

**GRASSLAND MANAGEMENT AND RESTORATION FOR BREEDING BIRDS:
AN ANNOTATED BIBLIOGRAPHY**

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INTRODUCTION

The following is an annotated bibliography of references that deal with the management and restoration of grasslands and their associated breeding birds. Following each citation is a summary of the results of the paper that seem most significant with respect to the management of grassland habitats. All the significant results of each paper are not discussed, just those that appear to be most pertinent to grassland management. This bibliography includes research dealing primarily with grasslands and grassland birds from the United States, but is not exhaustive. I have certainly missed some references. Nevertheless, this list should give you a pretty good, general overview of the literature pertaining to grassland management and restoration for breeding birds.

REFERENCES

Ailes, I. W. 1980. Breeding biology and habitat use of the upland sandpiper in central Wisconsin. *Passenger Pigeon* 42:53-63.

Research in Wisconsin found that upland sandpipers nested most frequently in hayfields and idle fields. Heavily grazed areas were not used for nesting, however, most adults took their young to heavily grazed pastures for brood rearing. Nest success was high (85%), with all nest failures attributable to livestock trampling.

Anderson, W.L. and R.E. Duzan. 1978. DDE residues and eggshell thinning in loggerhead shrikes. *Wilson Bulletin* 90:215-220.

Research in Illinois found evidence of DDE contamination in loggerhead shrikes. Although a negative correlation between egg shell thickness and DDE concentrations was found, nesting success was high. Suggests that the decline of loggerhead shrikes is more closely associated with survival of fledglings or adults than with reproduction.

Andren, H., P. Angelstam, E. Lindstrom and P. Widen. 1985. Differences in predation pressure in relation to habitat fragmentation: An experiment. *Oikos* 45: 273-277

Research in Sweden found that predation rates on experimental dummy nests was higher in field/meadow habitats than in forests. Suggests that the disproportionately high rate of nest losses in field/meadow habitats was due to a high density of generalist predators, which may be positively correlated with the proportion of agricultural land, human density, and the degree of habitat fragmentation.

Angelstam, P. 1986. Predation on ground-nesting birds' nests in relation to predator densities and habitat edge. *Oikos* 47:365-373 Swedish study suggests that the main factor affecting the rate of nest predation in patchy environments is the steepness of productivity gradients between the habitat island and the surrounding landscape matrix, rather than patch size itself. Nest predation may be greater in habitat

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islands surrounded by urban or intensively farmed areas than habitat islands in more pristine landscapes.

Anonymous 1983. The declining grassland birds. Illinois Natural History Survey Notes, No. 227.

Research conducted in Illinois by Richard and Jean Graber suggests population declines of over 90% for the upland sandpiper, bobolink, dickcissel, grasshopper sparrow, savannah sparrow, and Henslow's sparrow between 1957 and 1978.

Arnold, T.W. and K.F. Higgins. 1986. Effects of shrub coverage on birds on North Dakota mixed-grass prairies. Canadian Field-Naturalist 100:10-14.

Species richness and total density of birds were greater along shrubby transects. However most of this richness was due to shrubland birds. Savannah sparrows and Baird's sparrows were encountered only in shrubless areas. Grasshopper sparrows and bobolinks occurred in highest densities in areas with the highest vegetation density (lightly grazed), in both shrubby and shrubless areas. Brown-headed cowbirds were significantly more abundant in shrubby areas.

Askins, R.A. 1993. Population trends in grassland, shrubland, and forest birds in eastern North America. Current Ornithology 11:1-34.

Provides a very good review of the status of grassland birds in eastern North America as well as a review of factors than may be influencing population declines.

Basore, N. S., L. B. Best and J. B. Wooley, Jr. 1986. Bird nesting in Iowa no-tilled cropland. Journal of Wildlife Management 50:19-28.

Research in Iowa showed that grassland birds nest more frequently in no-tilled fields than tilled fields. Nest destruction by farming implements was infrequent in no-tilled fields, contrary to tilled fields. However, nest predation in no-tilled fields was very high, and bird productivity was below levels needed to maintain viable populations of these species without influx from areas with greater nesting success.

Berger, A.J. 1951. The cowbird and certain host species in Michigan. Wilson Bulletin 63:26-34.

Research in Michigan found that nest parasitism rates for field-nesting bird species were usually higher in portions of fields bordered by a woodlot or thicket than in areas not near such vegetation.

Bernstein, N.P., K.B. Baker and S.R. Wilmot. 1990. Changes in a prairie bird population from 1940 to 1989. Journal of the Iowa Academy of Science 97:115-120.

Compares grassland bird populations in a Iowa prairie in 1989 to those reported by Charles Kendeigh in 1940. Found populations of all prairie nesting species to be lower in 1989 than in 1940. Reports that populations of all forest and forest-edge nesting species on the area increased over this period. The most obvious reason for the decline of grassland birds was the reduced area of

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grassland habitat in the study area because of woody succession.

Best, L.B. 1978. Field sparrow reproductive success and nesting ecology. *Auk* 95:9-22

Research in Illinois found nest success for field sparrows to be very low (10%). Nest losses were primarily due to predation by snakes (76% of all active nests). Nest parasitism rates were only 11%. The frequency of cowbird parasitism, snake predation, and successful nesting were not significantly different among grassland, shrub-grassland, and shrub-woodland habitats. Mammalian predation was significantly lower for nests in grass litter than for nests located in forbs or shrubs. Over 85% of the nests parasitized by brown-headed cowbirds were less than 23 meters from the shrub-woodland border. Due to the low nest success of birds breeding at this site, the stability of the population was dependent on immigration from other areas.

Best, L.B. 1979. Effects of fire on a field sparrow population. *American Midland Naturalist* 101:434-442.

Study of the effects of fire on an Illinois field sparrow population inhabiting a grassland/shrub-grassland area. April burning increased use of the shrub-grassland area and reduced usage of the grassland area by field sparrows. Rates of nest desertion and cowbird parasitism were lower after the burn.

Best, L.B. 1986. Conservation tillage: ecological traps for nesting birds. *Wildlife Society Bulletin* 14:308-317.

Suggests that conservation tillage fields may constitute "ecological traps" (man-made areas that, on the basis of physical and/or vegetational characteristics, appear to be suitable habitat for nesting but which, by virtue of some confounding factor(s), result in population sinks rather than sources for species settle there) for some nesting birds because they appear to provide more suitable nesting cover than more heavily tilled fields but where nest disturbance may still be frequent enough to cause poor nest success.

Birkenholz, D.E. 1972. Habitat relationships of grassland birds at Goose Lake Prairie Nature Preserve. Pp. *in* Proceedings of the Third Midwest Prairie Conference.

Research in Illinois found three species of grassland birds, upland sandpiper, bobolink, and grasshopper sparrow to be more common in introduced bluegrass than in native prairie. Henslow's sparrows were more common in adjacent native grasses, being most common in meadows dominated by bluejoint, little bluestem, and prairie dropseed.

Bock, C.E. and J.H. Bock. 1987. Avian habitat occupancy following fire in a Montana Shrubsteppe. *Prairie Naturalist* 19:153-158.

Examines breeding bird use of burned and unburned areas following a 1983 wildfire. The fire converted an *Artemisia* shrubsteppe into a pure high plains grassland. Two-to-three years following the fire, the burned area supported a much lower variety and abundance of nesting birds than the unburned shrubsteppe. Lark buntings, lark sparrows, and Brewer's sparrows occupied patches of unburned habitat and completely avoided the burned area. Grasshopper sparrows also were significantly more abundant on the unburned site. Only the western meadowlark was equally abundant in both areas, and no species were more common in the

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burned grassland.

