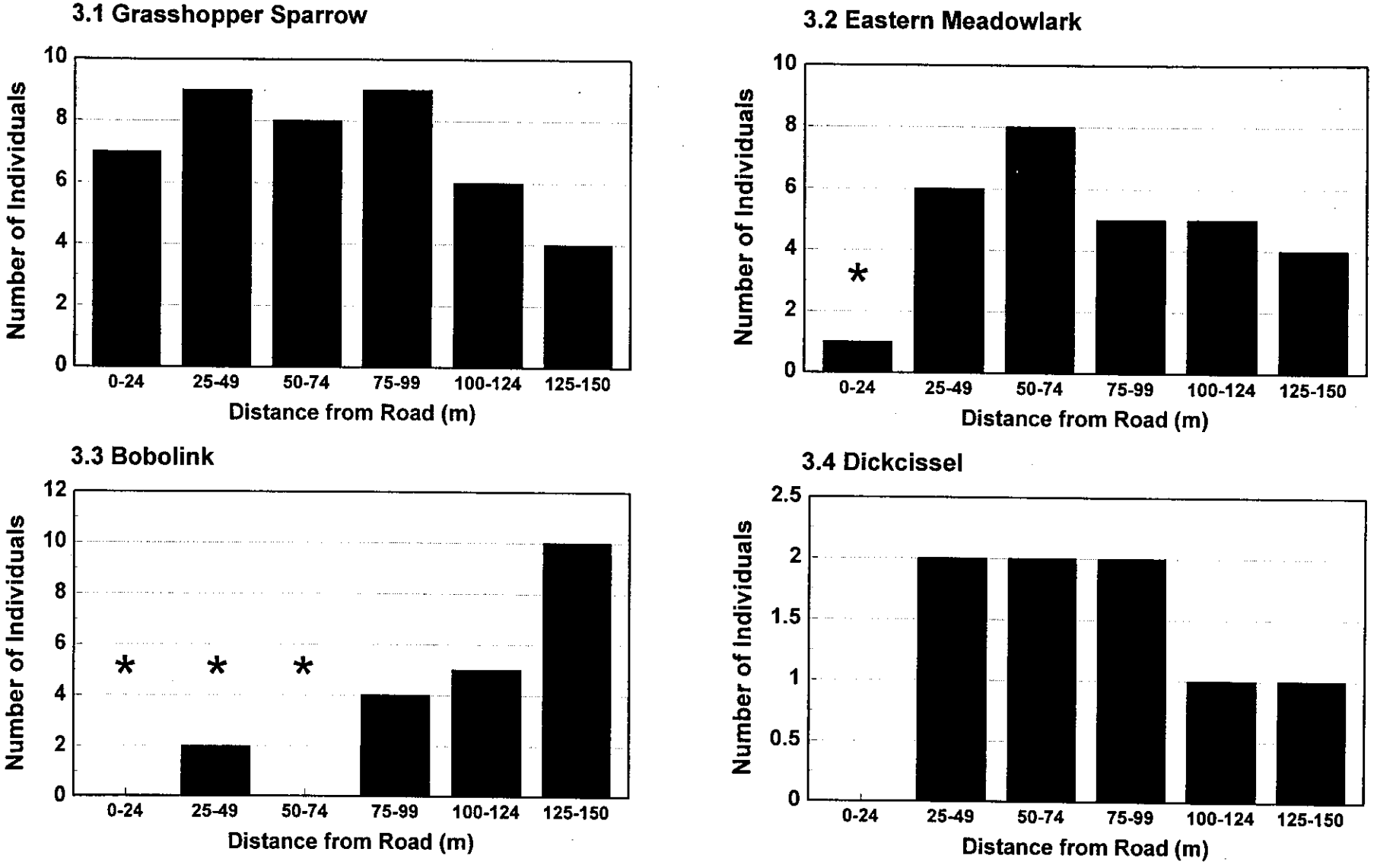
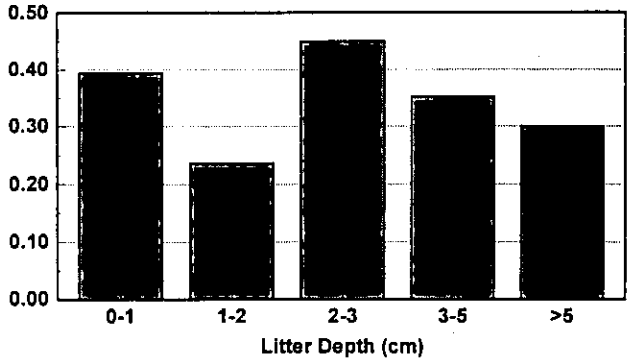
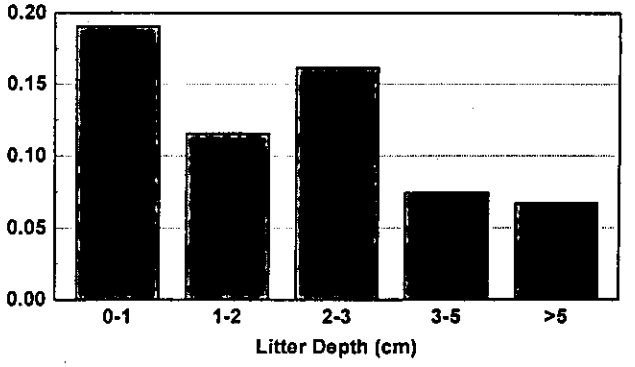


FIGURE 3. INFLUENCE OF ROADS ON BIRD ABUNDANCE WITHIN PROJECT GRASSLANDS. ASTERISKS DENOTE A SIGNIFICANT DEPARTURE FROM EXPECTED ABUNDANCE FOR PARTICULAR DISTANCE CLASSES.

