

**EFFECTS OF MANAGEMENT PRACTICES
ON GRASSLAND BIRDS:
UPLAND SANDPIPER**



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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.

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Species for which syntheses are available or are in preparation:

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

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UPLAND SANDPIPER

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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and effects of habitat management on grassland birds were summarized from information in more than 4,000 published and unpublished papers.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.npwr.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.

UPLAND SANDPIPER
(*Bartramia longicauda*)

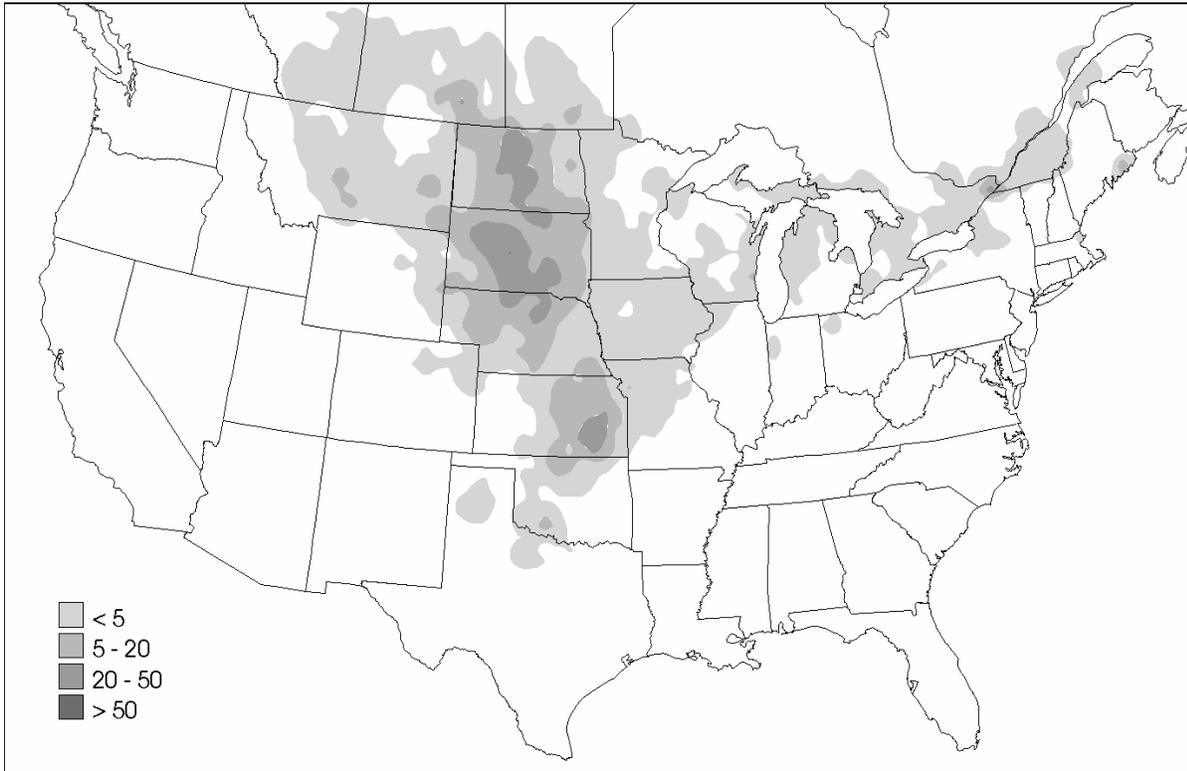


Figure. Breeding distribution of the Upland Sandpiper in the United States and southern Canada, based on Breeding Bird Survey data, 1985-1991. Scale represents average number of individuals detected per route per year. Map from Price, J., S. Droege, and A. Price. 1995. The summer atlas of North American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

Key to management is providing grasslands of various heights with few shrubs. Upland Sandpipers require short vegetation for foraging, taller vegetation for nesting, and short to medium vegetation for brood cover. In general, Upland Sandpipers forage in vegetation <30 cm high, nest in vegetation 10-64 cm high, and rear broods in vegetation usually <15 cm high.

Breeding range:

Upland Sandpipers breed from northeastern British Columbia to southwestern Ontario, south to northeastern Oregon, Idaho, Wyoming, Colorado, and Oklahoma, east to Virginia and along the East Coast north to New Brunswick (National Geographic Society 1987). (See figure for the relative densities of Upland Sandpipers in the United States and southern Canada, based on Breeding Bird Survey data.) An isolated population breeds in southeastern Alaska, northern British Columbia, and southwestern Yukon Territories.