Bock, C.E. and J.H. Bock. 1990. Effect of fire on wildlife in southwestern lowlands. Pp. 50-64 in J.S. Krammer, Technical Coordinator. Effects of fire management of southwestern natural resources. USDA Forest Service General Technical Report RM-191. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Reviews information about the response of wildlife to fire in the grasslands and shrublands of Arizona and New Mexico. Botteri's, Cassin's and grasshopper sparrows were all found to disappear from areas burned by a lightning ignited wildfire in southeastern Arizona. Densities of these three sparrows remained low in the second year following the fire. Overall, birds were more than five times as abundant on the burned areas than they were on adjacent unburned areas, apparently as a result of high use by horned larks, lark sparrows, and mourning doves. The authors conclude that fire is likely to be more destructive than beneficial to wildlife and wildlife habitat in Sonoran and Mojave desertscrub, black grama ranges in the lower parts of the Chihuahua shrubsteppe, and riparian woodlands. Prescribed fire is potentially beneficial in Great Basin shrubsteppe, interior chaparral, semidesert and plains grassland portions of Chihuahua shrubsteppe, Sonoran savanna grassland, and sacaton floodplains. However, fire should be used infrequently and grasses and herbs should be allowed to fully recover before being burned again.

Bock, C.E. and J.H. Bock. 1992. Response of birds to wildfire in native versus exotic Arizona grasslands. *The Southwestern Naturalist* 37:73-81.

Research in southeastern Arizona found that mourning doves, horned larks, and lark sparrows were attracted to burned sites during the breeding season, whereas eastern meadowlarks and grasshopper, Botteri's and Cassin's sparrows avoided burned plots during the breeding season. Fire effects were ephemeral in both native and exotic grassland habitats, and there was no evidence that burning facilitated permanent return of native plant species to depauperate plantations of exotic grasses. However, fire may have rendered exotic grasslands more suitable to certain summer birds by reducing otherwise heavy accumulations of litter.

Bock, C.E. and B. Webb. 1984. Birds as grazing indicator species in southeastern Arizona. *Journal of Wildlife Management* 48:1045-1049.

Research in mixed grass-shrublands in Arizona reports that grasshopper sparrows and Cassin's Sparrows were found only in ungrazed areas, and that horned larks and lark sparrows were significantly more common in grazed areas.

Bock, J.E., J.H. Bock, W.R. Kenney, and V.M. Hawthorne. 1984. Responses of birds, rodents and vegetation to livestock enclosure in a semidesert grassland site. *Journal of Range Management* 37:239-242.

Compares bird use of grazed and ungrazed grasslands in southeastern Arizona. The grazed area supported significantly higher numbers of breeding birds. Numbers of scaled quail, morning doves, horned larks, and lark sparrows, were

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significantly more abundant in the grazed pasture. Cassin's and grasshopper sparrows were significantly more numerous in the protected area.

Bohning-Gaese, K., M.L. Taper, and J.H. Brown. 1993. Are declines in North American insectivorous songbirds due to causes on the breeding range? *Conservation Biology* 7:76-86.

Primarily addresses forest bird species but does include a few grassland bird species and does have grassland implications. Research found that a bird species' susceptibility to nest failure on the breeding grounds was most strongly correlated with population trends from 1968 to 1987. Specifically, birds with low, open-cup nests and high rates of cowbird parasitism were more likely to exhibit population declines than species with high, concealed nests and low rates of cowbird parasitism.

Bollinger, E.K. and T.A. Gavin. 1992. Eastern bobolink populations: ecology and conservation in an agricultural landscape. Pp. 497-506 in J.M. Hagen III and D.W. Johnston eds. *Ecology and Conservation of Neotropical Landbirds*. Smithsonian Institute Press. 609 pp.

Found bobolink abundance in New York to be greater in older hayfields with a relatively high grass to legume ratio. Bobolink abundance was also found to increase exponentially with field size and was highest in fields with the least alfalfa coverage. Suggests that conservation strategies designed for bobolinks should be concentrated on creating or maintaining large habitat patches that resemble old hayfields.

Bollinger, E.K., P.B. Bollinger, and T.A. Gavin. 1990. Effects of hay-cropping on eastern populations of the bobolink. *Wildlife Society Bulletin* 18:142-150.

Research on the effects of hay-cropping on the reproductive success of bobolinks nesting in New York hayfields. Found that hay cutting and associated disturbances destroyed 94% of the eggs and nestlings in these habitats. Hay cutting also killed more than 50% of the recently fledged bobolinks in these fields. In adjacent undisturbed fields, more than 80% of the bobolink nestlings fledged. Suggests that hay-cropping may be contributing to the declines of bobolinks and other grassland birds in the eastern United States.

Bowen, B.S. and A.D. Kruse. 1993. Effects of grazing on nesting by upland sandpipers in southcentral North Dakota. *Journal of Wildlife Management* 57:291-301.

Research on the effects of grazing on nest density and nest success of upland sandpipers in southcentral North Dakota found that grazing during the nesting season significantly reduced nest density of this species. Found a slight tendency toward lower nest success on fields with May-June grazing and high stocking rates, although nest success varied greatly among years. Most nest destruction was due to predation, suggesting that the presence of cattle does not affect nest success directly (i.e., trampling, etc.) but rather it may have an indirect effect on nest success. Recommends that public lands with breeding populations of upland sandpipers include a complex of fields under various management practices, including fields undisturbed during the nesting season.

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Brooks, B.L. and S.A. Temple. 1990. Dynamics of a loggerhead shrike population in Minnesota. *Wilson Bulletin* 102:441-450.

Research on loggerhead shrikes in Minnesota suggests that shrike declines in the Upper Midwest may be associated with overwinter survival. Suggests that conservation efforts for loggerhead shrikes may need to be concentrated on their winter range.

Brooks, B.L. and S.A. Temple. 1990. Habitat availability and suitability for loggerhead shrikes in the upper Midwest. *American Midland Naturalist* 123:75-83.

Research in Minnesota was unable to find convincing evidence that the abundance of loggerhead shrikes in the Upper Midwest is limited by availability of suitable breeding habitat.

Bryan, G.G. and L.B. Best. 1991. Bird abundance and species richness in grassed waterways in Iowa rowcrop fields. *American Midland Naturalist* 126:90-102.

Research in Iowa documents substantial use of grassed waterways by breeding birds. Densities of grassland birds in waterways were comparable to densities reported from other grassland habitats. Bird use of waterways peaked in early July possibly due to mowing of other nearby grasslands (e.g., hayfields, roadsides). Points to the importance of having unmowed/undisturbed grasslands in highly fragmented Midwestern landscapes.

Buhnerkempe, J.E., W.R. Edwards, R.D. Vance, and R.L. Westemeier. 1984. Effects of residual vegetation on prairie-chicken nest placement and success. *Wildlife Society Bulletin* 12:382-386.

Research in Illinois found that fields containing only successful nests had lower nest densities and more residual vegetation than fields containing only unsuccessful nests.

Buhnerkempe, J.E. and R.L. Westemeier. 1988. Breeding biology and habitat selection of upland sandpipers on prairie-chicken sanctuaries in Illinois. *Transactions of the Illinois State Academy of Sciences* 81:153-162.

Upland sandpipers selected fields that had been rotary mowed or burned the previous year. Nests were usually located in fields having a mixture of narrow-leaved grasses (redtop, timothy, bluegrass) and forbs. No nests were found in tall, rank prairie grasses. Forty-six percent of the nests monitored were lost to predators.

Burger, L.D., L.W. Burger, Jr., and J. Faaborg. 1994. Effects of prairie fragmentation on predation on artificial nests. *Journal of Wildlife Management* 58:249-254.

Research in Missouri prairie fragments, found that artificial nests in prairies < 15 ha were depredated more than those in larger prairies. Artificial nests < 60 meters from woody cover were also less successful than nests farther away from woody cover. Proximity to woody cover had more influence on artificial-nest success than did prairie size when both variables were examined jointly. Recommends that the potential effects of prairie size and woody vegetation on success of ground nesting bird should be considered in decisions regarding

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acquisition and management of prairie habitats.

Camp, M. and L.B. Best. 1994. Nest density and nesting success of birds in roadsides adjacent to rowcrop fields. *American Midland Naturalist* 131:347-358.