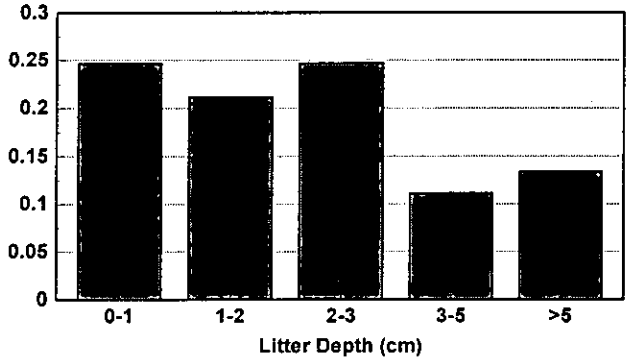
4.01 American Goldfinch (Birds/pt); P = 0.018



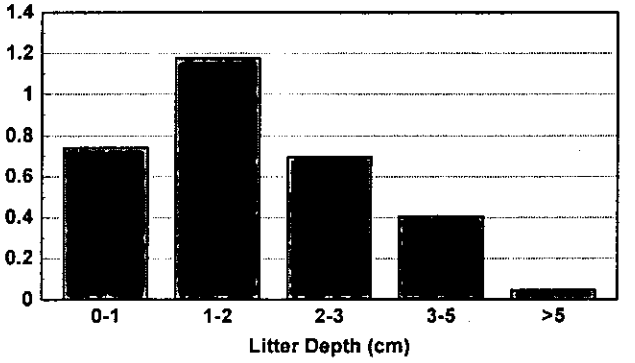
4.02 American Robin (Birds/pt); P = 0.037



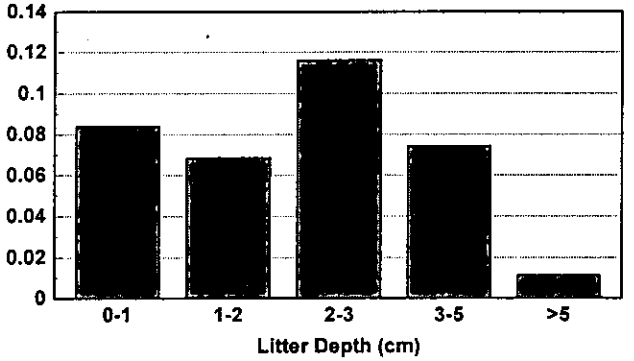
4.03 Brown-headed Cowbird (Birds/pt); P = 0.479



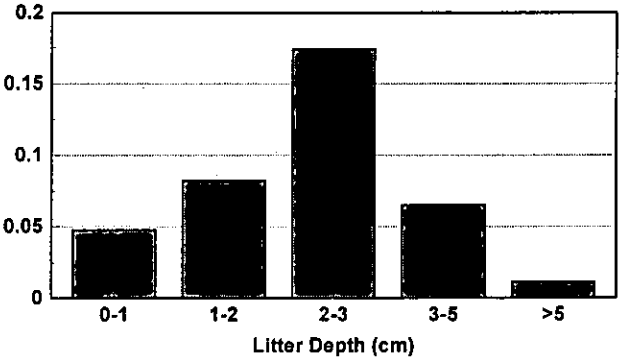
4.04 Bobolink (Birds/pt); P < 0.001



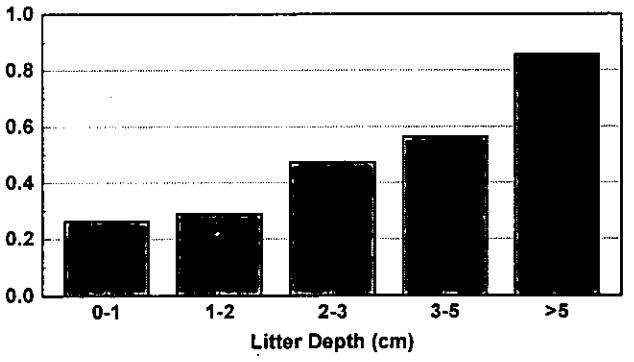
4.05 Brown Thrasher (Birds/pt); P = 0.159



4.06 Common Grackle (Birds/pt); P = 0.269



4.07 Common Yellowthroat (Birds/pt); P < 0.001



4.08 Dickcissel (Birds/pt); P = 0.037

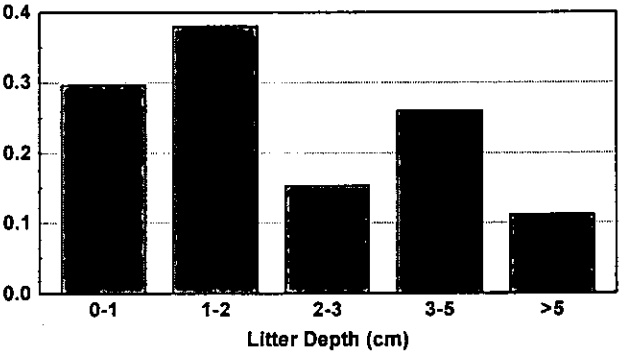
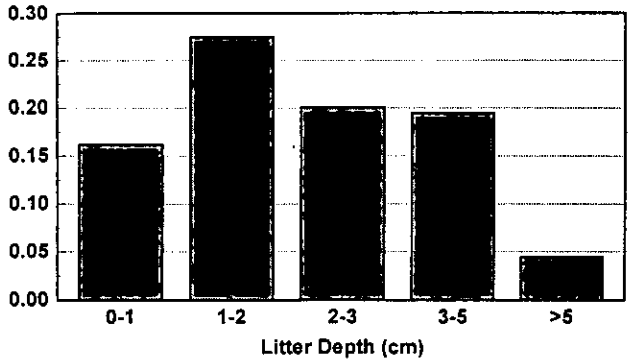
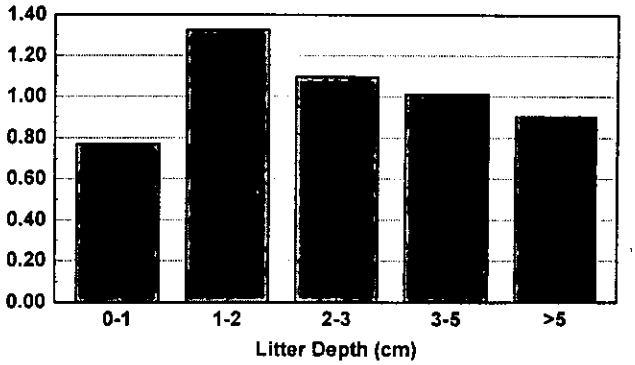


