University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

USGS Northern Prairie Wildlife Research Center Wildlife Damage Management, Internet Center for

1-1-2002

Effects of Management Practices on Grassland Birds: Clay-Colored Sparrow

Jill A. Dechant

Marriah L. Sondreal

Douglas H. Johnson

Lawrence D. Igl

Christopher M. Goldade

See next page for additional authors

Follow this and additional works at: http://digitalcommons.unl.edu/usgsnpwrc

Part of the Other International and Area Studies Commons

Dechant, Jill A.; Sondreal, Marriah L.; Johnson, Douglas H.; Igl, Lawrence D.; Goldade, Christopher M.; Nenneman, Melvin P.; and Euliss, Betty R., "Effects of Management Practices on Grassland Birds: Clay-Colored Sparrow" (2002). *USGS Northern Prairie Wildlife Research Center*. Paper 121.
http://digitalcommons.unl.edu/usgsnpwrc/121

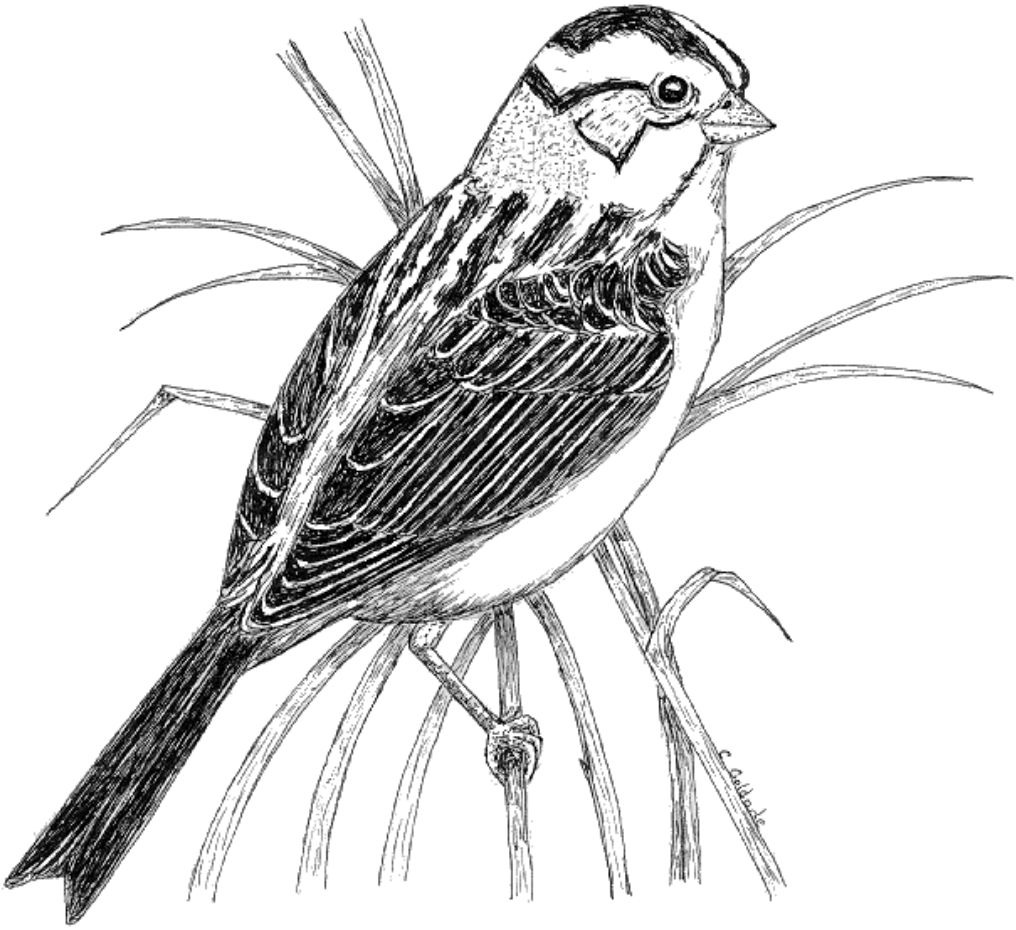
This Article is brought to you for free and open access by the Wildlife Damage Management, Internet Center for at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in USGS Northern Prairie Wildlife Research Center by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Authors
Jill A. Dechant, Marriah L. Sondreal, Douglas H. Johnson, Lawrence D. Igl, Christopher M. Goldade, Melvin P. Nenneman, and Betty R. Euliss

This article is available at DigitalCommons@University of Nebraska - Lincoln: http://digitalcommons.unl.edu/usgsnpwrc/121

EFFECTS OF MANAGEMENT PRACTICES ON GRASSLAND BIRDS:

CLAY-COLORED SPARROW



Grasslands Ecosystem Initiative
Northern Prairie Wildlife Research Center
U.S. Geological Survey
Jamestown, North Dakota 58401

This report is one in a series of literature syntheses on North American grassland birds. The need for these reports was identified by the Prairie Pothole Joint Venture (PPJV), a part of the North American Waterfowl Management Plan. The PPJV recently adopted a new goal, to stabilize or increase populations of declining grassland- and wetland-associated wildlife species in the Prairie Pothole Region. To further that objective, it is essential to understand the habitat needs of birds other than waterfowl, and how management practices affect their habitats. The focus of these reports is on management of breeding habitat, particularly in the northern Great Plains.

Suggested citation:

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, M. P. Nenneman, and B. R. Euliss. 1998 (revised 2002). Effects of management practices on grassland birds: Clay-colored Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 22 pages.

Species for which syntheses are available or are in preparation:

American Bittern
Mountain Plover
Marbled Godwit
Long-billed Curlew
Willet
Wilson's Phalarope
Upland Sandpiper
Greater Prairie-Chicken
Lesser Prairie-Chicken
Northern Harrier
Swainson's Hawk
Ferruginous Hawk
Short-eared Owl
Burrowing Owl
Horned Lark
Sedge Wren
Loggerhead Shrike
Sprague's Pipit
Grasshopper Sparrow
Baird's Sparrow
Henslow's Sparrow
Le Conte's Sparrow
Nelson's Sharp-tailed Sparrow
Vesper Sparrow
Savannah Sparrow
Lark Sparrow
Field Sparrow
Clay-colored Sparrow
Chestnut-collared Longspur
McCown's Longspur
Dickcissel
Lark Bunting
Bobolink
Eastern Meadowlark
Western Meadowlark
Brown-headed Cowbird

EFFECTS OF MANAGEMENT PRACTICES ON GRASSLAND BIRDS:

CLAY-COLORED SPARROW

Jill A. Dechant, Marriah L. Sondreal, Douglas H. Johnson, Lawrence D. Igl,
Christopher M. Goldade, Melvin P. Nenneman, and Betty R. Euliss

Series Coordinator: Douglas H. Johnson
Series Assistant Coordinator: Lawrence D. Igl

Reviewers: Richard W. Knapton and Stephanie L. Jones

Range Map: Jeff T. Price

Cover Art: Christopher M. Goldade

Major Funding: Prairie Pothole Joint Venture, U.S. Fish and Wildlife Service
U.S. Geological Survey

Funding also provided by: U.S. Forest Service

Collaborators:

Louis B. Best, Iowa State University
Carl E. Bock, University of Colorado
Brenda C. Dale, Canadian Wildlife Service
Stephen K. Davis, Saskatchewan Wetland Conservation Corporation
James J. Dinsmore, Iowa State University
James K. Herkert, Illinois Endangered Species Protection Board
Fritz L. Knopf, Midcontinent Ecological Science Center
Rolf R. Koford, Iowa Cooperative Fish and Wildlife Research Unit
David R. C. Prescott, Alberta NAWMP Centre
Mark R. Ryan, University of Missouri
David W. Sample, Wisconsin Department of Natural Resources
David A. Swanson, Ohio Division of Wildlife
Peter D. Vickery, Massachusetts Audubon Society
John L. Zimmerman (retired), Kansas State University

February 1998
(revised January 2002)

ORGANIZATION AND FEATURES OF THIS SPECIES ACCOUNT

Information on the habitat requirements and effects of habitat management on grassland birds were summarized from information in more than 4,000 published and unpublished papers. A ***range map*** is provided to indicate the relative densities of the species in North America, based on Breeding Bird Survey (BBS) data. Although birds frequently are observed outside the breeding range indicated, the maps are intended to show areas where managers might concentrate their attention. It may be ineffectual to manage habitat at a site for a species that rarely occurs in an area. The species account begins with a brief ***capsule statement***, which provides the fundamental components or keys to management for the species. A section on ***breeding range*** outlines the current breeding distribution of the species in North America, including areas that could not be mapped using BBS data. The ***suitable habitat*** section describes the breeding habitat and occasionally microhabitat characteristics of the species, especially those habitats that occur in the Great Plains. Details on habitat and microhabitat requirements often provide clues to how a species will respond to a particular management practice. A ***table*** near the end of the account complements the section on suitable habitat, and lists the specific habitat characteristics for the species by individual studies. A special section on ***prey habitat*** is included for those predatory species that have more specific prey requirements. The ***area requirements*** section provides details on territory and home range sizes, minimum area requirements, and the effects of patch size, edges, and other landscape and habitat features on abundance and productivity. It may be futile to manage a small block of suitable habitat for a species that has minimum area requirements that are larger than the area being managed. The Brown-headed Cowbird (*Molothrus ater*) is an obligate brood parasite of many grassland birds. The section on ***cowbird brood parasitism*** summarizes rates of cowbird parasitism, host responses to parasitism, and factors that influence parasitism, such as nest concealment and host density. The impact of management depends, in part, upon a species' nesting phenology and biology. The section on ***breeding-season phenology and site fidelity*** includes details on spring arrival and fall departure for migratory populations in the Great Plains, peak breeding periods, the tendency to renest after nest failure or success, and the propensity to return to a previous breeding site. The duration and timing of breeding varies among regions and years. ***Species' response to management*** summarizes the current knowledge and major findings in the literature on the effects of different management practices on the species. The section on ***management recommendations*** complements the previous section and summarizes specific recommendations for habitat management provided in the literature. If management recommendations differ in different portions of the species' breeding range, recommendations are given separately by region. The ***literature cited*** contains references to published and unpublished literature on the management effects and habitat requirements of the species. This section is not meant to be a complete bibliography; a searchable, annotated bibliography of published and unpublished papers dealing with habitat needs of grassland birds and their responses to habitat management is posted at the Web site mentioned below.

This report has been downloaded from the Northern Prairie Wildlife Research Center World-Wide Web site, www.npwrc.usgs.gov/resource/literatr/grasbird/grasbird.htm. Please direct comments and suggestions to Douglas H. Johnson, Northern Prairie Wildlife Research Center, U.S. Geological Survey, 8711 37th Street SE, Jamestown, North Dakota 58401; telephone: 701-253-5539; fax: 701-253-5553; e-mail: Douglas_H_Johnson@usgs.gov.

CLAY-COLORED SPARROW
(*Spizella pallida*)

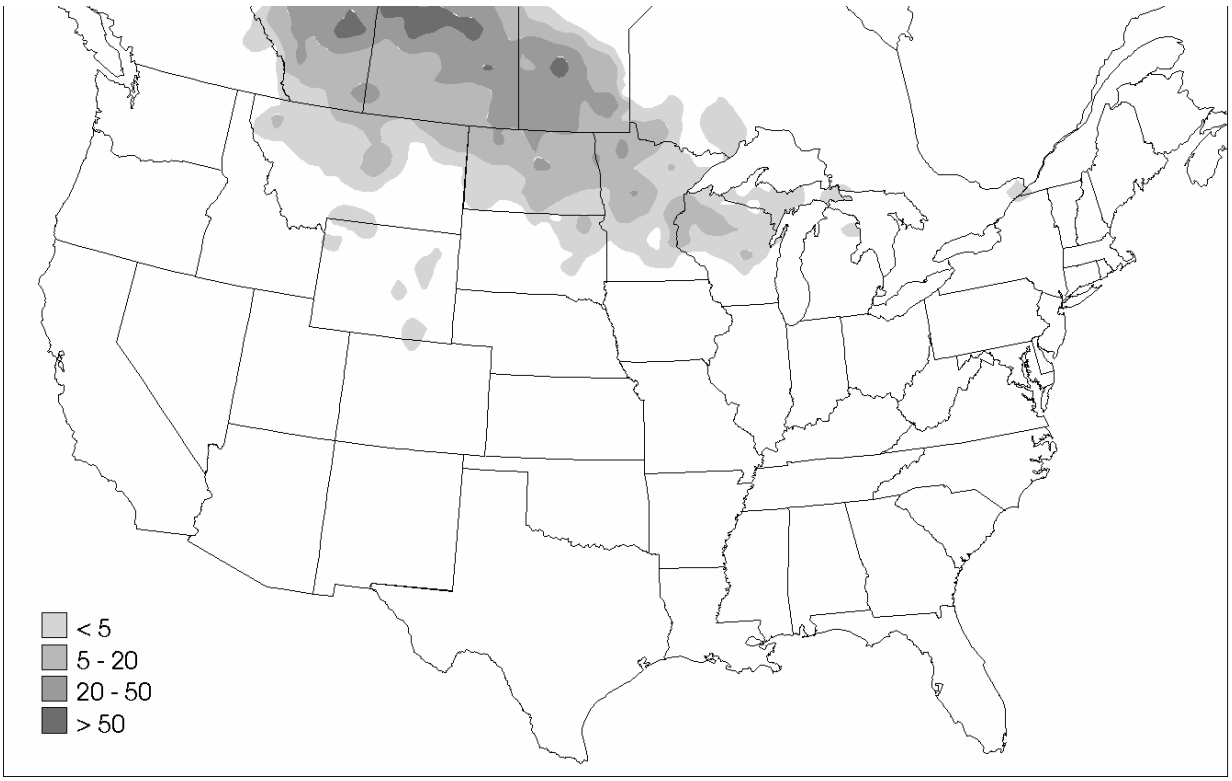


Figure. Breeding distribution of the Clay-colored Sparrow in the United States and southern Canada, based on Breeding Bird Survey data, 1985-1991. Scale represents average number of individuals detected per route per year. Map from Price, J., S. Droege, and A. Price. 1995. The summer atlas of North American birds. Academic Press, London, England. 364 pages.

Keys to management include providing shrubby grasslands and woody edges or thick, densely vegetated grasslands in shrubless areas.

Breeding range:

Clay-colored Sparrows breed from southern Northwest Territories south through eastern British Columbia and southwestern Ontario to western Wyoming and northern Nebraska, and east to southeastern Ontario (National Geographic Society 1987). (See figure for the relative densities of Clay-colored Sparrows in the United States and southern Canada, based on Breeding Bird Survey data.)