Documents relatively high densities of birds nesting in Iowa grass roadsides, but also found low reproductive success and high rates of nest predation. Nest predation accounted for the fate of 55% of all red-winged blackbird nests and 52% of the nests of all species combined. Cowbird parasitism rates were also relatively high, 46% for red-winged blackbirds and 50% of the nests for all species combined. Although nest density was high few grassland bird species nested in this habitat, bobolinks, grasshopper sparrows, savannah sparrows and upland sandpipers were conspicuously absent from the roadsides studied.

Cody, M.L. 1985. Habitat selection in grassland and open-country birds, Pp. 191-226 in M.L. Cody (ed). *Habitat Selection in Birds*. Academic Press, Inc., Orlando.

Suggests that some of the year-to-year variability in grassland bird numbers may be due to recent weather patterns, including rainfall amounts and spring temperatures.

Delany, M.F., H.M. Stevenson, and R. McCracken. 1985. Distribution, abundance, and habitat of the Florida grasshopper sparrow. *Journal of Wildlife Management* 49:626-631.

Compared with the habitat of the eastern grasshopper sparrow, habitat used by the Florida subspecies (*floridanus*) had lower values for variables pertaining to vegetation height, vertical density, litter depth, and litter cover, but much higher values for percentage shrub cover and bare ground. Habitat loss or alteration due to pasture management is the greatest threat to the subspecies. Authors recommend maintaining a low growth of palmettos and woody shrubs in areas where this species occurs.

Duebbert, H.F. and J.T. Lokemoen. 1977. Upland nesting of American bitterns, marsh hawks, and short-eared owls. *Prairie Naturalist* 9:33-40.

Research in the Dakotas found that northern harriers were most likely to nest in fields with tall dense cover, most frequently in areas with cover more than 60 cm. Cover at short-eared owl nests was in the 30-60 cm range.

Elliot, P.F. 1978. Cowbird parasitism in the Kansas tallgrass prairie. *Auk* 95:161-167.

Studied brood parasitism by the brown-headed cowbird in a tallgrass prairie community in northeastern Kansas. Found very high rates of parasitism - eastern meadowlark (70%), grasshopper sparrow (50%), and dickcissel (95%). Parasitized nests fledged very few host young, and produced significantly fewer host young than unparasitized nests. The high intensity of brood parasitism was attributed to high relative densities of cowbirds.

Fitzgerald, S.M. and G.W. Tanner. 1992. Avian community response to fire and mechanical shrub control in south Florida. *Journal of Range Management* 45:396-400.

Research on the effects of prescribed fire and roller chopping on woody vegetation

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and the associated bird community of a southwestern Florida former dry prairie. Bird species richness and abundance were similar in control and burn plots. Bird species richness in areas where woody vegetation was removed by chopping was low. The majority of birds seen in the chop plots were eastern meadowlarks, Bachman's sparrows, loggerhead shrikes, and grasshopper sparrows, indicating a trend toward the reestablishment of grassland habitat. A reduction in complexity of vertical habitats due to prairie restoration lowered overall species diversity on treated areas but benefitted grassland birds.

Freeman, S., D.F. Gori, and S. Rohwer. 1990. Red-winged blackbirds and brown-headed cowbirds: some aspects of a host-parasite relationship. *Condor* 92:336-340.

Suggests that in treeless habitats, cowbirds may frequently be unable to gather enough information on the status of potential host nests to lay at an appropriate time.

Fretwell, S. 1972. The regulation of bird populations on Konza Prairie: the effects of events off the prairie. *Proceedings of the Third Midwest Prairie Conference* Pp. 71-76.

Suggests that populations of some prairie birds may be regulated, at least in part, on the wintering grounds.

Gates, J.E. and Gysel, L.W. 1978. Avian nest dispersion and fledgling success in field-forest ecotones. *Ecology* 59:871-883.

Research in Michigan showed that birds nesting in contiguous field and forest habitats had higher nesting success with increasing distance from the forest-field edge. Predation and cowbird parasitism were the most important nest mortality factors. Predation rates and nest losses to cowbird parasitism were greatest in close proximity to the habitat discontinuity.

Gavin, T.A. and E.K. Bollinger. 1988. Reproductive correlates of breeding-site fidelity in bobolinks (*Dolichonyx oryzivorus*). *Ecology* 69:96-103.

Research in upstate New York found that male and female bobolinks that successfully fledged one or more young were significantly more likely to return to the same breeding area in subsequent years.

George, T.L., A.C. Fowler, R.L. Knight, and L.C. McEwen. 1992. Impacts of a severe drought on grassland birds in western North Dakota. *Ecological Applications* 2:275-284.

Studied the effects of the 1988 drought on grassland bird populations in western North Dakota. Total grassland bird density declined by 61% between June 1987 (pre-drought) and June 1988 (drought). Densities of six of the eight most common species declined during the drought. Species richness declined more on fair condition range than on good condition range. Populations recovered quickly, and for all but two species attained pre-drought levels within one year of the drought. Nest success for the vesper sparrow was significantly lower in the drought year than in either the pre- or post-drought years. These data suggest that year-to-year fluctuations in densities of some grassland bird species may not be tightly linked to short-term changes in local productivity. Recommends managing livestock grazing in a manner that assists

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recovery of degraded rangeland and maintains good condition range.

Halvorsen, H.H. and R.K. Anderson. 1980. Evaluation of grassland management for wildlife in central Wisconsin. Proceedings of the North American Prairie Conference. 7:267-279.

Research in central Wisconsin documents density declines of 80% for savannah sparrows and 94% for clay-colored sparrows following spring (late March - early April) burning of a large old-field habitat.

Hands, H., R.D. Drobney, and M.R. Ryan. 1989. Status of the Bachman's sparrow in the Northcentral United States. USFWS, Twin Cities, MN.

Reviews the population status, distribution, life history characteristics, and limiting factors of the Bachman's sparrow. Also provides management guidelines and identifies research and information needs that will address this species recovery.

Hands, H., R.D. Drobney, and M.R. Ryan. 1989. Status of the northern harrier in the Northcentral United States. USFWS, Twin Cities, MN.

Reviews the population status, distribution, life history characteristics, and limiting factors of the northern harrier. Also provides management guidelines and identifies research and information needs that will address this species recovery.

Hands, H., R.D. Drobney, and M.R. Ryan. 1989. Status of the loggerhead shrike in the Northcentral United States. USFWS, Twin Cities, MN.

Reviews the population status, distribution, life history characteristics, and limiting factors of the loggerhead shrike. Also provides management guidelines and identifies research and information needs that will address this species recovery.

Hands, H., R.D. Drobney, and M.R. Ryan. 1989. Status of the Henslow's sparrow in the Northcentral United States. USFWS, Twin Cities, MN.

Reviews the population status, distribution, life history characteristics, and limiting factors of the Henslow's sparrow. Also provides management guidelines and identifies research and information needs that will address this species recovery.

Hands, H., R.D. Drobney, and M.R. Ryan. 1989. Status of the common barn owl in the Northcentral United States. USFWS, Twin Cities, MN.

Reviews the population status, distribution, life history characteristics, and limiting factors of the common barn owl. Also provides management guidelines and identifies research and information needs that will address this species recovery.

Hergenrader, G.L. The incidence of nest parasitism by the brown-headed cowbird (*Molothrus ater*) on roadside nesting birds in Nebraska. Auk 79:85-88.

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Study of cowbird parasitism rates in Nebraska roadsides. Found relatively high rates of nest parasitism for some grassland birds including: red-winged blackbirds (54%), dickcissels (53%), and eastern meadowlarks (16%).

Herkert, J.R. 1991. Prairie birds of Illinois: population response to two centuries of habitat change. *Illinois Natural History Survey Bulletin* 34:393-399.

Data from Illinois grassland fragments shows that upland sandpipers and northern harriers do not utilize grassland fragments less than 30 ha, and that bobolinks, savannah sparrows, grasshopper sparrows, and Henslow's sparrows do not colonize grassland fragments less than 10-30 ha.