FIGURE 4. INFLUENCE OF LITTER DEPTH ON BIRD ABUNDANCE (MEAN NUMBER OF BIRDS/POINT) WITHIN PROJECT GRASSLANDS. P-VALUES RESULTING FROM A ONE-WAY ANOVA COMPARING BIRD DENSITIES AMONG LITTER DEPTH CLASSES ARE ALSO SHOWN FOR EACH SPECIES.

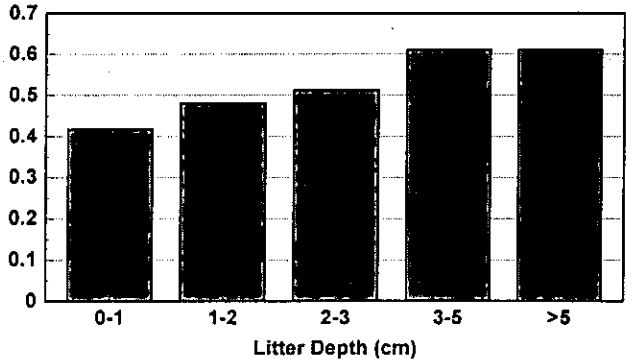
4.09 Eastern Kingbird (Birds/pt); P = 0.015



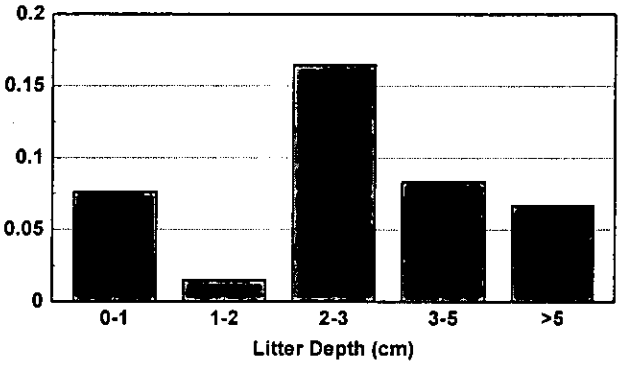
4.10 Eastern Meadowlark (Birds/pt); P < 0.001



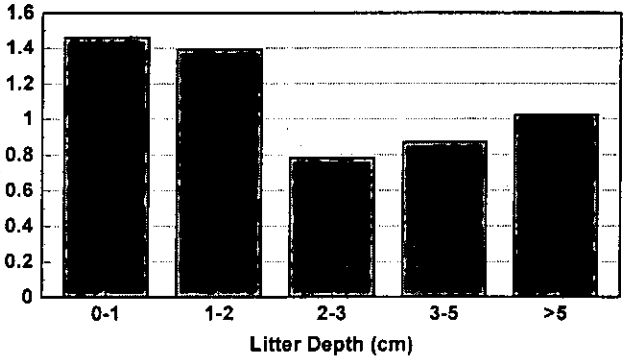
4.11 Field Sparrow (Birds/pt); P = 0.261



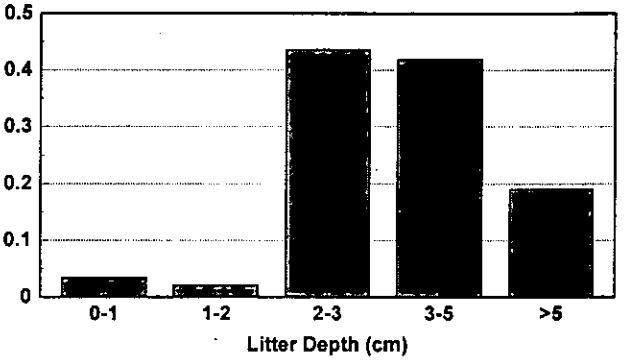
4.12 Gray Catbird (Birds/pt); P < 0.001



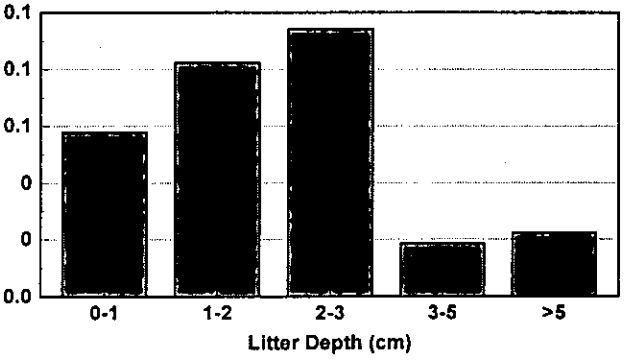
4.13 Grasshopper Sparrow (Birds/pt); P < 0.001