Suitable habitat:

Clay-colored Sparrows nest in residual vegetation on the ground or low (usually ≤50 cm high) in small trees and shrubs (Peabody 1899, Walkinshaw 1939, Smith and Smith 1966, Root 1968, Stewart 1975, Knapton 1978). In Manitoba, Clay-colored Sparrows preferred to nest in western snowberry (*Symphoricarpos occidentalis*), which provided better concealment and less light penetration than other shrub species (Knapton 1978). In southcentral Saskatchewan, high densities were found in grazed pastures with shrubs (Dale 1983); in southern Saskatchewan,

occurrence was negatively associated with distance from nest to shrub, and positively associated with narrow-leaved (<5 mm wide) grasses 10-30 cm high (SWCC 1997). In North Dakota, abundance of Clay-colored Sparrows was positively associated with density of low-growing shrubs and plant communities dominated by shrubs (western snowberry and silverberry [*Elaeagnus commutata*]) and introduced grasses (smooth brome [*Bromus inermis*], Kentucky bluegrass [*Poa pratensis*], and quackgrass [*Agropyron repens*]) (Schneider 1998). Abundance was negatively associated with plant communities dominated solely by shrubs, by native grass (*Stipa*, *Bouteloua*, *Koeleria*, and *Schizachyrium*), or by wet-meadow vegetation. Strongest vegetational predictor of the presence of Clay-colored Sparrows was increasing cover of low-growing shrubs. Clay-colored Sparrows in aspen parkland of Alberta were most abundant in habitats with >50% shrub cover (Prescott et al. 1995). In central Wisconsin, Clay-colored Sparrows occupied territories that contained more habitat features with high nest cover value than were generally available (Munson 1992).

Breeding territories are commonly placed adjacent to suitable foraging areas. Clay-colored Sparrows prefer to forage in open areas with sparse, short vegetation, such as cropland and pastures (Knapton 1978, Dale 1983, Knapton 1994). Clay-colored Sparrows will use both native and tame vegetation (Peabody 1899, Walkinshaw 1939, Rand 1948, Fox 1961, Salt 1966, Root 1968, Stewart 1975, Renken 1983, Arnold and Higgins 1986, Munson 1992, Knapton 1994, Prescott and Murphy 1996, Davis and Duncan 1999). In fields enrolled in the Conservation Reserve Program (CRP) in North Dakota, Clay-colored Sparrow abundance exhibited a positive association with alfalfa (*Medicago sativa*) and sweet clover (*Melilotus* spp.), which may substitute for brushy vegetation (Johnson and Schwartz 1993*a*). In Saskatchewan, Clay-colored Sparrows were more numerous in native grasslands invaded by tame grasses than in pure stands of native grasslands, and occurrence was positively associated with western snowberry (Dale 1992). In Saskatchewan, Clay-colored Sparrows preferred native pastures to tame pastures of crested wheatgrass (*Agropyron cristatum*) or brome (*Bromus*), possibly because native pastures had more shrubs (primarily western snowberry) >10 cm high (Anstey et al. 1995, Davis and Duncan 1999). In Alberta, frequency of occurrence was similar among native and tame pastures (Prescott and Murphy 1996). In native pasture, Clay-colored Sparrows used areas characterized by high cover diversity; in tame pasture, they used areas characterized by high herbaceous biomass, moderate height variability, and high forb:grass ratio (Prescott and Murphy 1996). In Manitoba, Clay-colored Sparrow abundance was positively correlated with tame vegetation and negatively correlated with native vegetation (Wilson and Belcher 1989). In North Dakota, abundance of Clay-colored Sparrows was positively associated with percent forb cover, visual obstruction (vegetation height/density), litter depth, and vegetation density (Schneider 1998). Abundance was negatively associated with percent clubmoss (*Selaginella densa*) cover. A table near the end of the account lists the specific habitat characteristics for Clay-colored Sparrows by study.

<u>Area requirements</u>:

Nesting territories are relatively small, about 0.1 to 0.5 ha (Fox 1961, Salt 1966, Root 1968). In Manitoba, Knapton (1979) reported smaller territories of about 0.04-0.1 ha. Territory size and arrangement in relation to other territories may depend upon shrub cover; Clay-colored Sparrows nesting in areas with less dense brush cover may require larger territories (Knapton 1979). Although little area was needed for nesting, Clay-colored Sparrows required foraging

areas outside of defended nest territories (Knapton 1979, 1994). In southern Saskatchewan, the occurrence of Clay-colored Sparrows was negatively associated with area (SWCC 1997).

Nest success may be higher in larger, contiguous grassland areas. In Minnesota tallgrass prairie, nest depredation and Brown-headed Cowbird (*Molothrus ater*) brood parasitism decreased farther from woody edges, and nest depredation rates were lower on large (130-486 ha) than on small (16-32 ha) grasslands (Johnson and Temple 1990). The probability of encountering Clay-colored Sparrows was highest on small fragments near a forest edge; however, nest productivity was highest for nests far from a forest edge and 1 yr postburn (Johnson and Temple 1986).

Brown-headed Cowbird brood parasitism:

Clay-colored Sparrow nests are frequently parasitized by Brown-headed Cowbirds (Friedmann and Kiff 1985). Parasitism rates vary from 5% of 793 nests (M. Winter and D. H. Johnson, *unpublished data*) to 39% of 33 nests (Stewart 1975). Refer to Table 1 in Shaffer et al. (2003) for rates of cowbird brood parasitism. Clay-colored Sparrows may be multiply-parasitized (Peabody 1899, Knapton 1978, SWCC 1997) and may abandon parasitized nests (Fox 1961, Hill and Sealy 1994). Parasitism almost always results in lower Clay-colored Sparrow productivity (Fox 1961, Salt 1966, Root 1968, Knapton 1978, Buech 1982, Romig and Crawford 1995). In North Dakota, parasitized nests had significantly lower mean clutch size and mean fledging rate, and were significantly closer to the nearest perch site, than unparasitized nests (Romig and Crawford 1995). No nest located >52 m from a perch was parasitized. Mean height of nest above ground was not significantly different. In Saskatchewan, parasitized nests had less concealment cover than unparasitized nests (S. K. Davis, Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan, *unpublished data*).

Breeding-season phenology and site fidelity:

Clay-colored Sparrows breed from about late April to mid-August, and depart for the wintering grounds during August-October (Salt 1966, Root 1968, Knapton 1978, Stewart 1975, Janssen 1987). Second broods may be attempted, especially when breeding begins early. During one breeding season in Manitoba, pairs that successfully raised young in the first attempt did not renest (Knapton 1978). However, in the following year, more nests were initiated prior to 23 May, and 11 pairs attempted a second brood. In Minnesota, one male produced a second clutch with a second female after the clutch from the first mated female was depredated (M. Winter and D. H. Johnson, *unpublished data*).

In Manitoba, site fidelity was exhibited in both males and females (Knapton 1978). Return rates for males ranged from a low of 62% of 28 birds to a high of 85% of 33 birds over three years and two study sites. Return rates for females ranged from a low of 14% of 5 birds to a high of 29% of 5 birds. Of 52 Clay-colored Sparrows banded in Minnesota, one male and two females returned the year following banding (M. Winter and D. H. Johnson, *unpublished data*). Klimkiewicz and Futcher (1987) reported that a bird banded in North Dakota was recaptured 5 yr later in the same location where it was originally banded.