Herkert, J.R. 1994. Breeding bird communities of Midwestern prairie fragments: the effects of prescribed burning and habitat-area. *Natural Areas Journal* 14:128-135.

Examines the effects of spring burning and habitat-area on grassland bird communities in Illinois prairie fragments. Three grassland bird species, Henslow's sparrow, bobolink, and grasshopper sparrow were influenced the most by prescribed burning. Found that habitat-area had a much greater influence on breeding bird community composition than prescribed burning. Recommends managing large prairie fragments to provide a mosaic of both burned and unburned areas.

Herkert, J.R. 1994. Status and habitat selection of the Henslow's sparrow in Illinois. *Wilson Bulletin* 106:35-45.

Research in Illinois suggests that habitat-area is the most important factor influencing Henslow's sparrows in Illinois. Henslow's sparrow rarely were encountered on grasslands less than 100 ha. In large grassland areas Henslow's sparrows prefer areas having tall, dense vegetation with a high proportion of residual standing dead plant material. Prescribed burning and mowing removes the tall dense vegetation this species requires and significantly reduced bird densities within parts of grasslands that had been recently managed.

Herkert, J.R. 1994. The influence of habitat fragmentation on Midwestern grassland bird communities. *Ecological Applications* 4(3):461-471.

Research on grassland fragments in Illinois found that large grassland areas had significantly more breeding grassland bird species than small areas. Identifies five area-sensitive grassland bird species, savannah sparrow, grasshopper sparrow, Henslow's sparrow, bobolink, eastern meadowlark. Preliminary estimates of minimal area for the five area sensitive species ranged from 5 (eastern meadowlark) to 55 ha (Henslow's sparrow). Suggests that the absence of some area-sensitive grassland bird species from some small fragments may result, in part, from the absence of suitable nesting habitat.

Herkert, J.R., R.E. Szafoni, V.M. Kleen, and J.E. Schwegman. 1993. Habitat establishment, enhancement, and management for forest and grassland birds in Illinois. Illinois Department of Conservation, Natural Heritage Technical Publication #1. 20 pp. Provides guidelines for the management and restoration of grassland areas, including 15 specific grassland management recommendations.

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Higgins, K.F. 1986. A comparison of burn season effects on nesting birds in North Dakota mixed-grass prairie. *Prairie Naturalist* 18:219-228.

Compared the nest success of grassland nesting waterfowl on spring (June) and fall (August & September) burned areas in North Dakota. Nest success was greater in fall burned areas than in Spring burned areas. Recommends burning grasslands every 2-3 years, with a rotation of spring and fall burns.

Higgins, K.F., T.W. Arnold and R.M. Barta. 1984. Breeding bird community colonization of sown stands of native grasses in North Dakota. *Prairie Naturalist* 16:177-182.

Documents breeding bird use of three restored grassland areas in North Dakota.

Eight characteristic grassland birds (sedge wren, grasshopper sparrow, savannah sparrow, western meadowlark, bobolink, clay-colored sparrow, northern harrier, and upland sandpiper) colonized these areas during the second, third, and fourth growing seasons. The total number of passerine species in these recently established stands was comparable to numbers in other mature, upland grassland habitats in the region.

Hill, R.A. 1976. Host-parasite relationships of the brown-headed cowbird in a prairie habitat of west-central Kansas. *Wilson Bulletin* 88:555-565.

Research on cowbird parasitism rates on birds in west-central Kansas found all but one species of grassland birds to be moderately to heavily parasitized.

Parasitized nests fledged 66% less young than unparasitized nests.

Howe, R.W., D.M. Roosa, J.P. Schaufenbuel, and W.R. Silcock. 1985. Distribution and abundance of birds in the loess hills of western Iowa. *Proceedings of the Iowa Academy of Sciences* 92:164-175.

Examined the distribution and abundance of birds in the loess hills of western Iowa. Found that agricultural grasslands (brome or alfalfa hayfields) generally support a greater diversity of grassland species than did native prairies. Proposes that small habitat-area, steepness of slope, and other factors render today's prairie remnants poorly suited for grassland birds. Suggests that the best quality grasslands in the region probably occurred in lowlands or on gentle slopes, which today have been converted to agriculture.

Huber, G.E. and A.A. Steuter. 1984. Vegetation profile and grassland bird response to spring burning. *Prairie Naturalist* 16:55-61.

Research in mixed-prairie in South Dakota found that upland sandpipers, western meadowlarks, horned larks, and chestnut-collared longspurs favored burned areas whereas grasshopper sparrows, savannah sparrows and clay-colored sparrows favored unburned areas.

Hunter, W.C. 1990. Handbook for nongame bird management and monitoring in the southeast region. U.S. Fish and Wildlife Service, Atlanta, GA. 198 pp.

Provides information on habitat use and management recommendations for common barn-owls, loggerhead shrikes, Bachman's sparrows, and Henslow's sparrows in

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the southeastern United States. Identifies habitat loss, grazing, mining, and woody encroachment as the primary management problems for grasslands in the southeast.

Johnson, D.H. and M.D. Schwartz. 1993. The Conservation Reserve Program and grassland birds. *Conservation Biology* 7:934-937.

Reports on the results of censuses of CRP fields in eastern Montana, North Dakota, South Dakota, and western Minnesota. Found that a number of grassland birds that had exhibited significant population declines over the last 25 years were common in CRP fields in the region. Results demonstrates the value of CRP fields to grassland birds and suggests that the continuation of the CRP program in future Farm Bills has the potential to reverse the downward trends for these species.

Johnson, D.H. and M.D. Schwartz. 1993. The conservation reserve program: habitat for grassland birds. *Great Plains Research* 3:273.295.

Documents the colonization of Conservation Reserve Program fields in western Minnesota, North Dakota, South Dakota, and eastern Montana by relatively large numbers of grassland birds. Grasshopper sparrow, lark bunting, red-winged blackbird, western meadowlark, horned lark, savannah sparrow, brown-headed cowbird, bobolink, clay-colored sparrow, and common yellowthroat were the ten most abundant species (listed in order of decreasing abundance). Grassland birds numbers varied with respect to geographic location and annual effects suggesting significant annual shifts in distribution. No conservation practice was found to be uniformly better than another in terms of overall density of breeding birds, although certain practices seemed to favor certain species.

Johnson, R.G. and S.A. Temple. 1986. Assessing habitat quality for birds nesting in fragmented tallgrass prairies. Pp. 245-250 in Verner, J.A., M.L. Morrison, and C.J. Ralph, (eds). *Wildlife 2000*. University of Wisconsin Press. Madison.

Research in western Minnesota found grassland bird nest productivity to be highest in large prairie areas located far from a forest edge with one growing season since the vegetation was last burned. Grassland bird abundance was not highest in the areas identified as high quality (based on productivity). Management actions based solely on bird abundance would have favored areas of lower productivity. Suggests that many of these areas may be population sinks. Recommends management of prairie fragments be designed to provide areas that are devoid of forest edge and are frequently burned.

Johnson, R.G. and S.A. Temple. 1990. Nest predation and brood parasitism of tallgrass prairie birds. *Journal of Wildlife Management* 54:106-111

Rates of nest predation and brood parasitism on grassland bird species nesting in western Minnesota tallgrass prairie fragments were significantly influenced by prairie fragment size, distance from the nest to a wooded edge, and the number of growing seasons since the vegetation around the nest was last burned. Nest predation rates were lowest on large grasslands in areas that were far from a wooded edge. Nest predation rates were also lower in areas of prairie that had been recently burned (< 3 yr). Nest parasitism was greatest near wooded edges. Prairie management to maximize grassland bird nest success should provide

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large, regularly burned prairies with no nearby wooded edges.

Kahl, R.B., T.S. Baskett, J.A. Ellis, and J.N. Burroughs. 1985. Characteristics of summer habitats of selected nongame birds in Missouri. University of Missouri-Columbia, College of Agriculture, Agricultural Experiment Station, Research Bulletin 1056. 155 pp.