4.14 Henslow's Sparrow (Birds/pt); P < 0.001



4.15 House Wren (Birds/pt); P = 0.210



4.16 Indigo Bunting (Birds/pt); P = 0.074

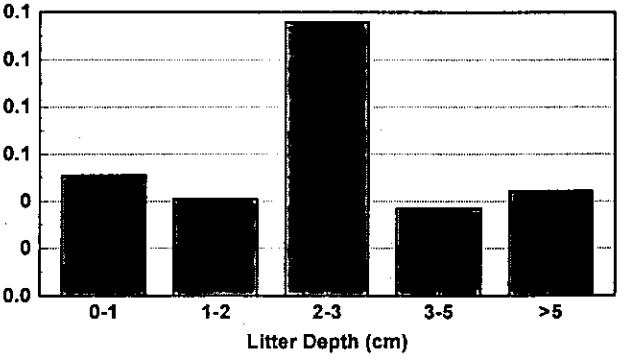
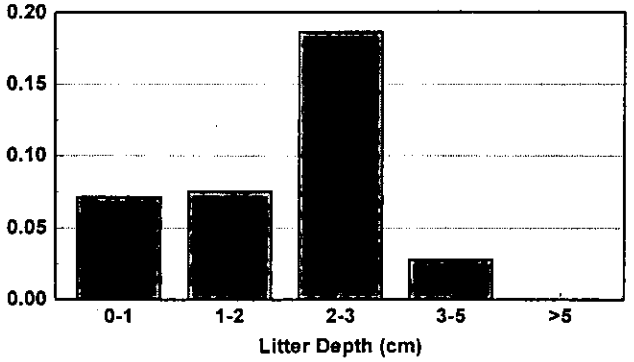
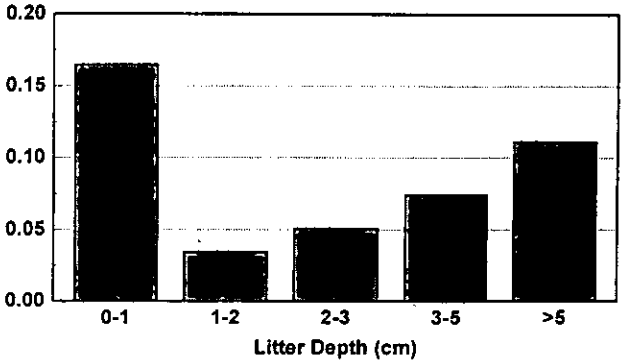


FIGURE 4. CONTINUED.

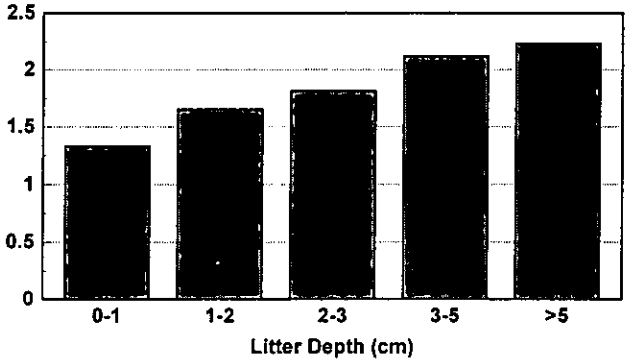
4.17 Orchard Oriole (Birds/pt); P < 0.001



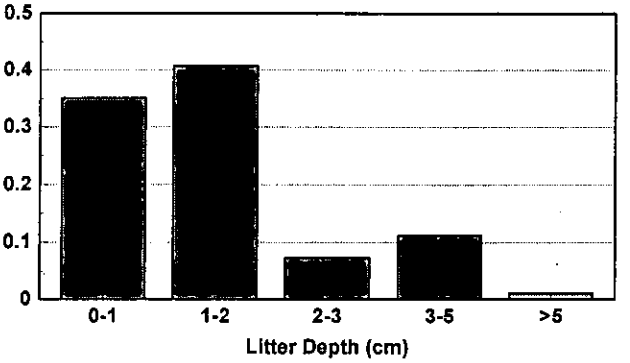
4.18 Ring-necked Pheasant (Birds/pt); P = 0.224



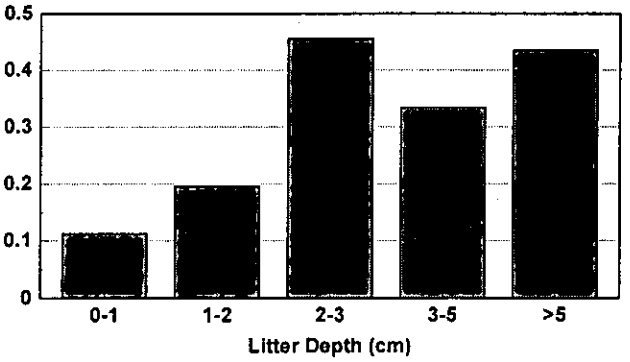
4.19 Red-winged Blackbird (Birds/pt); P = 0.139



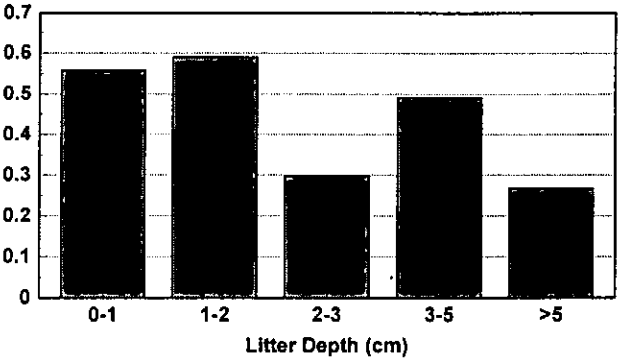
4.20 Savannah Sparrow (Birds/pt); P < 0.001