Suitable habitat:

In general, Upland Sandpipers use areas with low to moderate forb cover, low woody cover, moderate grass cover, moderate to high litter cover, and little bare ground (Buss and

Hawkins 1939, Rotenberry and Wiens 1980, Renken 1983, Skinner et al. 1984, Sample 1989, Kantrud and Higgins 1992, Hull et al. 1996). Fence posts or other display perches may be important components of suitable habitat (Bent 1962, Salt and Salt 1976, White 1983). Upland Sandpipers use native and tame grasslands, wet meadows, hayland, pastures, planted cover (e.g., Conservation Reserve Program [CRP] and dense nesting cover [DNC]), cropland, highway and railroad rights-of-way, and grassy areas of airports (Bates 1907, Bent 1962, Goering 1964, Oetting and Cassel 1971, Higgins 1975, Stewart 1975, Johnsgard 1980, White 1980, Renken 1983, Messmer 1985, Renken and Dinsmore 1987, Snyder et al. 1987, Sample 1989, Kantrud and Higgins 1992, Johnson and Schwartz 1993, Johnson and Igl 1995, King and Savidge 1995, Hull et al. 1996). In Wisconsin, Upland Sandpipers were more numerous in non-forested areas with level terrain and with large, unfragmented agricultural fields, preferably hay, oats, or pasture, but not corn (White 1980, 1983).

In North Dakota, South Dakota, Montana, Wyoming, Colorado, and Nebraska, densities of Upland Sandpipers were highest in areas with moderately grazed typical ustoll soils (Kantrud and Kologiski 1982). Upland Sandpipers were associated with silty range and thin upland range sites in North Dakota; these sites were characterized by thin topsoil, loamy soil, 1-25% slope, grassy cover, low shrub cover, and moderate to high litter cover (Messmer 1990). Maximum vegetation height ranged from 50 to 70 cm and average litter depth ranged from 3.8 to 9.1 cm. Sedivec (1994), however, in the same study area found that Upland Sandpipers preferred overflow range sites (areas receiving more than normal soil moisture because of run-off from higher land or from flooding) to silty range sites. In Kansas, Upland Sandpipers appeared to prefer clay, upland range sites and to avoid loamy, upland range sites and limestone breaks (Bowen 1976). In Wisconsin, Upland Sandpipers were found on areas of Clyde silt loam and peat, but did not use Miami silt loam, possibly because these areas supported trees (Buss and Hawkins 1939).

In general, Upland Sandpipers forage within short vegetation and nest and rear broods within taller vegetation. However, time of day, daily activities, and phase of nesting cycle also influence habitat use (Dorio 1977, Dorio and Grewe 1979, Bolster 1990). For example, in Colorado, Upland Sandpipers were encountered most frequently on heavily grazed (average vegetation <10 cm high) pastures and on cut and baled alfalfa (*Medicago sativa*) fields during the morning; during the evening, they preferred bare ground and small-grain fields (vegetation <27 cm high) (Bolster 1990). This account will first present information on foraging, followed by nesting, then brood rearing.

Upland Sandpipers prefer short vegetation for foraging. Upland Sandpipers exhibited seasonal use of foraging habitats in Minnesota (Dorio 1977, Dorio and Grewe 1979). Upon first arriving on the breeding grounds, Upland Sandpipers used plowed and seeded fields; in May, sedge (*Carex*)/grass meadows were used until vegetation was 30 cm high; overgrazed pastures were used in May and June; and mowed fields of red clover (*Trifolium pratense*) were used in late summer when vegetation was 2.5-15.0 cm high. In Wisconsin, a few sandpipers were observed foraging in plowed and fallow (previously pasture, but plowed and left idle) fields and recently seeded corn fields, in which corn was 5-10 cm high (Ailes 1976, Ailes and Toepfer 1977). The corn field was no longer used when the corn was >15 cm high. Overall, however, idle fields, plowed fields, and cropland were used infrequently for foraging, and feeding occurred mostly in grazed pastures, followed by ungrazed pastures and hayfields (Ailes 1976). Upland Sandpipers foraged in pastures and corn fields before corn emerged and while corn was

still short (Ducey and Miller 1980). Graber and Graber (1963) suggested that open and idle fields and cropland were used for foraging in Illinois. In Minnesota, both young and adults preferred to feed in vegetation <10 cm high (Dorio 1977, Dorio and Grewe 1979). In Kansas, Zimmerman (1993) surmised that Upland Sandpiper was most abundant in annually burned grassland because it used these areas as foraging habitat. Goering (1964) found Upland Sandpipers foraged in areas with short grass, especially burned pasture, upon their arrival in spring. In Nebraska, Upland Sandpipers foraged in wheat stubble (Bates 1907).