Describes characteristics of breeding bird habitats in Missouri. Reports that eastern meadowlarks, grasshopper sparrows and Henslow's sparrows all tended to avoid grassland areas with encroaching woody vegetation. Suggests that the presence of suitable song perches (low woody stems < 1 m or tall forbs) may affect habitat suitability of the Henslow's sparrow and grasshopper sparrow.

Kantrud, H.A. 1981. Grazing intensity effects on the breeding avifauna of North Dakota native grasslands. Canadian Field-Naturalist 95:404-417.

Compared bird densities in lightly, moderately, and heavily grazed and hayed native grasslands in North Dakota. Heavy grazing resulted in reduced species richness, and increased dominance by a few bird species. Horned larks and chestnut-collared longspurs were most abundant in heavily grazed areas. Baird's and grasshopper sparrows were most abundant on moderate to lightly grazed areas. Bobolink, savannah sparrow, sedge wren, and Le Conte's sparrow numbers were greatly reduced or eliminated by heavy grazing.

Kantrud, H.A. and K.F. Higgins. 1992. Nest and nest site characteristics of some ground-nesting, non-passerine birds of northern grasslands. Prairie Naturalist 24:67-84.

Summary of 29 years of nesting data from North Dakota, South Dakota, Montana, and Manitoba. Report fairly high nest success for several species, northern harrier (61%), upland sandpiper (67%), and short-eared owl (58%). Predation was the major cause of nest failure. Wild mammals destroyed the most nests (58%), followed by birds (4%), and unknown predators (38%). Nest success rates were consistent among native and seeded grasslands. Upland sandpipers had higher nest success in idle than grazed fields, and frequently nested in stands of introduced grasses. Northern harriers nested in undisturbed grasslands with an effective height greater than 55 cm. Northern harriers never nested where the dead vegetation was less than 12%. Short-eared owls nested most frequently in fields idled during previous growing seasons than in fields under long-term grazing regimes. Short-eared owls never nested in fields where livestock were present during the nesting season.

Kantrud, H.A. and R.L. Kologiski. 1982. Effects of soils and grazing on breeding birds of uncultivated upland grasslands of the northern great plains. USFWS, Wildlife Research Report 15. Washington, D.C.

Research in Montana, North Dakota, South Dakota, Nebraska, Colorado and Wyoming compared bird densities in lightly, moderately and heavily grazed native rangeland. Light to moderate grazing resulted in increased species richness. Horned larks responded positively to grazing, while densities of common yellowthroats, bobolinks, grasshopper sparrows, Baird's sparrows, and Brewer's sparrows were reduced by grazing. Mountain plovers appeared to be associated with heavily grazed areas. These data show that grazing influences breeding

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birds, but that this influence is variable among different soils and habitat types.

Kantrud, H.A. and R.L. Kologiski. 1983. Avian associations of the northern great plants grasslands. *Journal of Biogeography* 10:331-350.

Research found that moderate grazing resulted in greater bird species richness in nearly all subregions, however, the effects of grazing on total bird density were more variable. Found that bobolinks, western meadowlarks, and grasshopper, Baird's and clay-colored sparrows favored areas with light grazing; Sprauge's pipits, and savannah and vesper sparrows favored light-to-moderate grazing; mountain plovers, burrowing owls, and horned larks favored heavily grazed grasslands. Also reported, however, that several common bird species responded differently to grazing in different subregions, suggesting that the response of grassland bird species to grazing may be regionally dependent.

Kirsch, L.M. and A.D. Kruse. 1972. Prairie fires and wildlife. *Proceedings of the Tall Timbers Fire Ecology Conference* 12:289-303.

Found greater nest success and bird species richness on plots during the second growing season post fire than on undisturbed or grazed plots of similar size.

Kirsh, L.M. and K.F. Higgins. 1976. Upland sandpiper nesting and management in North Dakota. *Wildlife Society Bulletin* 4:16-22.

Upland sandpiper nest success was lowest on grazed areas and highest on prairie managed by prescribed burning. Former cropland seeded to domestic grass-legume mixtures was too dense for upland sandpipers. Recommends management toward preserving/restoring native grasslands that are burned at 3-year intervals, also suggests that early May burns may be most effective.

Knopf, F.L. 1994. Avian assemblages on altered grasslands. *Studies in Avian Biology* 15:247-257.

Presents data from the North American Breeding Bird Survey which show that grassland birds have shown steeper, more consistent and more widespread population declines over the last quarter century (1966-1991) than any other behavioral or ecological guild of U.S. bird species.

Kruse, A.D. and J.L. Piehl. 1986. The impacts of prescribed burning on ground nesting birds. *Proceedings of the North American Prairie Conference* 9:153-156.

Research in North Dakota documented that 69% of the active ground nests survived mid-June burns in mix-grass prairie in 1982 and 1984. However, three out of four active northern harrier nests were destroyed by fire.

Lingle, G.R. and P.A. Bedell. 1989. Nesting ecology of sedge wrens in Hall County, Nebraska. *Nebraska Bird Review* 57:47-49.

Observations in Nebraska found sedge wrens to be significantly more common in ungrazed pasture than grazed pasture.

Mankin, P.C. and R.E. Warner. 1992. Vulnerability of ground nests to predation on an agricultural habitat island in east-central

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Illinois. American Midland Naturalist 128:281-291.

Research in east-central Illinois found that predation on artificial ground nests was influenced by heterogeneity of vegetation and nest concealment. Distances from nests to field edges did not affect nest outcome. Suggests that dense prairie vegetation regrowth following burning may reduce nest predation rates.

Martin, T. E. 1993. Nest predation among vegetation layers and habitat types: revising the dogmas. American Naturalist 141:897-913.

Suggests that nest predation rates on ground-nesting birds are not universally higher than on off-ground-nesting birds. Although nest predation rates for ground-nesting forest birds may not be higher than off-ground-nesting species, predation rates for ground-nesting grassland birds do appear to be higher than off-ground-nesting grassland species. Nesting mortality in general was found to be greater in grassland and shrubland habitats than in forests.

Maurer, B.A. 1985. Avian community dynamics in desert grasslands: observational scale and hierarchical structure. Ecological Monographs 55:295-312.

Research conducted in desert grassland pastures in Arizona reports densities of loggerhead shrikes, grasshopper sparrows and Cassin's sparrows to be higher in grasslands with low mesquite tree densities, and densities of Bell's vireos were highest in grasslands with high mesquite densities.

Maurer, B.A. 1986. Predicting habitat quality for grassland birds using density-habitat correlations. Journal of Wildlife Management 50:556-566.

Suggests that bird species may not be as closely tied to habitat conditions as has been previously thought. Although some species appear to be associated consistently with some habitat variables, others exhibit a great deal of variation in habitat associations among geographic locations. Suggests that managers should view the associations of bird populations with habitats as site, or at least regionally, specific.

Meanly, B. 1963. Nesting ecology and habitats of the dickcissel on the Arkansas grand prairie. Wilson Bulletin:75:418-432.

Optimum dickcissel habitat in Arkansas was woody patches along roadsides bordering maturing oats fields.

Norris, R.T. 1947. The cowbirds of Preston Frith. Wilson Bulletin 59:83-103.

Research results from Pennsylvania suggest that the intensity of cowbird parasitism in fields may be related to alternative opportunities in the surrounding landscape. Research found that in early-May cowbirds tended to parasitize birds nesting in open country. Once forest birds began nesting in the adjacent woodlands in Mid-May, cowbirds shifted to parasitizing woodland species and rarely parasitized open-country birds.

Overmire, T.G. 1963. The effects of grazing upon habitat utilization of the dickcissel (*Spiza americana*) and Bell's vireo (*Vireo bellii*) in northcentral Oklahoma. Ph.D. thesis, Oklahoma State University, Stillwater.