Species' response to management:

Intense fires which burn off shrubs have a negative short-term effect on Clay-colored Sparrows (Halvorsen and Anderson 1983, Huber and Steuter 1984, Madden 1996, Johnson 1997). In Saskatchewan, breeding densities in burned areas 3 yr postfire were one-third the

densities in unburned areas (Pylypec 1991). In South Dakota, the species avoided burned areas, preferring denser vegetation in a lightly-grazed, unburned area (Huber and Steuter 1984). Madden (1996) found that Clay-colored Sparrows in North Dakota mixed-grass responded negatively to fire, and were most abundant in areas unburned in >80 yr, compared to areas burned 0.5-8 yr ago. Clay-colored Sparrow numbers increased with the number of years since the most recent burn, suggesting that moderate and long fire return intervals would be most beneficial (Madden 1996, Johnson 1997, Madden et al. 1999). Burned areas which retained shrubs were used immediately after burning (Johnson 1997). In Wisconsin, however, burning of residual cover caused a 94% decline in Clay-colored Sparrow density after spring burning, even though no differences in shrub density were noted between burned and unburned areas (Halvorsen and Anderson 1983).

Although Clay-colored Sparrows will utilize hayland, it does not appear to be preferred habitat (Kantrud 1981, Anstey et al. 1995, Dale 1992, Prescott et al. 1995, Dale et al. 1997). In Alberta, Manitoba, and Saskatchewan, however, Clay-colored Sparrows occurred more frequently on grasslands enrolled in the Permanent Cover Program (PCP) that were hayed than on grazed PCP fields (McMaster and Davis 1998). PCP was a Canadian program that paid farmers to seed highly erodible land to perennial cover; it differed from CRP in that haying and grazing were allowed annually in PCP. In Saskatchewan, Dale (1993) found that Clay-colored Sparrows used alfalfa as a nesting substrate in place of shrubs. Clay-colored Sparrows in Alberta preferred deferred hayland (mowed after 15 July) to hayland mowed earlier in the growing season, although use of idle habitats was higher than use of either hayland type (Prescott et al. 1995). In North Dakota, Clay-colored Sparrows were marginally more abundant in the year after mowing in idled portions of CRP fields than in mowed portions (Horn and Koford 2000). In southern Saskatchewan hayfields, number of pairs was not affected by amount of cropland or wetland within 1.6 km of study areas (McMaster et al. 1999).

Lightly to moderately grazed grasslands are often used, but shrub cover may be a more important factor in determining habitat suitability than grazing regime (Owens and Myres 1973, Kantrud 1981, Kantrud and Kologiski 1982, Dale 1984, Bock et al. 1993, Anstey et al. 1995, Saab et al. 1995). Heavy grazing is detrimental, possibly because ground and/or shrub cover are reduced (Kantrud 1981, Kantrud and Kologiski 1982, Dale 1983). In North Dakota, Clay-colored Sparrows were common in several grazing treatments as well as in idle grasslands, but were consistently most abundant in areas with western snowberry (Messmer 1990). The grazing treatments were short-duration, twice-over, and season-long. Short-duration grazing involves a system of pastures rotated through a grazing schedule of about 1 wk grazed and 1 mo ungrazed, repeated throughout the season. Twice-over rotation involves grazing a number of pastures twice per season, with about a 2 mo rest in between grazing. Season-long grazing involves leaving a herd on the same pasture all growing season. In Saskatchewan, Clay-colored Sparrows were more frequent in native pasture than tame pasture with less shrub cover (Anstey et al. 1995). In Alberta grazed lands, Clay-colored Sparrows were most abundant on continuously grazed (season-long) parkland (a habitat which contained patches of shrub cover) (Prescott et al. 1995). They were more abundant in deferred tame pasture than in season-long or deferred mixed-grass pasture, and were uncommon in season-long tame pasture.

Idle grasslands support high densities of breeding Clay-colored Sparrows (Renken 1983, Messmer 1990, Hartley 1994, Prescott et al. 1995, Madden 1996, Koford 1999). In North Dakota, areas left unburned >80 yr, and areas ungrazed >11 yr, had higher Clay-colored Sparrow densities than recently burned and grazed areas (Madden 1996, Johnson 1997). In southcentral

North Dakota, use of idle areas decreased after mowing and as western snowberry cover decreased (Messmer 1990). In southern and southcentral North Dakota grasslands planted to dense nesting cover (DNC), Clay-colored Sparrows used tall, dense grass and forb cover in shrubless areas (Renken 1983, Renken and Dinsmore 1987, Johnson and Schwartz 1993*a*). Clay-colored Sparrow density was significantly higher in idle grassland than in DNC or grazed areas (Renken 1983). Koford (1999) found that Clay-colored Sparrows were more abundant in Waterfowl Production Areas (tracts of grassland and wetland managed by the U. S. Fish and Wildlife Service to provide nesting and brood-rearing habitat for waterfowl) than in CRP fields in North Dakota and Minnesota. Waterfowl Production Areas contained more western snowberry and sweet clover that was used for nesting than did CRP fields. In eastcentral Saskatchewan, the species occurred with almost equal frequency in idle, native grassland as in DNC (Hartley 1994). Within the same general geographical area (and with two overlapping study sites), Clay-colored Sparrows were more common in DNC and planted cover of creeping red fescue (*Festuca rubra*) and Kentucky bluegrass fields than in fallow fields (Dale 1993). In another Saskatchewan study, Clay-colored Sparrows preferred idle native grasslands invaded by tame grasses over native grasslands and hayland (Dale 1992). In Manitoba, no difference in productivity or abundance of Clay-colored Sparrows was detected between idle DNC, tame DNC, and idle grasslands; the species was found in the taller and denser DNC plots (Dhol et al. 1994). In another Manitoba study, however, Clay-colored Sparrows were more productive in native grassland than in tame grassland, woodland, or hayland; another study found Clay-colored Sparrows were more common in native grassland than in tame DNC, native DNC, or tame hayland (Jones 1994). In Alberta, Clay-colored Sparrows were absent from tame DNC <2 yr old; abundance increased until DNC reached 5 yr old, then average abundance decreased (Prescott and Murphy 1999). Clay-colored Sparrows were more abundant in tame DNC than in native DNC (Prescott et al. 1995).

In Manitoba, Clay-colored Sparrows were more common in DNC or native grassland than in cropland (Hartley 1994). In Alberta, Manitoba, and Saskatchewan, Clay-colored Sparrows were more common in PCP fields than in cropland (McMaster and Davis 1998). In Saskatchewan, Clay-colored Sparrows were more abundant in DNC than in cropland on organic, conventional, or minimum-tillage farmland (Shutler et al. 2000). Presence of Clay-colored Sparrows was negatively related to number of wetlands within 2.8 km^2 of point counts. Clay-colored Sparrows were observed in wetlands or wetland margins within all farmland types and within DNC.

Cropland rarely is used for nesting (Salt 1966, Johnson and Schwartz 1993*b*, Knapton 1994, Anstey et al. 1995), but may provide sparser, shorter vegetation suitable for foraging (Dale 1983, Knapton 1994). Shrubs retained along field edges are often used for nesting (Owens and Myres 1973, Dale 1983). In eastcentral Saskatchewan, Clay-colored Sparrows were frequently detected in wheat fields (Hartley 1994), whereas in parkland, Clay-colored Sparrows were not present in cropland (Prescott and Murphy 1999). In Alberta, Salt (1966) often observed them in cultivated fields after young fledged, and Owens and Myres (1973) detected Clay-colored Sparrows more frequently along a roadside route through cultivated land than along a route with more native grassland.

In a Texas study examining the effects on avian density of discing, spraying of 2,4,5-T about 14 yr prior to the study, and construction of brush shelters, grassland sparrows, as a group, were more abundant in the treated than untreated areas; effects on particular species, such as

Clay-colored Sparrow, composing the group of grassland sparrows, were not examined (Gruver and Guthery 1986).