Upland Sandpipers nest in a variety of habitats and vegetation heights and densities, from idle prairie with dense, homogeneous vegetation to wet meadows, oldfields, pastures, hayland, cropland, tame vegetation, burned areas, and sandy areas with sparse vegetation (Musselman 1935, Buss and Hawkins 1939, Bent 1962, Graber and Graber 1963, Goering 1964, Higgins 1975, Ailes 1976, Dorio 1977, Dorio and Grewe 1979, White 1980, Buhnerkempe and Westemeier 1988, Colwell and Oring 1990, Kantrud and Higgins 1992, Faanes and Lingle 1995). Nests may occur in depressions covered by grass arching over the top, in grass clumps, in dense vegetation, or at the base of forbs or shrubs (Lindmeier 1960, Bent 1962, Ailes 1976, Salt and Salt 1976, Skinner et al. 1984). In Wisconsin, Upland Sandpiper territories included loafing, nesting, and feeding sites; loafing and feeding sites were near nesting sites, and were shared by several pairs (Buss and Hawkins 1939). Suitable loafing areas were pastures with low-growing grass clumps, sparsely vegetated prairie, or open hayland. Choice of nesting site may change as the season progresses; early nests were located in pasture and later nests were in ungrazed prairie. Prior to the time when Upland Sandpipers in Colorado began incubating nests, they used heavily grazed fields more often and weedy fields less often than expected (Bolster 1990). During incubation, Upland Sandpipers appeared to prefer lightly grazed fields (average vegetation 17-23 cm tall) and small-grain fields (vegetation <27 cm tall), and to use tall (>27 cm) alfalfa and small-grain fields (vegetation \geq 27 cm tall) less than expected (Bolster 1990). White (1983) found that 38% of 553 nests were in pastures, one-fifth of which were in burned pastures. An additional 28% of nests were in tallgrass prairie, 7% in hayfields, and the remainder in woody areas, cropland, wetlands, and idle fields adjacent to airport runways.

Vegetation height around the majority of nests ranges from 10.2 to 63.5 cm (Lindmeier 1960, Goering 1964, Higgins et al. 1969, Ailes 1976, Kaiser 1979, Buhnerkempe and Westemeier 1988, Eldridge 1992). In North Dakota, South Dakota, Montana, and Manitoba, nests were located in grass-dominated sites with 100% visual obstruction at <15 cm, effective vegetation height <30 cm, and 30-99% litter cover (Kantrud and Higgins 1992); Upland Sandpipers avoided nesting where visual obstruction was >40 cm or vegetation height was >85 cm. In South Dakota, nest concealment for nests in grazed prairie was measured from various angles: all nests had \geq 50% vertical concealment by residual and living vegetation, 33% of nests were concealed on all sides, 55% were concealed on two sides, and 12% had no side concealment (Kaiser 1979). In Wisconsin, Upland Sandpipers did not initiate nests in vegetation >40 cm tall, although when eggs hatched, vegetation was as tall as 70 cm (Ailes 1976, 1980). In North Dakota, Upland Sandpipers most commonly nested in areas where grass accounted for \geq 50% canopy cover and forbs for <50% canopy cover (Bowen and Kruse 1993). Other habitats used for nesting were those in which forbs accounted for \geq 50% canopy cover and grass for <50% canopy cover, in which western snowberry (*Symphoricarpos occidentalis*) with a grass understory accounted for <50% canopy cover, and in which grass accounted for \geq 50% canopy cover and forbs for <50% canopy cover; habitats in which western snowberry with a grass

understory accounted for $\geq 50\%$ canopy cover were avoided. In northwestern Minnesota, vegetation height measured within 10 d after the first egg was laid averaged 25.4 cm, and consisted largely of residual vegetation (Lindmeier 1960). Standing vegetation over Upland Sandpiper nests was fairly thin, with a light intensity average of 222 candles/m² for 12 nests. In another study in northwestern Minnesota, mean vegetation measurements from 40 sampling points within four Upland Sandpiper territories were 79 cm vegetation height, 35% ground cover (coverage of live vegetation with a total height of ≤ 10 cm), and 24 cm phanerophyte height (Niemi and Hanowski 1983). Phanerophytes were defined as shrubs, forbs, or graminoids >40 cm high and present each year. In Saskatchewan, Upland Sandpipers nested in tall, dense, homogeneous vegetation >15 cm in height (Colwell and Oring 1988).

No clear pattern of preference for native versus tame vegetation over the breeding range of the Upland Sandpiper is discernible. In central Wisconsin and central Minnesota, Upland Sandpipers were found nesting in tame vegetation; study areas, however, may have contained little or no native vegetation (Ailes 1976, Dorio 1977). In northwestern Minnesota, 20 of 22 nests were found in native grasses; the other two were in alfalfa (Lindmeier 1960). Likewise, in southeastern Wisconsin, nests were placed in both tame and native vegetation; two nests were found in legumes (alfalfa and sweet clover [*Melilotus* sp.]) (Buss and Hawkins 1939). Musselman (1935) noted that Upland Sandpipers in Missouri and Illinois nested within abandoned clover (no scientific name provided) fields and grass. In Illinois, Upland Sandpipers preferred stands of Kentucky bluegrass (*Poa pratensis*) and other tame grass species as opposed to tallgrass prairie, and preferred older (>5 yr) plantings of tame grasses and forbs (Birkenholz 1973, Buhnerkempe and Westemeier 1988). In Kansas, Upland Sandpipers nested in tallgrass as well as in tame grasses (Goering 1964). In a study encompassing Great Plains grasslands, areas considered to be the best habitat for Upland Sandpipers were dominated by wheatgrass (*Agropyron*) and Kentucky bluegrass, followed by green needlegrass (*Stipa viridula*), buffalo grass (*Buchloe dactyloides*), western snowberry, and slimspike three-awn (*Aristida longiseta*) (Kantrud and Kologiski 1982). Dominant vegetation at nest sites in North Dakota, South Dakota, Montana, and Manitoba were Kentucky bluegrass, smooth brome (*Bromus inermis*), needle-and-thread (*Stipa comata*), and quackgrass (*Agropyron repens*); although most nests were located within mixed-grass, Upland Sandpipers readily nested in stands of tame grasses (Kantrud and Higgins 1992). King and Savidge (1995) observed Upland Sandpipers in CRP fields seeded warm-season grasses and native tallgrass in Nebraska. Within ungrazed grasslands in North Dakota and South Dakota, 38 of 41 nests were in either native or tame grasses located in idle fields or in rights-of-way; one of these nests was in alfalfa and brome (Higgins et al. 1969). The other three nests were in pasture. Within grazed grasslands in North Dakota, vegetation within 1 m of nests was composed of native grasses and small amounts of tame grasses such as Kentucky bluegrass and smooth brome (Bowen and Kruse 1993). In South Dakota, Upland Sandpipers nested only in native prairie; 32 of the 33 nests were in prairie classified as in good or excellent range condition (Kaiser 1979). In Manitoba, numbers of Upland Sandpipers were positively correlated with presence of native vegetation and negatively correlated with presence of tame vegetation (Wilson and Belcher 1989). In Saskatchewan, Upland Sandpipers were present in low abundance in both native mixed-grass and tame grasslands dominated by crested wheatgrass (*Agropyron cristatum*) (Sutter and Brigham 1998).