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Found populations of dickcissels and Bell's vireos were 50% lower on grazed grassland than they were on ungrazed grasslands.

Owens, R.A. and M.T. Myers. 1973. Effects of agriculture upon populations of native passerine birds of an Alberta fescue grassland. *Canadian Journal of Zoology* 51:697-713.

Research in southern Alberta found that disturbance of native fescue grassland by mowing or grazing reduced or eliminated populations of Baird's sparrows and Sprague's pipits; did not influence populations of savannah sparrows, clay-colored sparrows, or western meadowlarks; and permitted the colonization of horned larks and chestnut-collared longspurs.

Paton, P.C. 1994. The effect of edge on avian nesting success: how strong is the evidence? *Conservation Biology* 8:17-26.

Evaluates existing empirical evidence on the effects of edge on breeding bird nest success. Found that a majority of studies found that nest predation and parasitism rates increased near edges. Also found that there was a consistent positive relationship between nest success and patch size. The most conclusive studies suggest that edge effects usually occur within 50 meters of an edge, whereas studies proposing that increased depredation rates extend further than 50 meters are less convincing.

Peterson, A. 1983. Observations on habitat selection by Henslow's sparrow in Broome County, New York. *Kingbird* 33:155-163.

Study in New York found Henslow's sparrows to inhabit a range of tall herbaceous communities in a variety of moisture regimes. Henslow's sparrows were found only in large fields, with virtually no woody invasion, and sweeping panoramic views. Suggests that even a single tree line or forest edge at a short distance may preclude occupancy by this species. Grasslands in valley bottoms, with hills, or surrounded by treelines were never occupied.

Prescott, D.R.C., and D.M. Collister. 1993. Characteristics of occupied and unoccupied loggerhead shrike territories in southeastern Alberta. *Journal of Wildlife Management* 57:346-352.

Examines habitat use by loggerhead shrikes in southeastern Alberta. Found occupied areas to contain a higher percentage of tall (>20 cm) grass, and to have a higher mean height of grass than unoccupied areas. Suggests that loggerhead shrikes may be limited by habitat in southeastern Alberta, and that the availability of suitable habitat could be increased by management practices that increase the prevalence of tall grass, such as reducing grazing pressure.

Pylypec, B. 1991. Impacts of fire on bird populations in a fescue prairie. *Canadian Field-Naturalist* 105:346-349.

Research on the effects of fire on bird populations in a Saskatchewan fescue grassland. Populations of the two most common grassland species, savannah sparrow and clay-colored sparrow, were both adversely affected by the burn. Sprague's pipits and western meadowlark were also adversely affected initially by the burn but by the third year, population densities in the burned and unburned areas were comparable. Baird's sparrows did not use the burned area in the first year. In the second year post fire, Baird's sparrow numbers increased, and in the third post-burn year densities were identical in burned and unburned areas. Only the vesper sparrow showed a preference for the burned

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area in the first year after the burn.

Renken R.B. and J.J. Dinsmore. 1987. Nongame bird communities on managed grasslands in North Dakota. *Canadian Field Naturalist* 101:551-557.

Research in North Dakota compared densities of nongame birds among grazed and idle native prairie and planted alfalfa-wheatgrass habitats. Each habitat supported prairie bird species unique to that habitat type. Recommends the incorporation of a mixture of grassland habitat types into management plans in order to support all members of the mixed-grass prairie bird community.

Robins, J.D. 1971. A study of the Henslow's sparrow in Michigan. *Wilson Bulletin* 83:39-48.

Characterizes Henslow's sparrow habitat requirements in southern Michigan as having an intermediate moisture range, vegetation dominated by herbaceous plants particularly grasses and sedges, which is dense or, at least, with frequent dense patches, presence of litter, and singing perches. Nest success was low, only 37% of all nests or young found successfully fledged.

Roseberry, J.T. and W.D. Klimstra. 1970. The nesting ecology and reproductive performance of the eastern meadowlark. *Wilson Bulletin* 82:243-267.

Research in southern Illinois documented very low nest success (30.5%) for eastern meadowlarks. Highest densities were recorded in pastures (20.9 birds/100 acres), hayfields (12.6), and soilbank fields (5.1). Predation and mowing were the primary destructive agents of nests, destroying 51% and 12% of all nests respectively.

Rotenberry, J.T. and J.A. Wiens. 1989. Reproductive biology of shrubsteppe passerine birds: geographical and temporal variation in clutch size, brood size, and fledgling success. *Condor* 91:1-14.

Examined geographic variability of reproductive success in three shrubsteppe passerines in the northern Great Basin of western North America. Found that regional differences in reproductive success were associated with site specific variation in nest predation rates and were attributable to differences in the abundances of snakes. Nests at a site that lacked snakes suffered virtually no predation, whereas birds in other areas lost 40-93% of their nest to predation.

Ryan, M.R. 1986. Nongame management in grassland and agricultural ecosystems. Pp. 117-136. in J.B. Hale, L.B. Best, R.L. Clawson (eds). *Management of Nongame Wildlife in the Midwest: A Developing Art*. The Wildlife Society. 171 p.

Describes the pristine prairie as a mosaic of habitat types that comprise a continuum of vegetative conditions, with cover types varying from short, sparse habitat to tall, dense growth. Suggests that conservation of prairie wildlife requires the management of grassland ecosystems so that all aspects of the continuum are provided. Also suggests that grassland management decisions be made on a state or regional basis, with the size of habitat units influencing management options. Recognizes prescribed fire and grazing as the

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primary tools for managing grassland habitats.

Ryan, M.R. 1990. A dynamic approach to the conservation and management of the prairie ecosystem in the Midwest. Pp 93-106 in J.M. Sweeney, (ed). Management of Dynamic Ecosystems. North Central Section, The Wildlife Society, West Lafayette, IN.

Portrays the prairie ecosystem as a two-dimensional continuum along interrelated gradients of soil moisture, and fire and grazing frequency and intensity. Suggests that to conserve the biotic diversity of the prairie ecosystem a variety of grassland habitats must be conserved.

Samson, F.B. 1980. Island biogeography and the conservation of prairie birds. Proceedings of the North American Prairie Conference. 7:293-305.

Research on prairie fragments in Missouri (1-500 ha) showed that the number of breeding grassland birds is significantly correlated with fragment size. Identifies the Henslow's sparrow, upland sandpiper and greater prairie-chicken as particularly sensitive to reductions in grassland area.

Samson, F.B. 1980. Island Biogeography and the conservation of nongame birds. Transactions of the North American Wildlife and Natural Resources Conference 45:245-251.

Suggests that size of habitat be emphasized in the conservation of nongame birds. Based on research in Missouri, provides preliminary estimates of minimum habitat requirements to maintain viable breeding populations. Estimates that greater prairie chickens need more than 100 ha of grassland habitat, and that northern harriers, upland sandpipers, sedge wrens, Henslow's sparrows, vesper sparrows and lark sparrows need 10-100 ha of grassland habitats.

Skinner, R.M. 1975. Grassland use patterns and prairie bird populations in Missouri. Pp. 171-180 in M.K. Wali (ed). Prairie: a Multiple View.

Compares breeding bird use on native and non-native grassland areas in northern and western Missouri. Shows that idle grasslands had the fewest species and individuals of all grassland areas studied. Only sedge wrens and Henslow's sparrows were abundant in idle grasslands. Hayed and seed-combined fields had more species than idle fields. Seed-combined fields provided better habitat for Henslow's sparrows than hayed grasslands, but hayed fields were more attractive to upland sandpipers, eastern meadowlarks, and grasshopper sparrows. Grazed fields had more individuals and more species than hayfields, combined fields, or idle fields. Sedge wren and Henslow's sparrow numbers were directly related to grass height. Upland sandpiper, eastern meadowlark, bobolink, and grasshopper sparrow numbers were greatest where grass heights were between 10 and 30 cm. Forb abundance significantly influenced grassland bird abundance especially in grazed grasslands. However, when forbs become dominant the number of grassland birds declined greatly.