In a Saskatchewan study that examined whether the abundance of grassland birds differed between roadsides and trailsides, abundance of Clay-colored Sparrows was not significantly different along trailsides than along roadsides (Sutter et al. 2000). Roads were defined as traveling surfaces with adjacent drainage ditches planted to smooth brome and ending with a fence 11-18 m from the traveling surface. Trails were defined as a single pair of wheel ruts visually indistinct from surrounding habitat in terms of plant structure and composition. Habitat along roads and trails were parcels of lightly to moderately grazed native prairie >256 ha.

Management Recommendations:

Allow grasslands to remain idle for long intervals between treatments to encourage shrubby vegetation favorable to Clay-colored Sparrows (Arnold and Higgins 1986, Johnson 1997). Arnold and Higgins (1986) recommend leaving patches of shrubs when burning or using herbicides.

Maintain dense grasslands with tall forbs and abundant litter. In areas without woody vegetation, planted cover such as Conservation Reserve Program fields or dense nesting cover can provide suitable nesting habitat (Renken and Dinsmore 1987, Berkey et al. 1993, Johnson and Schwartz 1993*a*, Johnson 1997).

Discourage conversion of brush land to cropland, since croplands are not preferred breeding habitat (Salt 1966; Root 1968; Johnson and Schwartz 1993*a*,*b*). Brushy edges around cropland should be promoted and retained, as they are used for nesting (Owens and Myres 1973, Dale 1983).

Woodland edges, wooded riparian areas, and other linear woody habitats such as windbreaks and shelterbelts can provide breeding habitat (Maher 1974, Faanes 1983). Succession following disturbances, such as logging, can be beneficial to Clay-colored Sparrows (Root 1968).

Do not implement grazing or burning regimes which frequently eliminate shrub and/or ground cover (Dale 1983, Halvorsen and Anderson 1983, Madden 1996, Johnson 1997).
In mesic mixed-grass prairie, conduct prescribed burns at moderate to long (5-10 yr) fire return intervals (Madden 1996, Johnson 1997, Madden et al. 1999). Shorter fire return intervals can frequently reduce woody vegetation and litter, resulting in decreased Clay-colored Sparrow density or avoidance of burned habitats altogether (Huber and Steuter 1984, Pylypec 1991, Berkey et al. 1993).

In North Dakota, Clay-colored Sparrow density increased with number of years since most recent burn, and remained high in areas where recent fire had not damaged shrubs (Madden 1996, Johnson 1997). In Wisconsin**,** burning of residual cover caused a 94% decline in Clay-colored Sparrow density after spring burning, even though no differences in shrub density were noted between burned and control plots (Halvorsen and Anderson 1983).

In Saskatchewan, Clay-colored Sparrows preferred idle grasslands to haylands mowed either annually or periodically (about every 3-8 yr) (Dale et al. 1997). Although Clay-colored Sparrows tend to avoid haylands in North Dakota, mowing can be used to halt long-term succession (Kantrud 1981, Berkey et al. 1993).

Clay-colored Sparrows exhibit ambiguous responses to grazing, but appear to be affected more by shrub coverage than by grazing regime (Bock et al. 1993). In North Dakota, Clay-colored Sparrows were common in variety of grazing treatments, including short-duration, seasonlong, idle, and twice-over rotation, but were most abundant in areas with greater shrub cover (Messmer 1990).

Light to moderate grazing on mixed-grass prairie may benefit Clay-colored Sparrows by providing foraging areas of sparser cover, particularly if shrub cover is retained (Owens and Myres 1973, Kantrud 1981, Kantrud and Kologiski 1982, Dale 1983, Huber and Steuter 1984, Arnold and Higgins 1986, Messmer 1990, Bock et al. 1993, Knapton 1994, Anstey et al. 1995, Saab et al. 1995). Avoid heavy grazing which removes ground cover (Kantrud 1981, Kantrud and Kologiski 1982, Dale 1983). In Alberta, heavy grazing may be acceptable if shrubs remain (Owens and Myres 1973).

Table. Clay-colored Sparrow habitat characteristics.

Author(s)	**Location(s)**	**Habitat(s) Studied***	**Species-specific Habitat Characteristics**
Anstey et al. 1995	Saskatchewan	Cropland, mixed-grass pasture, tame hayland, tame pasture	Were more frequent in native pasture with shrubs >10 cm tall than in tame pasture; favored lightly or heavily grazed pastures more than moderately grazed; abundance was positively associated with broad-leaved grasses ≤10 cm tall and with shrubs 20-100 cm tall; abundance was negatively associated with distance to nearest shrub
Arnold and Higgins 1986	North Dakota	Mixed-grass hayland, mixed-grass pasture	Were more abundant in shrubby areas containing many tall western snowberry (*Symphoricarpos occidentalis*; mean height 44.7 cm) and silverberry (*Eleagnus commutata*; 74.8 cm) shrubs than in areas with few shrubs
Dale 1983, 1984	Saskatchewan	Idle mixed-grass, mixed-grass pasture	Were more abundant in grazed than ungrazed areas; percent shrub cover in occupied areas far exceeded that of unoccupied areas; used areas had high values for litter depth, grass coverage, and forb height; preferred shrubs in or near areas of sparser cover for foraging
Dale 1993	Saskatchewan	Dense nesting cover (DNC; idle tame), idle, low nesting cover: idle tame	Were more common in DNC planted to tall wheatgrass (*Agropyron elongatum*), intermediate wheatgrass (*Agropyron intermedium*), alfalfa (*Medicago sativa*), and sweet clover (*Melilotus*) and in planted cover of creeping red fescue (*Festuca rubra*) and Kentucky bluegrass (*Poa pratensis*) than in fallow fields
Dale et al. 1997	Saskatchewan	Idle mixed-grass, idle tame, tame hayland	Occurred in higher numbers on idle mixed-grass prairie than on annually or less frequently mowed tame hayland
Davis and Duncan 1999	Saskatchewan	Mixed-grass pasture, tame pasture	Were more frequent in native pasture than in tame pasture, which had fewer shrubs than native pasture; occurrence was

			positively associated with western snowberry and negatively associated with crested wheatgrass (*Agropyron cristatum*), clubmoss (*Selaginella densa*), vegetation height, and cover of bare ground
Dhol et al. 1994	Manitoba	DNC (idle seeded-native, idle tame), idle mixed-grass	Were equally abundant and productive in mixed-grass prairie as in tame DNC (tall wheatgrass, intermediate wheatgrass, slender wheatgrass [*Agropyron caninum*], and alfalfa), and native DNC (western wheatgrass [*Pascopyrum smithii*], thick-spike wheatgrass [*Agropyron dasystachyum*], slender wheatgrass, streambank wheatgrass [*Agropyron riparium*], green needlegrass [*Stipa viridula*], big bluestem [*Andropogon gerardii*], switchgrass [*Panicum virgatum*], and purple prairie clover [*Dalea purpurea*]); appeared to prefer the taller and denser DNC plots
Faanes 1983	North Dakota	Idle mixed-grass, mixed-grass pasture, woodland	Used wooded draws; highest densities occurred in areas where western snowberry predominated
Fox 1961	Saskatchewan	Idle mixed-grass	Of 9 nests, 7 were in western snowberry, 1 in grass, and 1 on ground under grass clump
Halvorsen and Anderson 1983	Wisconsin	Burned tame, idle tame	Immediately after spring burning, average density declined by 94%
Hartley 1994	Saskatchewan	Cropland, DNC (idle seeded-native, idle seeded-native/tame, idle tame, idle tame hayland), idle mixed-grass	Were more common in DNC and idle native grassland than in wheat fields
Horn and Koford	North Dakota	CRP (idle tame, tame	Were marginally more abundant in the year after mowing in