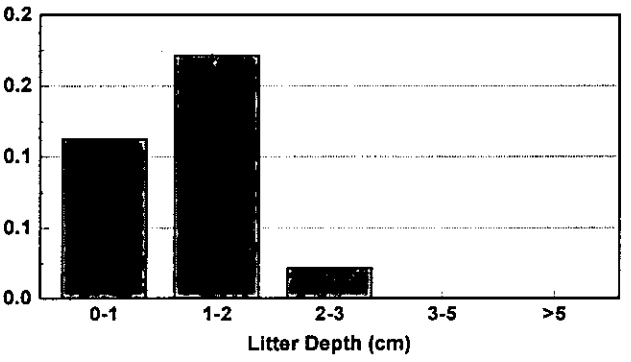
4.21 Sedge Wren (Birds/pt); P < 0.001



4.22 Song Sparrow (Birds/pt); P = 0.050



4.23 Upland Sandpiper (Birds/pt); P = 0.001



4.24 Willow Flycatcher (Birds/pt); P = 0.831

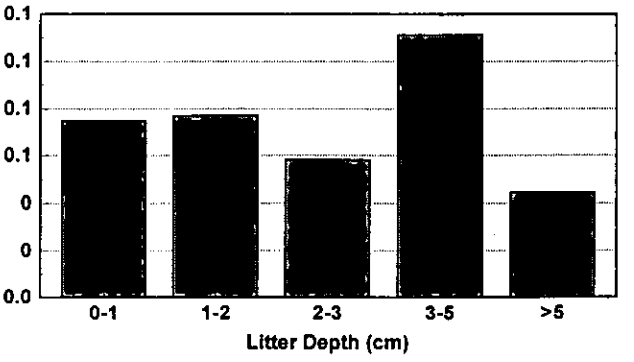


FIGURE 4. CONTINUED.

4.25 Yellow Warbler (Birds/pt); P = 0.245

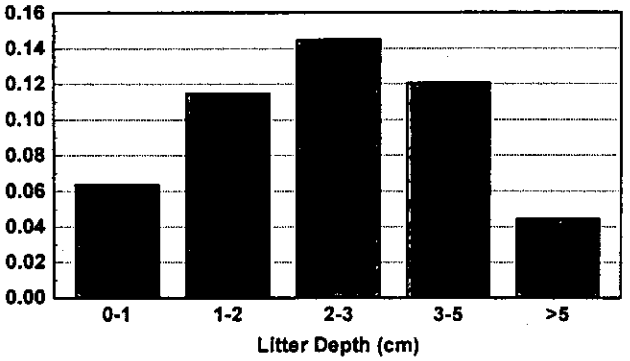
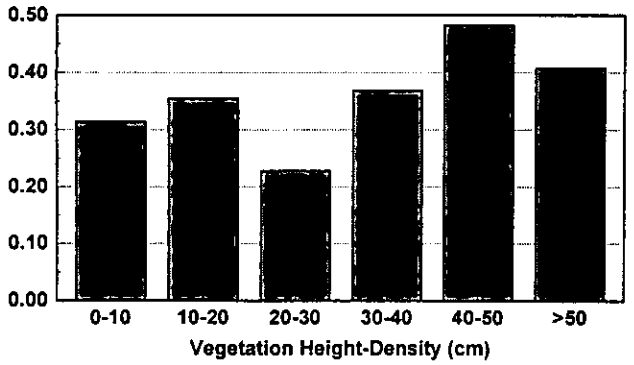
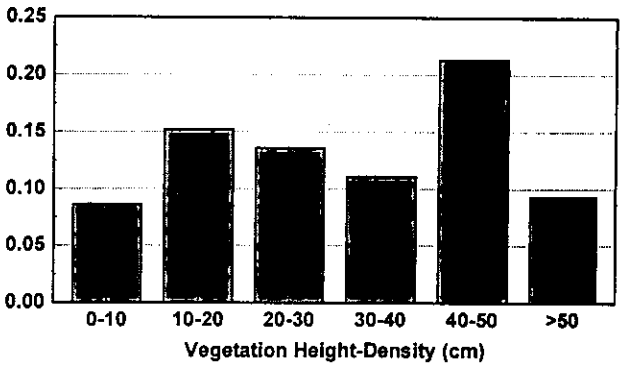


FIGURE 4. CONTINUED.

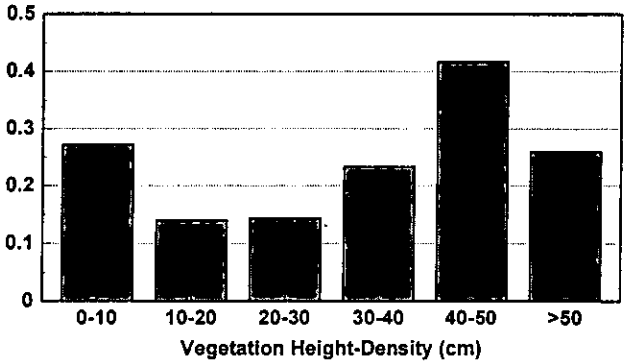
5.01 American Goldfinch (Birds/pt); P = 0.255



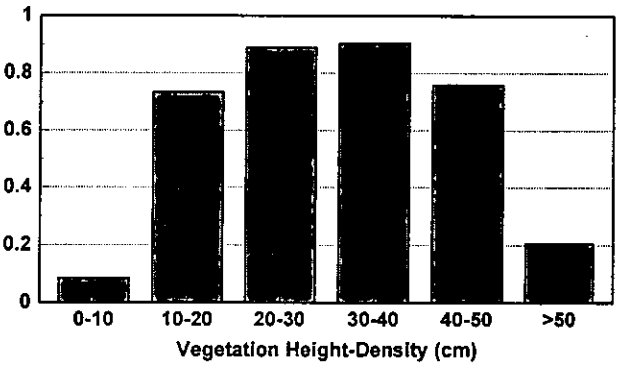
5.02 American Robin (Birds/pt); P = 0.034



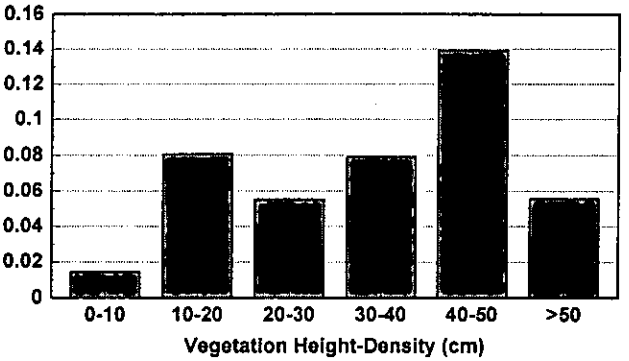
5.03 Brown-headed Cowbird (Birds/pt); P = 0.033