Moderate amounts of forbs may be an important component in suitable nesting habitat (Skinner 1975, Renken 1983, Buhnerkempe and Westemeier 1988, Klute 1994, Hull et al. 1996,

Klute et al. 1997). In North Dakota Waterfowl Production Areas, Upland Sandpipers used plots that had 57.4% grass cover and 23.5% forb cover (Renken 1983). In Illinois Greater Prairie-Chicken (*Tympanuchus cupido*) sanctuaries, Upland Sandpipers preferred to nest in fields containing a mixture of grasses and forbs; they preferred fields of seeded grasses that were being invaded by forbs (Buhnerkempe and Westemeier 1988). In Kansas tallgrass, Upland Sandpipers were significantly more abundant in pasture than in CRP; grazed pastures had significantly greater coverage of total vegetation, live vegetation, grasses, and forbs than did CRP (Klute et al. 1997). In Kansas CRP fields, Upland Sandpipers were present in fields described as having a medium frequency of occurrence of forbs (Hull et al. 1996). Skinner (1974) found fewer Upland Sandpipers in fields that were predominantly forbs than in fields with scattered forbs or with no forbs.

Upland Sandpipers require grasslands of various heights for rearing broods. In Minnesota, broods used weedy fields, open areas within oldfields, and overgrazed pastures (Dorio 1977, Dorio and Grewe 1979). Marshy areas of sedge and cattails (*Typha*) that had dried during drought were used as escape cover by broods (Dorio 1977). In Wisconsin, brood rearing occurred mostly in heavily grazed (vegetation <10 cm tall) pastures, followed by ungrazed pastures and hayfields (Ailes 1976). Some broods were observed in idle fields, plowed fields, and cropland. Late-summer feeding occurred mainly in heavily and moderately grazed pastures; lightly grazed pastures were used infrequently (Ailes 1980). In Illinois, broods were observed in wheat stubble, recently hayed legumes, redbud (*Agrostis stolonifera*) intermixed with weeds, and moderately grazed pastures (Buhnerkempe and Westemeier 1988). In Colorado, brood rearing occurred within short (≤ 27 cm high) and cut alfalfa and small-grain fields (vegetation <27 cm tall) more often than expected, whereas small-grain fields (vegetation ≥ 27 cm tall) were used less often than expected (Bolster 1990). Bolster (1990) observed a noticeable movement of broods from pastures to alfalfa fields. During pre-migration, heavily grazed fields, and cut and baled alfalfa were used more often, and lightly grazed fields, weedy fields, tall alfalfa, and small-grain fields (vegetation ≥ 27 cm) were used less often than expected. A table near the end of the account lists the specific habitat characteristics for Upland Sandpipers by study.

Area requirements:

Territory size in Wisconsin was 8-12 ha (Wiens 1969). Upland Sandpipers are highly sensitive to habitat fragmentation (Herkert 1991a, Herkert et al. 1993, Vickery 1993, Winter 1998). Abundance has been positively correlated to field or patch size (Herkert 1994, Vickery et al. 1994, Bollinger 1995, Helzer 1996). In Illinois, Upland Sandpipers required areas >30 ha (Herkert 1991b,c). In southwestern Missouri, Upland Sandpipers occurred only on tallgrass prairie fragments >75 ha in size (Winter 1998). In Nebraska, Upland Sandpipers required a minimum area of 50-61 ha to reach 50% incidence, with a perimeter-area ratio of 0.008 (Helzer 1996, Helzer and Jelinski 1999). Occurrence of Upland Sandpipers was positively correlated with patch area and inversely correlated with perimeter-area ratio (Helzer and Jelinski 1999). In Maine, Upland Sandpipers were rare in areas <50 ha, and reached 50% incidence at 200 ha (Vickery 1993, Vickery et al. 1994).