2000		hayland)	idled portions of CRP fields than in mowed portions
Huber and Steuter 1984	South Dakota	Burned mixed-grass pasture, mixed-grass pasture	Preferred dense vegetation of unburned areas; preferred lightly grazed pasture to spring-burned pasture
Johnson and Schwartz 1993*a,b*	Minnesota, Montana, North Dakota, South Dakota	Conservation Reserve Program (CRP; idle seeded-native, idle tame), cropland	Were common in CRP; positively associated with legumes; not detected in cropland
Johnson 1997	North Dakota	Burned mixed-grass, burned tame, idle mixed-grass	Density increased with number of years postburn; were common in burned areas where thickets were not affected by fires
Jones 1994	Manitoba	Cropland, DNC (idle seeded-native, idle tame), idle mixed-grass, idle tame, tame hayland, woodland	Were more productive and common in native grassland than in hayland, tame grassland, or woodland
Kantrud 1981	North Dakota	Mixed-grass hayland, mixed-grass pasture	Densities were similar on moderately and lightly grazed plots; avoided mowed areas
Kantrud and Kologiski 1982	Colorado, Montana, Nebraska North Dakota, South Dakota, Wyoming	Mixed-grass pasture, shortgrass pasture, shrubsteppe	Preferred lightly grazed areas with typic boroll soils, mean vegetation height of 30 cm, and 5% bare ground
Knapton 1978, 1994	Manitoba	Idle mixed-grass	Used low shrubs on the northern prairies; in mixed-grass, used western snowberry most often
Koford 1999	Minnesota,	CRP (idle tame),	Were more more abundant in WPA than in CRP; preferred

	North Dakota	Waterfowl Production Area (burned, hayland, idle native, idle native/tame, idle seeded-native, idle tame)	Waterfowl Production Areas that contained western snowberry (*Symphoricarpos occidentalis*) shrubs or sweet clover
Madden 1996, Madden et al. 1999	North Dakota	Burned mixed-grass, burned tame, idle mixed-grass, idle tame	Used areas with high shrub cover, high visual obstruction (average height of leaf canopy), high vegetation density (number of vegetation contacts), and low grass cover; average vegetation characteristics in used areas were 30.1% shrub cover, 20.8 cm visual obstruction, 21.7 vegetation contacts, and 33.6% grass cover; shrub cover best predicted occurrence of species; were most abundant in grasslands burned >80 yr ago, compared to grasslands burned 0.5-8 yr ago
Maher 1974	Saskatchewan	Cropland, idle mixed-grass, mixed-grass pasture, tame hayland, woodland	Inhabited coulees along rivers and wooded and brushy habitats
McMaster and Davis 1998	Alberta, Manitoba, Saskatchewan	Cropland, Permanent Cover Program (PCP; idle tame, tame hayland, tame pasture)	Were more common in PCP than in cropland; frequency of occurrence was higher in hayed PCP than in grazed PCP
McMaster et al. 1999	Saskatchewan	Hayland, PCP (tame hayland)	Amount of cropland or wetland within 1.6 km of study areas did not affect number of indicated pairs
Messmer 1990	North Dakota	Idle mixed-grass/tame, mixed-grass/tame hayland, mixed-grass/tame pasture,	Were common on all grazing treatments, including short-duration, seasonlong, idle, and twice-over rotation; density increased on short-duration and decreased on all other systems; highest densities occurred on areas with abundant western

		wet-meadow pasture	snowberry; increased over time with increasing shrub cover, vertical density, and litter depth
Munson 1992	Wisconsin	Idle	Preferred habitat with abundant nest cover, such as dense woody vegetation; avoided open grasslands
Owens and Myers 1973	Alberta	Cropland, idle mixed-grass, mixed-grass hayland, mixed-grass pasture	Occurred at all land-use types on roadside counts, but nested only on undisturbed and grazed plots; agricultural practices appeared to have no adverse affect on species; tolerated heavy and light grazing where shrubs remained
Peabody 1899	Minnesota	Idle tallgrass	Nested on the ground in residual vegetation or in small shrubs; used meadows and brushland
Prescott and Murphy 1996	Alberta	Mixed-grass pasture, tame pasture	Frequency of occurrence on tame and native pastures was similar; in native pastures, appeared in areas with high cover diversity, short grass, and grass moderate in uniform height; in tame pasture, appeared in areas with moderate to high amounts of herbaceous biomass, moderate to high variation in herbaceous height, and high proportion of forbs relative to grasses. Abundance was highest in native pasture with high cover diversity, and in tame pasture with high herbaceous biomass, moderate herbaceous height, and high forb:grass ratio
Prescott and Murphy 1999	Alberta	Cropland, DNC (idle seeded-native/tame)	Were present in tame DNC >2 yr old, abundance increased until DNC reached 5 yr old, then average abundance decreased; were absent from cropland
Prescott et al. 1995	Alberta	Cropland, DNC (idle seeded-native, idle tame), idle mixed-grass, idle parkland, idle tame, mixed-grass pasture, parkland	Were most abundant in brush/shrub habitats followed by tame DNC, continuously grazed native parkland, idle native parkland, deferred (grazed after 15 July) tame pasture, shelterbelts, idle mixed-grass, idle tame grassland, idle deciduous upland, delayed-cut hayfields (cut once per summer after 15 July), continuously grazed mixed-grass, deferred mixed-grass pasture,

		pasture, tame hayland, tame pasture, wetland, woodland	native DNC, small (< 1 ha) fresh wetlands, large (> 8 ha) fresh wetlands, large (> 8 ha) saline wetlands, tame pasture, and medium (1-8 ha) fresh wetlands*;* were absent from cropland and small and medium saline wetlands
Pylypec 1991	Saskatchewan	Burned mixed-grass, idle mixed-grass	Were one-third less abundant in burned areas 3 yr after burning than in unburned areas
Rand 1948	Alberta	Cropland, idle shortgrass, shortgrass pasture	Used shrubby areas, such as that provided by rose (*Rosa*) bushes
Renken 1983, Renken and Dinsmore 1987	North Dakota	DNC (idle tame), idle mixed-grass**,** mixed-grass pasture	Occurred at higher densities in idle native grasslands than in native grazed or idle tame grasslands; used areas of slightly greater litter cover, deeper litter, and more shrub cover than unused areas; used tall, dense grasses and forbs, such as wormwood (*Artemisia absinthium*), in absence of shrubs; mean vegetation values for used areas were 63.5% grass cover, 28.7% forb cover, 99.6% litter cover, 10.6% shrub cover, 0.1% bare ground, 16 cm effective vegetation height (average height of leaf canopy), and 3.0 cm litter depth
Root 1968	Rangewide	Idle, pasture	Nested low to the ground in brushy and weedy, dry habitats such as pastures, parklands, hillsides, field edges, roads, swamps, woods, poplar-willow bluffs, burned over areas, forest openings, and brushy urban areas where shrubs such as western snowberry, silverberry, sumac (*Rhus*), rose, and willow (*Salix*)/aspen (*Populus*) persisted; preferred wild prairies to human inhabited areas; defended small nesting territories
Salt 1966	Alberta	Idle native, idle tame	Nested along roadways, in idle fields of wheatgrass (*Agropyron*) and smooth brome (*Bromus inermis)*, and in brushy areas of rose and western snowberry; territories contained ≥1 clump of willow-aspen bush