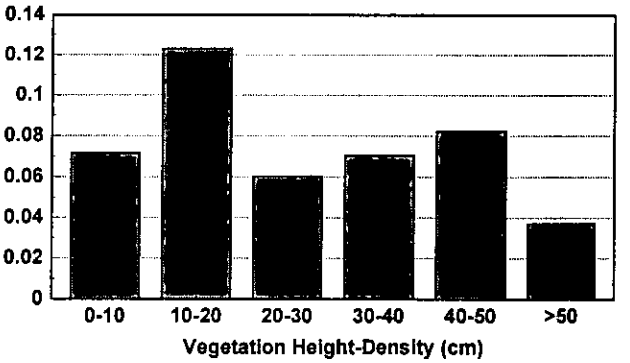
5.04 Bobolink (Birds/pt); P < 0.041



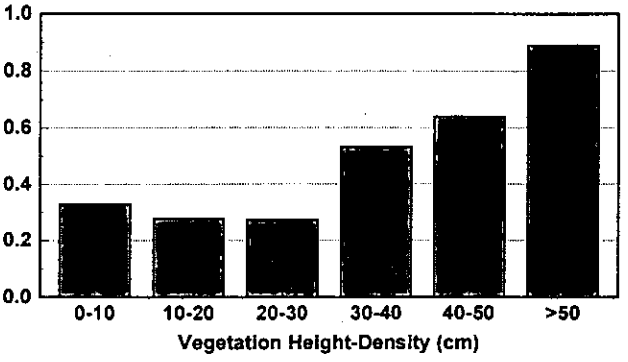
5.05 Brown Thrasher (Birds/pt); P = 0.112



5.06 Common Grackle (Birds/pt); P = 0.890



5.07 Common Yellowthroat (Birds/pt); P < 0.001



5.08 Dickcissel (Birds/pt); P = 0.030

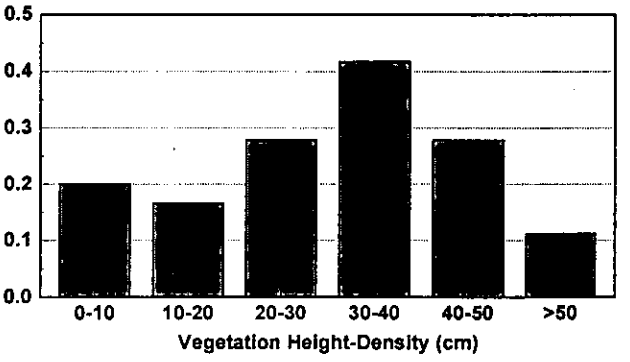
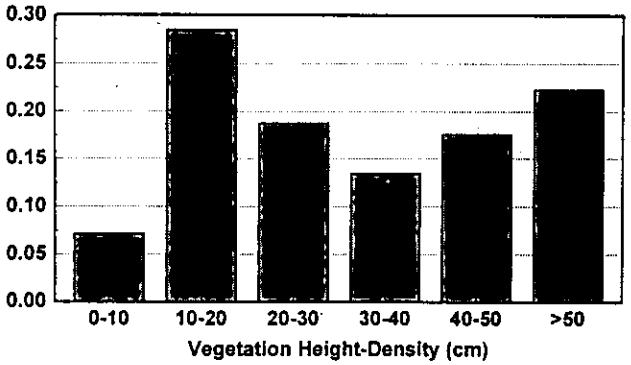
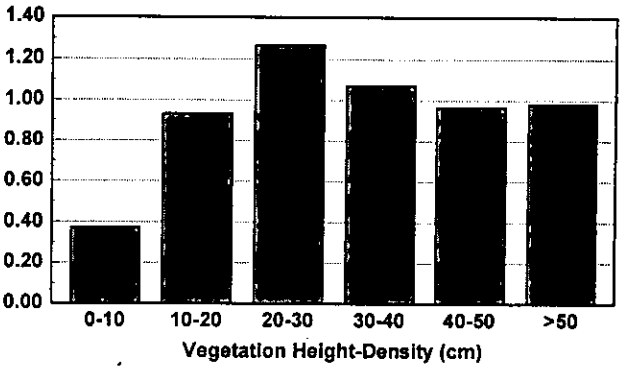


FIGURE 5. INFLUENCE OF VEGETATION HEIGHT-DENSITY ON BIRD ABUNDANCE (MEAN NUMBER OF BIRDS/POINT) WITHIN PROJECT GRASSLANDS. P-VALUES RESULTING FROM A ONE-WAY ANOVA COMPARING BIRD DENSITIES AMONG HEIGHT DENSITY CLASSES ARE ALSO SHOWN FOR EACH SPECIES.

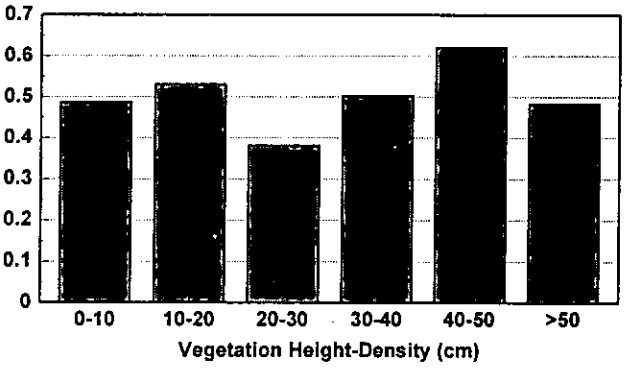
5.09 Eastern Kingbird (Birds/pt); P = 0.045