Brown-headed Cowbird brood parasitism:

Brood parasitism by Brown-headed Cowbirds (*Molothrus ater*) appears to be infrequent in Upland Sandpiper nests (Friedmann 1963, Friedmann and Kiff 1985). Documented rates of

parasitism are 0% of 28 nests (M. Winter and D. H. Johnson, *unpublished data*), 1% of 189 nests (Higgins and Kirsch 1975), and 5% of 43 nests (Faanes and Lingle 1995). Upland Sandpipers are unsuitable hosts because their young are precocial.

Breeding-season phenology and site fidelity:

Upland Sandpipers arrive on the breeding grounds from early April to early May (Buss and Hawkins 1939; Lindmeier 1960; Bent 1962; Goering 1964; Maher 1973; Higgins and Kirsch 1975; Ailes 1976, 1980; Bowen 1976; Dorio 1977; Johnsgard 1980; Buhnerkempe and Westemeier 1988; Kantrud and Higgins 1992) and depart from mid-July to late August (Buss and Hawkins 1939; Bent 1962; Goering 1964; Maher 1973; Wiens 1969; Higgins and Kirsch 1975; Ailes 1976, 1980; Dorio 1977; Johnsgard 1980; Bolster 1990). Upland Sandpipers sometimes nest semicolonially (Buss and Hawkins 1939, Bowen 1976, Bowen and Kruse 1993).

Breeding-site fidelity has been observed (Ailes 1976, 1980; Bowen 1976; Dorio 1977). Seasonal time limitations make double-broodedness in Upland Sandpiper unlikely; however, renesting following failure of initial nests has been observed (Buss and Hawkins 1939, Lindmeier 1960, Dorio and Grewe 1979).

Species' response to management:

Bent (1962) reported that burning and cultivation of mixed-grass prairie in Saskatchewan forced Upland Sandpipers to nest in cultivated fields. Also in Saskatchewan, Upland Sandpipers used a burned plot 2-3 yr postburn during 3 yr of postburn monitoring, but were not observed on an unburned plot (Pylypec 1991). In Minnesota, a 75% reduction in nesting cover due to spring fire may have reduced the numbers of Upland Sandpipers the year of the burn (Lindmeier 1960); numbers of breeding pairs returned to pre-burn levels the following year. Likewise, in Wisconsin, burning reduced or eliminated nesting in fields where nesting had occurred in the year previous to the burn (Buss and Hawkins 1939). In mixed-grass prairie in North Dakota, Upland Sandpipers were most abundant immediately following a burn and 1 yr postburn, as compared to 2-15 yr postburn (Johnson 1997). Upland Sandpipers used a burned native pasture in South Dakota significantly more than an unburned pasture (Huber and Steuter 1984). In Illinois tallgrass, Upland Sandpipers were most abundant 2 yr postburn, but were absent 3 yr postburn (Herkert 1994). In Illinois grasslands that were seeded to both native and tame grasses, Upland Sandpipers preferred nesting in fields 1 yr postburn. Burned fields were not preferred in the following years, and number of nesting seasons since fields were burned did not affect nest density (Buhnerkempe and Westemeier 1988).

Several burning-related studies have been conducted in the Kansas Flint Hills. Upland Sandpipers appeared to use unburned areas for nesting and foraging and annually burned grassland for foraging (Zimmerman 1993). Goering (1964) found nests in burned native grasses, as well as in heavily grazed and ungrazed native and tame grasses. Eddleman (1974) observed Upland Sandpipers on heavily grazed/annually burned pasture, moderately grazed/unburned pasture, and ungrazed/burned areas; Upland Sandpipers did not use unburned/ungrazed areas. Robel et al. (1998) found that Upland Sandpipers were present only on spring-burned, seeded-native CRP fields and not on unburned fields. Bowen (1976) observed that Upland Sandpiper abundance did not differ between burned and unburned pastures in Kansas. Upland Sandpipers appeared to prefer burned, loamy, upland range sites over all other burned range sites and used unburned and burned shallow and claypan range sites in proportion to their abundance; used

unburned and burned, clay, upland range sites more than expected based on abundance; and used unburned and burned, loamy upland and limestone breaks less than expected.

Upland Sandpipers occurred at higher densities in hayland than pasture and wet prairie in Wisconsin, although differences in densities were not statistically significant (Sample 1989). However, mowing may cause nest failure: three destroyed nests were found in a Nebraska alfalfa field following mowing (Ducey and Miller 1980). Hayfields were preferred over seed-combined fields in Missouri, and were used for foraging and loafing (Skinner 1974). Similarly, in Illinois grasslands that were seeded to both native and tame grasses, Upland Sandpipers preferred nesting in fields 1 yr after being rotary mowed, whereas grass meadows harvested for seed the previous year were used as nesting habitat less than other grasslands (Buhnerkempe and Westemeier 1988). In North Dakota, Upland Sandpipers used previously idled areas only after mowing (Messmer 1990). Upland Sandpipers were located in annually mowed native prairie in Iowa (Kendeigh 1941).