Skinner, R.M., T.S. Baskett, and M.D. Blenden. 1984. Bird habitat on Missouri prairies. Terrestrial Series #14. Missouri Department of Conservation. Jefferson City, MO. 42 pp.

Research on habitat selection of grassland birds in southwestern Missouri tallgrass prairies, found that grassland bird species differed widely in

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selection of cover, with most species observed in only a small segment of the spectrum of available cover types. Recommends that managers provide a wide range of cover types for grassland birds including areas with short, sparse vegetation as well as areas with tall, dense cover. Grazing was judged to be the most versatile management practice, with stocking rates being adjusted to provide tall to short cover conditions. Hayed grassland appeared to support fewer bird species and individuals than grazed grasslands. Prescribed April fires had a significant but short-lived effect on grassland bird populations when compared with grazing and haying. Idle grasslands were desirable habitat for Henslow's sparrows and sedge wrens. Moderate grazing favored populations of grasshopper sparrows, greater prairie-chickens, and eastern meadowlarks, and heavy grazing favored upland sandpipers, eastern meadowlarks, and horned larks.

Smith, C.R. 1991. Partners in Conservation. Living Bird Quarterly. Spring 1991:16-20.

Discusses research on grassland birds in New York that found that savannah sparrows were fairly general in their habitat selection using pastures of all sizes and qualities. Eastern meadowlarks were more particular, favoring pastures of 50 acres or more. Henslow's sparrows preferred high-quality, tallgrass pastures at least 70 acres in size. Grasshopper sparrows also required large pastures but with shorter grass than Henslow's sparrows.

Smith, C.R. 1992. Henslow's sparrow, *Ammodramus henslowi*. Pp. 315-330 in K.J. Schneider and D.M. Pence, (eds). Migratory Birds of Management Concern in the Northeast. U.S. Department of Interior, Fish and Wildlife Service, Newton Corner, Massachusetts. 400 pp.

In the Northeast, Henslow's sparrows breed in hayfields, pastures, wet meadows, dry saltmarsh areas, and old grassy fields. Recommends protection of breeding areas from disturbance from mid-May through August. Management regimes that produce dense, tall (> 30cm) vegetation should be considered for this species. Recommends the removal of woody vegetation from Henslow's sparrow breeding areas. Also recommends preservation of 30 ha or more of contiguous grassland habitat for Henslow's sparrow conservation.

Smith, E.L. and K.C. Kruse. 1992. The relationship between land-use and the distribution and abundance of loggerhead shrikes in south-central Illinois. Journal of Field Ornithology 63:420-427. Research in south-central Illinois found loggerhead shrikes to be most common near pastures, hedgerows, cornfields, and residential homes and their lawns. Also showed that shrike abundance was positively correlated with the amount of pasture-hay meadows and covercrops and negatively correlated with the amount of harvested cropland and woodland.

Steigman, K. 1990. Factors affecting dickcissel nesting success on parkhill prairie. Proceedings of the North American Prairie Conference 12:61-62.

Study in north-central Texas reports low nest success (14-30%) for dickcissel due to high rates of nest predation. Predation by snakes was believed to have destroyed nearly 65% of all dickcissel nests. Only three of 119 nests (<3%) were parasitized by brown-headed cowbirds.

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Tate, J., Jr. 1986. The blue list for 1986. *American Birds* 40:227-236.

The National Audubon Society's "early warning" list for birds. Grassland birds included on the 1986 (still the most recent) Blue List include: northern harrier, upland sandpiper, short-eared owl, loggerhead shrike, grasshopper sparrow, and Bachman's sparrow. Additionally, the following grassland birds were listed as of Special Concern: Swainson's Hawk, common barn-owl, burrowing owl, sedge wren, eastern meadowlark, dickcissel, and Henslow's sparrow.

Telfer, E.S. 1992. Habitat change as a factor in the decline of the western Canadian loggerhead shrike, *lanius ludovicianus*, population. *Canadian Field-Naturalist* 106:321-326.

Reports on field studies of habitat use by shrikes on their breeding range in Alberta and Saskatchewan and on winter range in Texas. Results confirm this species preference for short grass pastures. Regions of Alberta and Saskatchewan showing large shrike declines have lost more pasture area than regions where shrike populations have been less severe. In probable shrike winter range in Texas, pasture area has also declined due to encroachment by cropland and brush invasion. Suggests that in both Canada and Texas, loggerhead shrike management requires the preservation and enhancement of remaining grasslands.

Tester, J.R. and W.M. Marshall. 1961. A study of certain plant and animal interrelations on a native prairie in northwestern Minnesota. *Minnesota Museum of Natural History Occasional Papers* 8:1-51.

Study suggests that the distribution of bobolinks and savannah sparrow in native prairie habitat in Minnesota is influenced most by the presence of litter. Bobolinks were not located in areas where burning had removed a significant amount of litter. Suggests that savannah sparrows may require more than two years of litter accumulation following fire.

Toland, B.R. 1986. Nesting ecology of northern harriers in southwest Missouri. *Transactions of the Missouri Academy of Science* 20:49-57.

Describes characteristics of northern harrier nesting habitat in southwestern Missouri. Found fourteen of fifteen nests in patches of dense vegetation composed almost entirely of blackberry. Nesting success was higher for pairs nesting in idled (unburned) sections of the park than in managed (burned) sections.

Tyler, J.D. 1992. Nesting ecology of the loggerhead shrike in southwestern Oklahoma. *Wilson Bulletin* 104:95-104.

Reports on four years (1985-1988) of research in southwestern Oklahoma found shrikes to prefer Osage orange, hackberry, elm, and red cedar trees for nesting. Reports relatively low nest success, only 46% of all nests studied survived from the start of incubation to until fledging. Nest success varied among years apparently in response to changes in precipitation patterns. Concludes that local nesting habitat appeared to be relatively abundant, so explanations for the shrikes gradually failing numbers must be sought elsewhere.

United States Fish and Wildlife Service, Office of Migratory Bird Management. 1987. Migratory nongame birds on management concern in the U.S.: the 1987 list. USFWS, Washington D.C.

Identifies 30 species of nongame migratory birds which are currently of management concern at the National level because of documented or apparent population declines, small or restricted populations, or dependence on restricted or vulnerable habitats. The list includes six grassland bird species: northern harrier, common barn-owl, loggerhead shrike, Bachman's sparrow, Baird's sparrow, and Henslow's sparrow.

Vance, D.R., and R.L. Westemeier. 1979. Interactions of pheasants and prairie chickens in Illinois. Wildlife Society Bulletin 7:221-225.

Documents aggressive harassment of prairie chickens by cock pheasants, and suggests that on small booming grounds pheasants can easily disrupt the grounds to the extent that breeding could be delayed or prevented. Also documents nest parasitism of prairie chicken nests by hen pheasants, and a significant reduction in prairie chicken nest success as a result of this parasitism. Suggests that prairie chicken-pheasant interactions may have contributed to the decline of prairie chickens in the range of the pheasant.

Vickery, P.D. 1992. A regional analysis of endangered, threatened, and special concern birds in the northeastern U.S. Transactions of the Northeastern Section of the Wildlife Society 48:1-10.

A review of state listing of endangered, threatened, and special concern birds for New England and New York found two grassland birds (upland sandpiper and grasshopper sparrow) to be listed in all seven states. Also found that grassland and islands with colonial nesting birds supported the largest number of species in jeopardy in the region.

Vickery, P.D., M.L. Hunter Jr., and J.V. Wells. 1992. Is density an indicator of breeding success? Auk 109:706-710.

Research on grasslands in Maine found no clear correlation between high territory density and high reproductive success. Grasshopper sparrows were most successful in medium density plots, and did poorly when territory density was low. Savannah sparrows were significantly more successful at low density, and were least successful at high density. Vesper sparrow reproductive success was unaffected by territory density.

Vickery, P.D., M.L. Hunter Jr., J.V. Wells. 1992. Evidence of incidental nest predation and its effects on nests of threatened grassland birds. Oikos 63:281-288.