Schneider 1998	North Dakota	Mixed-grass pasture, tame pasture, wet-meadow pasture	Abundance was positively associated with percent forb cover, visual obstruction (vegetation height/density), litter depth, vegetation density, and with density of low-growing shrubs and plant communities dominated by shrubs (western snowberry and silverberry) and introduced grasses (smooth brome, Kentucky bluegrass, and quackgrass [*Agropyron repens*]); abundance was negatively associated with percent clubmoss cover and with plant communities dominated solely by shrubs, by native grass (*Stipa*, *Bouteloua*, *Koeleria*, and *Schizachyrium*), or by wet-meadow vegetation; strongest vegetational predictor of the presence of Clay-colored Sparrows was increasing cover of low-growing shrubs
Shutler et al. 2000	Saskatchewan	Cropland, DNC (idle seeded-native, idle seeded-tame), wetland	Were more abundant in DNC than in cropland on organic, conventional, or minimum-tillage farmland; presence was negatively related to number of wetlands within 2.8 km^2 of point counts; were detected in wetlands or wetland margins within all farmland types and within DNC
Smith and Smith 1966	Saskatchewan	Mixed-grass pasture	Three nests were located 25 to 46 cm above the ground in western snowberry
Stewart 1975	North Dakota	Cropland, hayland, idle native, wetland, woodland	Preferred western snowberry thickets, but commonly occurred in other shrubby habitats; regularly occurred in brushy areas within woodlands, shelterbelts, wooded riparian valleys, wooded slopes, and woodland edges; used retired cropland and oldfields; benefitted from brushy successional areas created by human disturbance such as fire and timber cutting
Sutter et al. 2000	Saskatchewan	Mixed-grass pasture	Abundance in mixed-grass prairie was not significantly different along roadsides than along trailsides
SWCC 1997	Saskatchewan	Mixed-grass pasture	Occurrence was negatively associated with distance from nest to shrub

Walkinshaw 1939	Michigan	Idle tallgrass	Nested in brushy prairie, usually on hillsides; occurred in areas burned a few years previous
Wilson and Belcher 1989	Manitoba	Idle mixed-grass, idle tame	Abundance was positively correlated with introduced vegetation including brome (*Bromus*), Kentucky bluegrass, and leafy spurge (*Euphorbia esula*) and negatively correlated with shorter native vegetation

*In an effort to standardize terminology among studies, various descriptors were used to denote the management or type of habitat. "Idle" used as a modifier (e.g., idle tallgrass) denotes undisturbed or unmanaged (e.g., not burned, mowed, or grazed) areas. "Idle" by itself denotes unmanaged areas in which the plant species were not mentioned. Examples of "idle" habitats include weedy or fallow areas (e.g., oldfields), fencerows, grassed waterways, terraces, ditches, and road rights-of-way. "Tame" denotes introduced plant species (e.g., smooth brome [*Bromus inermis*]) that are not native to North American prairies. "Hayland" refers to any habitat that was mowed, regardless of whether the resulting cut vegetation was removed. "Burned" includes habitats that were burned intentionally or accidentally or those burned by natural forces (e.g., lightning). In situations where there are two or more descriptors (e.g., idle tame hayland), the first descriptor modifies the following descriptors. For example, idle tame hayland is habitat that is usually mowed annually but happened to be undisturbed during the year of the study.

LITERATURE CITED

Anstey, D. A., S. K. Davis, D. C. Duncan, and M. Skeel. 1995. Distribution and habitat requirements of eight grassland songbird species in southern Saskatchewan. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan. 11 pages.

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

Berkey, G., R. Crawford, S. Galipeau, D. Johnson, D. Lambeth, and R. Kreil. 1993. A review of wildlife management practices in North Dakota: effects on nongame bird populations and habitats. Report submitted to Region 6. U.S. Fish and Wildlife Service, Denver, Colorado. 51 pages.

Bock, C. E., V. A. Saab, T. D. Rich, and D. S. Dobkin. 1993. Effects of livestock grazing on Neotropical migratory landbirds in western North America. Pages 296-309 *in* D. M. Finch and P. W. Stangel, editors. Status and management of Neotropical migratory birds. U.S.D.A. Forest Service, General Technical Report RM-229.

Buech, R. R. 1982. Nesting ecology and cowbird parasitism of Clay-colored, Chipping and Field Sparrows in a Christmas tree plantation. Journal of Field Ornithology 53:363-369.

Dale, B. C. 1983. Habitat relationships of seven species of passerine birds at Last Mountain Lake, Saskatchewan. M.S. thesis. University of Regina, Regina, Saskatchewan. 119 pages.

Dale, B. C. 1984. Birds of grazed and ungrazed grasslands in Saskatchewan. Blue Jay 42:102-105.

Dale, B. 1992. North American waterfowl management plan implementation program related to non-game studies within the Prairie Habitat Joint Venture area, Annual report 1991-1992. Unpublished report. Canadian Wildlife Service, Saskatoon, Saskatchewan. 66 pages.

Dale, B. 1993. 1992 Saskatchewan non-game bird evaluation of North American Waterfowl Management Plan: DNC and short grass cover - 1992. Unpublished report. Canadian Wildlife Service, Edmonton, Alberta; Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan. 23 pages.

Dale, B. C., P. A. Martin, and P. S. Taylor. 1997. Effects of hay management regimes on grassland songbirds in Saskatchewan. Wildlife Society Bulletin 25:616-626.

Davis, S. K., and D. C. Duncan. 1999. Grassland songbird occurrence in native and crested wheatgrass pastures of southern Saskatchewan. Pages 211-218 *in* J. Herkert and P. Vickery, editors. Ecology and conservation of grassland birds of the Western Hemisphere. Studies in Avian Biology 19.

Dhol, S., J. Horton, and R. E. Jones. 1994. 1994 non-waterfowl evaluation on Manitoba's North American Waterfowl Management Plan. Unpublished report. Wildlife Branch, Manitoba Department of Natural Resources, Winnipeg, Manitoba. 12 pages.

Faanes, C. 1983. Breeding birds of wooded draws in western North Dakota. Prairie Naturalist 15:173-187.

Fox, G. A. 1961. A contribution to the life history of the Clay-colored Sparrow. Auk: 78: 220-224.

Friedmann, H., and L. F. Kiff. 1985. The parasitic cowbirds and their hosts. Proceedings of the Western Foundation of Vertebrate Zoology 2:226-304.

Gruver, B. J., and F. S. Guthery. 1986. Effects of brush control and game-bird management on nongame birds. Journal of Range Management 39:251-253.

Halvorsen, H. H., and R. K. Anderson. 1983. Evaluation of grassland management for wildlife in central Wisconsin. Pages 267-279 *in* C. L. Kucera, editor. Proceedings of the Seventh North American Prairie Conference. Southwest Missouri State University, Springfield, Missouri.

Hartley, M. J. 1994. Passerine abundance and productivity indices in grasslands managed for waterfowl nesting cover. Transactions of the North American Wildlife and Natural Resources Conference 59:322-327.

Hill, D. P., and S. G. Sealy. 1994. Desertion of nests parasitized by cowbirds: have Clay-coloured Sparrows evolved an anti-parasite defense? Animal Behaviour 48:1063-1070.

Horn, D. J., and R. R. Koford. 2000. Relation of grassland bird abundance to mowing of Conservation Reserve Program fields in North Dakota. Wildlife Society Bulletin 28:653-659.