Because some studies report only the presence of Upland Sandpipers and not how they use grazed areas, it is difficult to give a general statement on effects of grazing on Upland Sandpipers. Besides nesting, Upland Sandpipers use grazed areas for foraging and brood rearing (Ailes 1976, Dorio 1977). Nest loss occasionally occurs as a result of trampling by cattle (Buss and Hawkins 1939; Ailes 1976, 1980; Dorio 1977; Bowen and Kruse 1993). Four studies were designed to determine the effect of grazing on productivity. Messmer (1990) and Sedivec (1994) compared rotational grazing systems, specifically short-duration grazing and twice-over rotation grazing, to season-long grazing and to idle grasslands. 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 (usually late May or early June until October). 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 cattle on the same pasture all growing season. Bowen and Kruse (1993) and Kirsch and Higgins (1976) examined seasonality and intensity of grazing, respectively. All four studies were conducted in southcentral North Dakota in mixed-grass prairie.

Research by Messmer (1985, 1990) revealed that nest density and nest success were highest with twice-over deferred and season-long grazing systems than on idle pastures, but that average density of breeding sandpipers was highest on the short-duration grazing system. In a continuation of Messmer's study, Sedivec (1994) reported that nest density was significantly higher on grazed than on idle grasslands. Both authors concluded that grazing is compatible with breeding needs of Upland Sandpipers

Bowen and Kruse (1993) compared nest density between the four grazing practices of autumn grazing, autumn-and-spring grazing, season-long grazing, and spring grazing to non-grazed areas. Nest densities were lower in pastures subjected to grazing during the nesting season (autumn-and-spring grazing, season-long grazing, and spring grazing) than in control fields or fields with autumn grazing. Nest densities did not differ between spring grazing with high stocking density (3.7 head of cattle/ha and grazing rate of 3.10 animal unit months [AUM]/ha) to that of season-long grazing with low stocking density (1.0 head of cattle/ha and grazing rate of 2.45 AUM/ha). Nest densities were significantly lower in years after pastures had been subjected to season-long and autumn-and-spring grazing than in the year before grazing treatments occurred (Bowen and Kruse 1993).

Within mixed-grass and tallgrass prairie in South Dakota, nest densities did not differ between idle sites and sites that were grazed in May at a grazing rate of 1.0-2.5 AUM/ha, and in which 20-80% of the current year's growth was removed (Kaiser 1979). Fourteen nests were found within a 256-ha fragment of moderately grazed prairie in South Dakota (Lokemoen and Duebbert 1974). Kirsch and Higgins (1976) reported that mean nest productivity was lowest on tilled areas (where no nests were observed), higher on grazed and idle areas, and highest on burned areas. The highest nest density of 6.8 nests/40.5 ha was on a grassland burned 2 yr previously. In North Dakota, South Dakota, Montana, and Manitoba, nest success was higher in idle grasslands than in grazed pastures (Kantrud and Higgins 1992). In eastern Kansas, Upland Sandpipers preferred native pasture to CRP seeded to native grasses, both of which were annually burned; nests were found only in pastures (Klute 1994, Klute et al. 1997).

The following researchers looked only at presence or density of Upland Sandpipers on grazed areas, but not specifically at productivity. Kantrud (1981) found that Upland Sandpipers were more attracted to heavily grazed native grasslands in North Dakota than either lightly or moderately grazed, or mowed grasslands, although densities were relatively high in all habitats compared to other bird species. Over a broader range (North Dakota, South Dakota, Montana, Wyoming, Colorado, Nebraska), however, sandpiper densities were highest on moderately grazed typical ustoll soils, and no relationship between density and grazing intensity was found (Kantrud and Kologiski 1982). Upland Sandpiper densities were significantly higher in idle and grazed mixed-grass than in tame DNC; they also occurred in areas 1 yr postgrazing (Renken 1983, Renken and Dinsmore 1987). In Nebraska, Upland Sandpipers were present on areas grazed by cattle and areas that were both grazed by American bison (*Bison bison*) and burned (Griebel et al. 1998).

In Alberta, Upland Sandpipers were found only on deferred-grazed native areas. Treatments included tame pastures of crested wheatgrass grazed in spring from late April to mid-June, native grassland grazed in early summer, and native grassland grazed after 15 July (deferred); the control was continuously grazed native pasture (Prescott and Wagner 1996). In Saskatchewan, Upland Sandpipers were observed on grazed pastures, but not on ungrazed areas (Dale 1984). In Ontario, Upland Sandpipers preferred lightly grazed pastures over hayland, oldfields, and cropland (Speirs and Orenstein 1967). In Kansas, Upland Sandpipers preferred grazed to ungrazed pastures (Bowen 1976). In Nebraska, avian diversity and density were higher on grazed than ungrazed areas because of the presence of Upland Sandpipers; sandpipers were not present on ungrazed areas (Cole and Sharpe 1976).