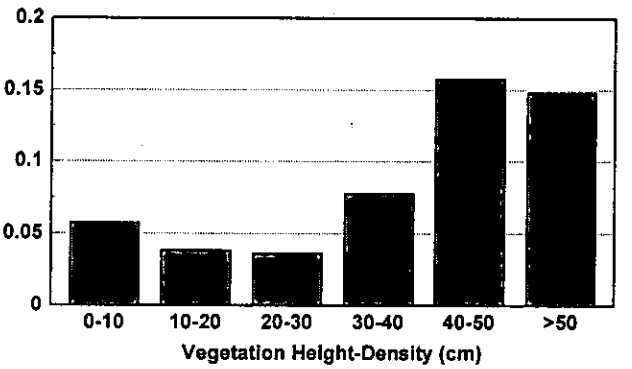
5.10 Eastern Meadowlark (Birds/pt); P < 0.001



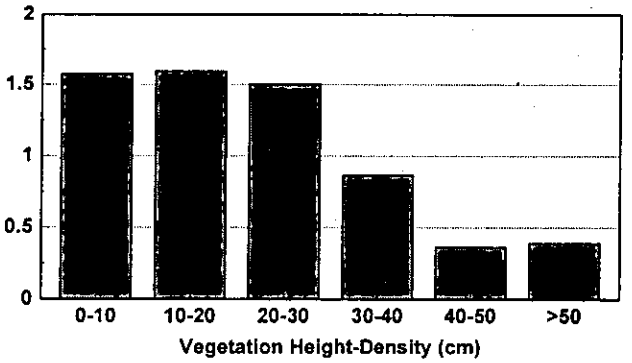
5.11 Field Sparrow (Birds/pt); P = 0.282



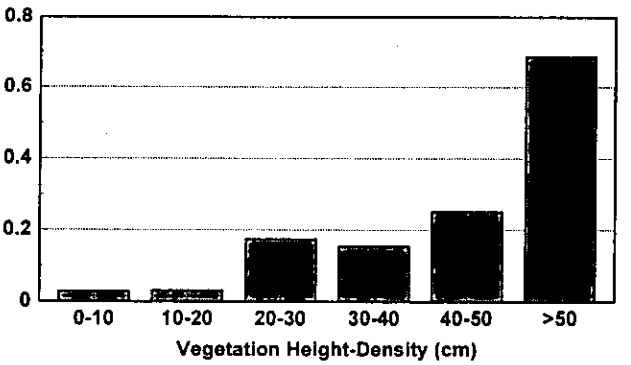
5.12 Gray Catbird (Birds/pt); P = 0.004



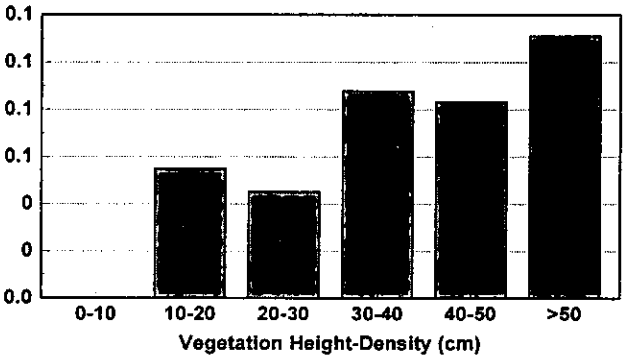
5.13 Grasshopper Sparrow (Birds/pt); P < 0.001



5.14 Henslow's Sparrow (Birds/pt); P < 0.001



5.15 House Wren (Birds/pt); P = 0.244



5.16 Indigo Bunting (Birds/pt); P = 0.056

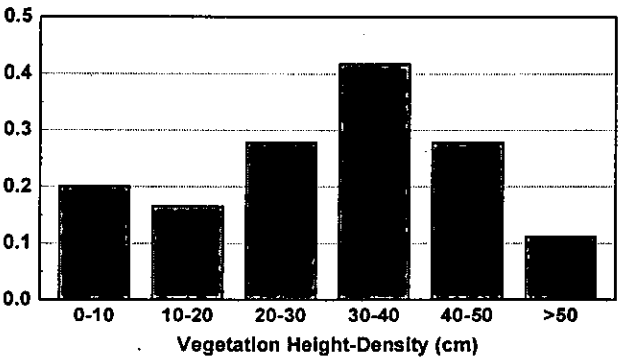
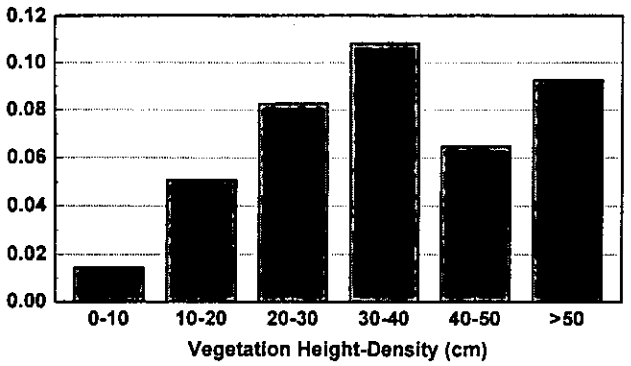
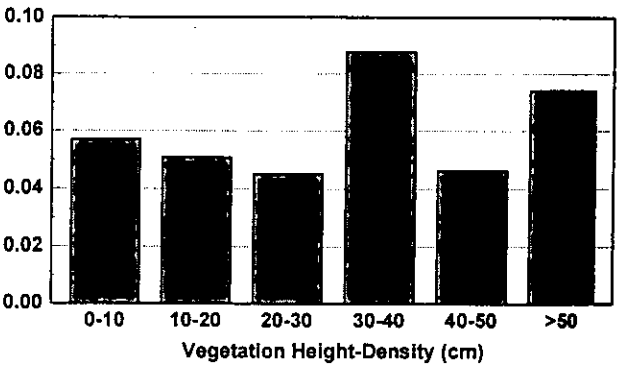


FIGURE 5. CONTINUED.