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

Janssen, R. B. 1987. Birds in Minnesota. University of Minnesota Press, Minneapolis, Minnesota. 352 pages.

Johnson, D. H. 1997. Effects of fire on bird populations in mixed-grass prairie. Pages 181-206 *in* F. L. Knopf and F. B. Samson, editors. Ecology and conservation of Great Plains vertebrates. Springer-Verlag, New York, New York.

Johnson, D. H., and M. D. Schwartz. 1993*a*. The Conservation Reserve Program: habitat for grassland birds. Great Plains Research 3:273-295.

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

Johnson, R. G., and S. A. Temple. 1986. Assessing habitat quality for birds nesting in fragmented tallgrass prairies. Pages 245-249 *in* J. Verner, M. L. Morrison, and C. J. Ralph, editors. Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison, Wisconsin.

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

Jones, R. E. 1994. Non-waterfowl evaluation of Manitoba's North American Waterfowl Management Program. Unpublished report. Wildlife Branch, Manitoba Department of Natural Resources, Winnipeg, Manitoba. 15 pages.

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

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. U.S. Fish and Wildlife Service, Wildlife Research Report 15. 33 pages.

Klimkiewicz, M. K. and A. G. Futcher. 1987. Longevity records of North American birds: Coerebinae through Estrildidae. Journal of Field Ornithology 58:318-333.

Knapton, R. W. 1978. Breeding ecology of the Clay-colored Sparrow. Living Bird 17:137-158.

Knapton, R. W. 1979. Optimal size of territory in the Clay-colored Sparrow, *Spizella pallida*. Canadian Journal of Zoology 57:1358-1370.

Knapton, R. W. 1994. Clay-colored Sparrow (*Spizella pallida*). *In* A. Poole and F. Gill, editors. The birds of North America, No. 120. The Academy of Natural Sciences, Philadelphia, Pennsylvania; The American Ornithologists' Union, Washington, D.C.

Koford, R. R. 1999. Density and fledging success of grassland birds in Conservation Reserve Program fields in North Dakota and west-central Minnesota. Pages 187-195 *in* P. D. Vickery and J. R. Herkert, editors. Ecology and conservation of grassland birds of the Western Hemisphere. Studies in Avian Biology 19.

Madden, E. M. 1996. Passerine communities and bird-habitat relationships on prescribe-burned, mixed-grass prairie in North Dakota. M.S. thesis. Montana State University, Bozeman, Montana. 153 pages.

Madden, E. M., A. J. Hansen, and R. K. Murphy. 1999. Influence of prescribed fire history on habitat and abundance of passerine birds in northern mixed-grass prairie. Canadian Field-Naturalist 113:627-640.

Maher, W. J. 1974. Matador Project: Birds II. Avifauna of the Matador area. Canadian Committee for the International Biological Programme, Matador Project, Technical Report 58. University of Saskatchewan, Saskatoon, Saskatchewan. 31 pages.

McMaster, D. G., and S. K. Davis. 1998. Non-game evaluation of the Permanent Cover Program. Unpublished report. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan. 75+ pages.

McMaster, D. G., J. H. Devries, and S. K. Davis. 1999. An integrated evaluation of cropland conversion in the Missouri Coteau of Saskatchewan: productivity of pintail and other grassland birds. Unpublished report. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan; Institute for Wetland and Waterfowl Research, Oak Hammock Marsh, Manitoba; Ducks Unlimited Canada, Oak Hammock Marsh, Manitoba.

Messmer, T. A. 1990. Influence of grazing treatments on nongame birds and vegetation structure in south central North Dakota. Ph.D. dissertation. North Dakota State University, Fargo, North Dakota. 164 pages.

Munson, E. S. 1992. Influence of nest cover on habitat selection in Clay-colored Sparrows. Wilson Bulletin: 104:525-529.

National Geographic Society. 1987. Field guide to the birds of North America, second edition. National Geographic Society, Washington, D.C. 464 pages.

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

Peabody, P. B. 1899. Clay-colored Sparrow. Oologist 16:177-180.

Prescott, D. R. C., and A. J. Murphy. 1996. Habitat associations of grassland birds on native and tame pastures of the aspen parkland in Alberta. NAWMP-021. Alberta NAWMP Centre, Edmonton, Alberta. 36 pages.

Prescott, D. R. C., and A. J. Murphy. 1999. Bird populations in seeded nesting cover on North American Waterfowl Management Plan properties in the aspen parkland of Alberta. Pages 203-210 *in* P. D. Vickery and J. R. Herkert, editors. Ecology and conservation of grassland birds of the Western Hemisphere. Studies in Avian Biology 19.

Prescott, D. R. C., A. J. Murphy, and E. Ewaschuk. 1995. An avian community approach to determining biodiversity values of NAWMP habitats in the aspen parkland of Alberta. NAWMP-012. Alberta NAWMP Centre, Edmonton, Alberta. 58 pages.

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

Rand, A. L. 1948. Birds of southern Alberta. National Museum of Canada, Ottawa, Canada. Bulletin no. 111. Biological series, no. 37. 105 pages.

Renken, R. B. 1983. Breeding bird communities and bird-habitat associations on North Dakota waterfowl production areas of three habitat types. M.S. thesis. Iowa State University, Ames, Iowa. 90 pages.

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

Romig, G. P., and R. D. Crawford. 1995. Clay-colored Sparrow in North Dakota parasitized by Brown-headed Cowbirds. Prairie Naturalist 27:193-205.

Root, O. M. 1968. *Spizella pallida*. Pages 1186-1208 *in* A. C. Bent, editor. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. U.S. National Museum Bulletin 237.

Saab, V. A., C. E. Bock, T. D. Rich, and D. S. Dobkin. 1995. Livestock grazing effects in western North America. Pages 311-353 *in* T. E. Martin and D. M. Finch, editors. Ecology and management of Neotropical migratory birds. Oxford University Press, New York.

Salt, W. R. 1966. A nesting study of *Spizella pallida*. Auk 83:274-281.

Saskatchewan Wetland Conservation Corporation (SWCC). 1997. Grassland bird conservation through Saskatchewan's native prairie stewardship program. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan. 25 pages.

Schneider, N. A. 1998. Passerine use of grasslands managed with two grazing regimes on the Missouri Coteau in North Dakota. M.S. thesis. South Dakota State University, Brookings, South Dakota. 94 pages.

Shaffer, J. A., C. M. Goldade, M. F. Dinkins, D. H. Johnson, L. D. Igl, and B. R. Euliss. 2003. Brown-headed Cowbirds in grasslands: their habitats, hosts, and response to management. Prairie Naturalist 35:146-186.

Shutler, D., A. Mullie, and R. G. Clark. 2000. Bird communities of prairie uplands and wetlands in relation to farming practices in Saskatchewan. Conservation Biology 14:1441-1451.

Skeel, M. A., D. C. Duncan, and S. D. Davis. 1995. Abundance and distribution of Baird's Sparrows in Saskatchewan. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan. 13+ pages.

Smith, H., and J. Smith. 1966. A breeding bird survey on uncultivated grassland at Regina. Blue Jay 24:129-131.

Stewart, R. E. 1975. Breeding birds of North Dakota. Tri-College Center for Environmental Studies, Fargo, North Dakota. 295 pages.

Sutter, G. C., S. K. Davis, and D. C. Duncan. 2000. Grassland songbird abundance along roads and trails in southern Saskatchewan. Journal of Field Ornithology 71:110-116.

Walkinshaw, L. H. 1939. Notes on the nesting of the Clay-colored Sparrow. Wilson Bulletin 51:17-21.

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.