In Missouri, Skinner (1974, 1975) compared sandpiper density between idle fields and fields subjected to haying, seed-combining, or grazing at four intensities. Density of Upland Sandpipers was highest under moderate grazing (vegetation 10.2-30.4 cm tall, 20-40% grass and forb cover at 25 cm tall) and heavy grazing (vegetation 0-10.2 cm tall, <20% grass and forb cover at 25 cm tall) (Skinner 1975, 1982). Upland Sandpipers were present in hayed, combined, and lightly grazed fields (vegetation >30.4 cm tall), but not in idle fields. Nests also were found on grazed tallgrass prairie (Skinner et al. 1984).

Cultivation may negatively impact Upland Sandpipers (Bent 1962, Faanes and Lingle 1995); cultivation eliminates brood-rearing areas and may force broods to inhabit edge habitat (Dorio 1977). In Nebraska, sandpipers preferred untilled areas such as alfalfa and pastures over tilled areas; however, they foraged in corn fields before and just after emergence of vegetation (Ducey and Miller 1980). Hatching success in southcentral North Dakota was lowest on

annually tilled cropland (none of six nests hatched) and highest on burned and idle grasslands (Kirsch and Higgins 1976). In North Dakota, Upland Sandpipers appeared to prefer minimum-tillage (seeding into untilled or moderately tilled land) and organic farming (cultivation and crop rotation, but no chemicals, are used to control weeds) over conventional tillage (spring and fall tillage and use of herbicides); most nests were placed in wheat stands that were physically similar to grasslands (Lokemoen and Beiser 1997). In North Dakota, Higgins (1975) found that Upland Sandpipers preferred nesting in untilled uplands (road rights-of-way, bands of vegetation around wetlands, heavily grazed grasslands, and idled grasslands) over fallow (bare ground), mulched or standing stubble, or growing small grain. In Illinois, preferred nesting habitat was seeded grasses mixed with forbs, such as young, rotary-mowed seedings and older, grass-seed meadows (Buhnerkempe and Westemeier 1988). Sandpipers preferred nesting in fields >5 yr after seeding, especially in those >8 yr old. Fields with homogeneous vegetation, or that were planted to smooth brome, were rarely selected. Grass meadows harvested for seed the previous year were not used.

Upland Sandpipers have been reported as relatively uncommon in CRP and rowcrops compared to other habitats (Kantrud and Higgins 1992, Klute 1994, Best et al. 1997). However, they have been observed in grassed waterways in Iowa cropland (Bryan and Best 1991), and they nested in Iowa CRP fields but not rowcrops (Patterson 1994, Patterson and Best 1996). They were more common in cropland than in CRP fields in North Dakota (Johnson and Igl 1995). Upland Sandpipers were fairly common within CRP fields in Minnesota, North Dakota, South Dakota, and Montana (Johnson and Schwartz 1993) and nested within CRP fields in Iowa (Patterson 1994). Three nests that were found in hayed strips and idled blocks within CRP fields in South Dakota were depredated (Luttschwager and Higgins 1992). In Kansas, no nests were found on spring-burned CRP (Klute 1994, Klute et al. 1997). In Nebraska, Upland Sandpipers were found in both native prairie and in CRP planted to native grasses (King and Savidge 1995).

Densities of Upland Sandpipers were higher in idle and grazed native prairie than in DNC (Renken and Dinsmore 1987). Upland Sandpipers were not present in idle fields in Missouri (Skinner 1975). Bowen and Kruse (1993) found that allowing mixed-grass prairie to remain idle for 2-3 yr between grazing treatments was not detrimental to breeding Upland Sandpipers. Thirty-eight of 41 nests located in the Missouri Coteau of North Dakota were in idle grasslands characterized by moderately tall (15-61 cm) grasses and abundant ground litter (Higgins et al. 1969).

Some pastures were used more frequently during years when they had been fertilized with nitrogen (Bowen 1976). In Wisconsin, fertilizing with manure reduced or completely excluded nesting; however, Upland Sandpipers were found nesting in grass clumps formed around manure droppings (Buss and Hawkins 1939).

Management Recommendations:

Maintain large (>100 ha), contiguous tracts of prairie to reduce edge, provide habitat heterogeneity, and to decrease nest depredation (Herkert et al. 1993, Herkert 1994, Klute 1994, Helzer 1996). Blocks should be within 1.6 km of each other and be contiguous with grassy habitats (e.g., pasture, hayfields) (Herkert et al. 1993). Shape, as well as area, of management

units must be taken into consideration; perimeter-area ratio strongly influenced occurrence of Upland Sandpipers in Nebraska (Helzer and Jelinski 1999).

Maintain native prairie by implementing burning, grazing, or haying treatments, or leaving idle, every 2-3 yr (Kaiser 1979, Kantrud 1981). In South Dakota, Upland Sandpipers successfully nested in pastures stocked in May at 1.0 to 2.5 AUM/ha (Kaiser 1979). In North Dakota, spring-burning at 3-yr intervals provided habitat conditions needed by Upland Sandpipers for nesting; grazing did to a lesser extent, but was more compatible than cropland or seeding tame grasses (Kirsch and Higgins 1976).

Allow some blocks of grassland to be undisturbed to serve as nesting cover (Lindmeier 1960, Bowen and Kruse 1993).