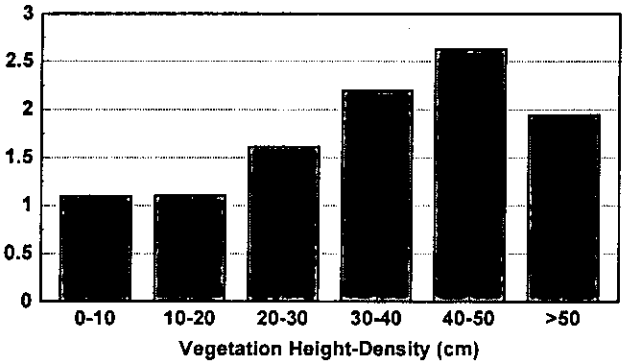
5.17 Orchard Oriole (Birds/pt); P = 0.399



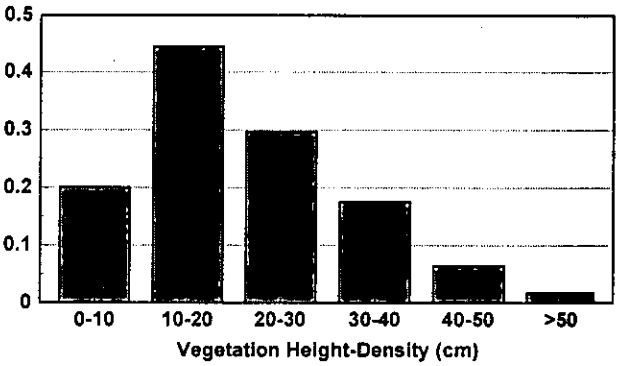
5.18 Ring-necked Pheasant (Birds/pt); P = 0.628



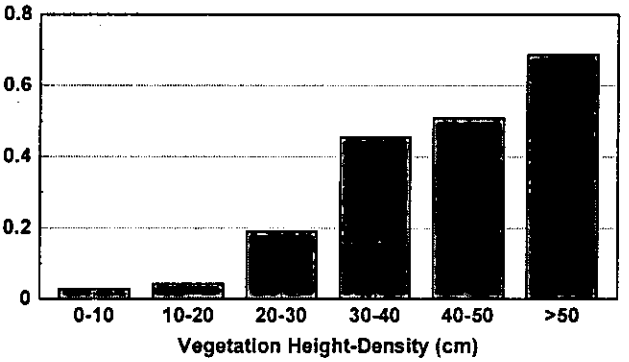
5.19 Red-winged Blackbird (Birds/pt); P < 0.001



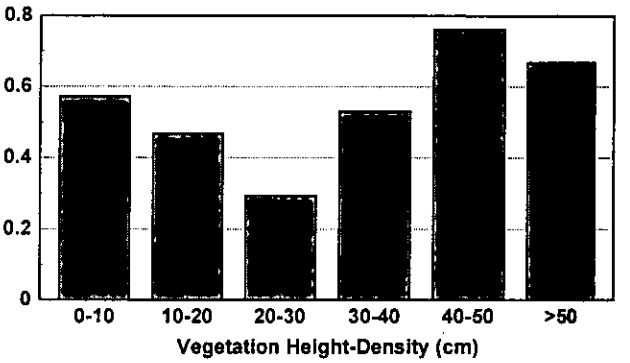
5.20 Savannah Sparrow (Birds/pt); P < 0.001



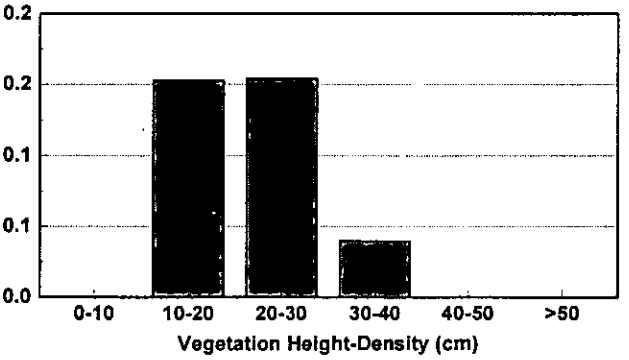
5.21 Sedge Wren (Birds/pt); P < 0.001



5.22 Song Sparrow (Birds/pt); P = 0.012



5.23 Upland Sandpiper (Birds/pt); P = 0.001



5.24 Willow Flycatcher (Birds/pt); P = 0.006

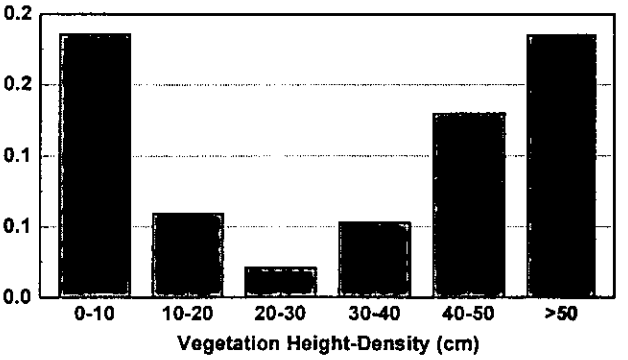


FIGURE 5. CONTINUED.

5.25 Yellow Warbler (Birds/pt); P = 0.032

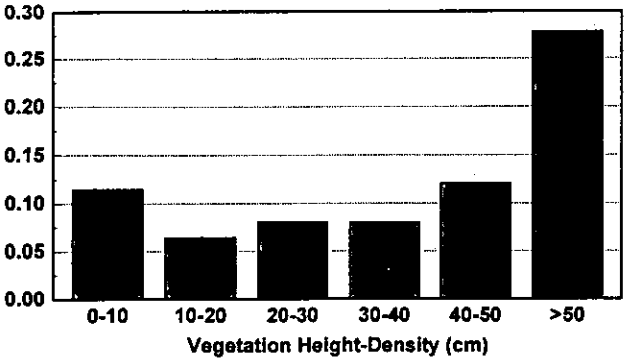


FIGURE 5. CONTINUED.