Examined nest predation rates of birds nesting in grasslands in Maine. Nest predation rates were not significantly correlated with vegetation physiognomy or distance to forest border. Predation on grassland bird eggs and nestlings was, however, positively correlated with foraging for invertebrates by striped skunks. Although nest predation rates at this site were high (58%), Skunk predation appeared to be incidental, rather than targeted toward bird nests. Suggests that incidental nest losses of grassland birds can severely limit recruitment, and thus populations, of rare or endangered species.

Volkert, W.K. 1992. Response of grassland birds to a large-scale prairie planting project. *The Passenger Pigeon* 54:191-196.

Documents grassland bird colonization of prairie restorations in southern Wisconsin. Within 2-3 years after planting grasshopper sparrows, bobolinks and eastern meadowlarks had colonized these restorations, and within 4-5 years had established sizable, apparently stable populations. Much of the success of this restoration is apparently attributable to the diverse structure of these restorations, a result of the use of a mixture of native grasses and forbs and the maintenance of structural diversity by the usage of a compartmentalized burning schedule. Provides convincing evidence that populations of declining grassland birds can benefit from the creation/restoration of grassland habitat.

White, R.P. 1983. Distribution and habitat preference of the upland sandpiper (*Bartramia longicauda*) in Wisconsin. *American Birds* 37:16-22.

A review of nest card records and the literature, suggests that upland sandpipers are over five times as likely to nest in grazed or burned pasture than they are in ungrazed or unburned pasture.

Whitmore, R.C. 1981. Structural characteristics of grasshopper sparrow habitat. *Journal of Wildlife Management* 45:811-814.

Study recommends management to maintain grasslands in an early successional stage with low vegetation density, litter depth and cover, and low shrub cover. Recommends that restorations of disturbed sites for grasshopper sparrows should be to bunch grasses. Also recommends avoiding shrub or tree plantings in restorations designed to benefit grasshopper sparrows.

Wiens, J.A. 1969. An approach to the study of ecological relationships among grassland birds. *Ornithological Monographs* No. 8.

Research in southern Wisconsin showed that grassland birds were variable in their habitat preferences with some species preferring short, sparse vegetation (e.g., vesper sparrow) and others preferring dense, tall vegetation (Henslow's sparrow, bobolink). Territories of some species (eastern meadowlark, bobolink, vesper sparrow) sometimes included trees or fence lines, but others (Henslow's sparrow, western meadowlark, savannah sparrow) did not. Territories of all species tended to be located farther away from trees than either fence lines or cultivated fields.

Wiens, J.A. 1973. Pattern and process in grassland bird communities. *Ecological Monographs* 43:237-270.

Research in grassland areas in Colorado, Montana, South Dakota, Texas, Oklahoma, and New Mexico found that local plot-to-plot differences associated with grazing intensity were more important than regional differences in determining bird species abundance and distribution patterns. Ungrazed or lightly grazed plots appeared to have slightly more species and greater species diversity than heavily grazed plots. Horned larks densities were greatest in grazed plots, western meadowlarks and grasshopper sparrows were more numerous on ungrazed plots. In short-grass prairie in Colorado, mountain plover productivity was greatest in heavily grazed areas; western meadowlark

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productivity was greatest in areas receiving moderate to light winter grazing.

Wilson, S.D. and J.W. Belcher. 1989. Plant and bird communities of native prairie and introduced Eurasian vegetation in Manitoba, Canada. *Conservation Biology* 3:39-44.

Examines the impact of introduced plants on bird communities in a mosaic of North American mixed-grass prairie and Eurasian vegetation. The total number of birds did not vary between vegetation types. Two out of eight bird species, upland sandpiper and Sprague's pipit, were significantly more abundant in native prairie than in introduced vegetation. No bird species were significantly more common in introduced vegetation. Two bird communities were identified. The first group (western meadowlark, upland sandpiper, Sprague's pipit, Baird's sparrow, and savannah sparrow) was positively correlated with native plant species and negatively correlated with introduced plants, a second group (vesper sparrow, clay-colored sparrow, and grasshopper sparrow) were negatively correlated with native plant species and positively correlated with introduced plant species.

Wray, T., III, K.A. Strait and R.C. Whitmore. 1982. Reproductive success of grassland sparrows on a reclaimed surface mine in West Virginia. *Auk* 99:157-164.

Research in West Virginia documents fairly high rates of nest predation (43% of all nests) on a grassland study area that was surrounded by woodlots and pastureland. Black racers and common crows were the major predators. Data suggests that adults are not replacing themselves and immigration is necessary to maintain a stable population.

Yosef, R. 1994. The effects of fencelines of the reproductive success of loggerhead shrikes. *Conservation Biology* 8:281-285. Study in Florida found that loggerhead shrikes nesting in fencelines suffered higher nest losses than shrikes nesting in pasture habitats. Documents a significant relationship between nest survivability and distance from fenceline. Concludes that hedgerows and fencelines are not necessarily optimal or even adequate nesting habitat for loggerhead shrikes, and points out that it is important to distinguish habitats that are population "sinks" and to delineate the factors that make them so.

Zimmerman, J.L. 1971. The territory and its density dependent effect in *Spiza americana*. *Auk* 88:591-612.

Found that two factors were most important in dickcissel habitat selection, presence of song perches and a sufficiently tall and dense cover of herbaceous vegetation.

Zimmerman, J.L. 1982. Nesting success of dickcissels (*Spiza americana*) in preferred and less preferred habitats. *Auk* 99:292-298.

Research in Kansas found no significant difference for nest success of dickcissels nesting in old-field and prairie habitats.

Zimmerman, J.L. 1983. Cowbird parasitism of dickcissels in different habitats and at different nest densities. *The Wilson Bulletin* 95:7-22.

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Research in Kansas found both the frequency and intensity of cowbird parasitism to be greater in prairie populations than in oldfield populations. The major effect of parasitism on dickcissel productivity was the removal of host eggs by the cowbird that resulted in a significant reduction in the numbers of dickcissels fledged from parasitized nests. The frequency of cowbird parasitism was found to be inversely associated with the density of available nests.

Zimmerman, J.L. 1984. Nest predation and its relationship to habitat and nest density in dickcissels. *The Condor* 86:68-72.

Research on dickcissels in Kansas found that predation rates in old-field habitats were higher than those in prairie habitats. Suggest that the higher predation rates in old-fields may be due to a greater abundance of predators, primarily snakes.

Zimmerman, J.L. 1988. Breeding season habitat selection by the Henslow's sparrow (*Ammodramus henslowii*) in Kansas. *Wilson Bulletin* 100:17-24.

Research in Kansas showed that Henslow's sparrows avoid prairie areas that had been burned in the Spring. Henslow's sparrow territories had greater coverage of standing dead vegetation, lesser cover by woody vegetation, and taller live grasses than areas without Henslow's sparrows.

Zimmerman, J.L. 1992. Density-independent factors affecting the avian diversity of the tallgrass prairie community. *Wilson Bulletin* 104:85-94.

Research on tallgrass prairie in Kansas found densities of upland sandpipers to be nearly twice as high in recently burned areas than in unburned prairie, and Henslow's sparrows to be restricted to unburned prairie areas. Dickcissels, grasshopper sparrows, and eastern meadowlarks exhibited slightly higher densities (13-22% higher) in burned prairie areas.

Zimmerman, J.L., and E.J. Finck. 1982. Success in a secondary habitat: the dickcissel in the tallgrass prairie. *Proceedings of the North American Prairie Conference* 8:47-49.

Reports that dickcissel densities are five times as high in oldfields than in tallgrass prairie habitat. Due to low density of dickcissel nests in prairie habitat, nests are more frequently parasitized by Brown-headed cowbirds than nests in oldfields. However, dickcissel nests in oldfields had a greater chance of being destroyed by predators than nests in prairie. The trade off between these two factors resulted in similar overall productivity in these two habitats.

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