Avoid burning, mowing, or plowing during the nesting season (Buss and Hawkins 1939, Lokemoen and Beiser 1997). Mowing and spraying of pesticides in CRP should be delayed until after July to avoid disturbances during peak nesting (Bolster 1990, Patterson 1994). Mowing of nesting and brooding habitat should be delayed until 1 July or later (Buhnerkempe and Westemeier 1988).

Provide display perches, such as fence posts, rock piles, or tree stumps (White 1983).

Prevent encroachment of woody vegetation (Herkert et al. 1993).

A complex of fields of different management practices may be necessary to meet Upland Sandpiper needs during the breeding season. Grazed, burned, and hayed fields provide suitable habitat for feeding, loafing, and brood rearing, but undisturbed fields are needed for nesting (Bowen and Kruse 1993). Provide a mosaic of habitat types, such as grassland of various heights and densities as well as cropland, to provide for the needs of Upland Sandpiper throughout the breeding season (Bolster 1990).

Annually burn 20-30% of grassland fragments <80 ha (Herkert 1994). Small fragments should have <50% of their area burned at a time, and, if next to other fragments, should be burned in a rotating manner that allows unburned fragments to be next to burned fragments. Burns should occur from March to early April or October to November (Herkert et al. 1993).

Avoid mowing road rights-of-way until late July (Oetting and Cassel 1971).

Graze at moderate levels to provide diverse grass heights and densities (Skinner 1974). Graze using a rotational system of two or more grazing units to increase grass heights and densities within and among units.

Avoid season-long grazing; where grazing is necessary, delay grazing until mid- to late June to maintain nest densities (Bowen and Kruse 1993, Sedivec 1994). Choose rotational grazing over season-long grazing to provide more undisturbed cover during the nesting season by deferring two or more pastures until mid- to late June (Sedivec 1994). With rotational grazing systems,

delay grazing until late May to early June to benefit nesting sandpipers as well as to optimize calf performance. Follow stocking rates as outlined by the U.S. Soil Conservation Service (1984); rates may be slightly higher for rotational grazing (Sedivec 1994).

Encourage no-till or minimum-till practices instead of annual tillage practices, so that habitat is undisturbed during the nesting season (Kantrud and Higgins 1992, Lokemoen and Beiser 1997). Nest productivity is low on annually tilled cropland and former cropland planted to grass/legumes (Kirsch and Higgins 1976). Encourage adoption of organic farming in cultivated areas, but delay first tillage until late June or early July to prevent destruction of nests (Lokemoen and Beiser 1997).

Maintain heterogeneous fields of cool-season, tame grasses that are >5 yr old; to obtain a mixture of forbs and grasses, fields should not be re-seeded until they are 10-12 yr old (Buhnerkempe and Westemeier 1988). Management of seeded grasses includes allowing them to idle, rotary mowing to a height of 15-30 cm on a 3-yr rotation, or burning. Moderate grazing may provide suitable habitat in both native and tame grasses, but more research needs to be done.

Table. Upland Sandpiper habitat characteristics.

Author(s)	Location(s)	Habitat(s) Studied*	Species-specific Habitat Characteristics
Ailes 1976, 1980; Ailes and Toepfer 1977	Wisconsin	Cropland, tame hayland, tame pasture, woodland	Foraged in heavily grazed (vegetation <10 cm tall) pasture, ungrazed pasture, hayland, fallow fields, and recently plowed corn field (corn 5-10 cm tall); no longer used corn when it was >15 cm tall. Nested in hayland, idle fields, grazed and ungrazed pastures, hayland 1 yr postmowing, and cover <40 cm tall; did not nest in heavily grazed fields or cropland. Reared broods in heavily to moderately grazed (vegetation <10 cm high) fields, ungrazed pastures, hayfields, idle fields, plowed fields, and cropland
Bates 1907	Nebraska	Cropland	Foraged in wheat stubble that contained grain
Bent 1962	Rangewide	Cropland, burned mixed-grass, idle mixed-grass	Preferred open prairies and grassy fields; nested in cultivated fields, in sandy areas with sparse vegetation, in rough brush, in long grass and on dry, grassy prairies in slight depressions in long, thick grass; burning and cultivation of prairies forced Upland Sandpipers to nest in cultivated fields; perched on fenceposts, telephone poles, tree stumps, or rocks
Best et al. 1997	Indiana, Iowa, Kansas, Michigan, Missouri, Nebraska	Cropland, Conservation Reserve Program (CRP; burned seeded-native, burned seeded- native/tame, burned tame, idle seeded- native, idle seeded- native/tame, idle	Generally uncommon in CRP and in rowcrops, but used rowcrops (probably for foraging) more often than CRP

		tame, seeded-native/tame hayland, tame hayland)	
Birkenholz 1973	Illinois	Idle, idle tallgrass, idle tame, wet meadow, wetland	Preferred stands of Kentucky bluegrass (<i>Poa pratensis</i>) to tallgrass prairie
Bolster 1990	Colorado	Bare ground, cropland, hayland, idle, pasture	Prior to incubation, used heavily grazed fields more often and weedy fields less often than expected; in general, used lightly to moderately grazed pastures and bare ground in proportion to their availability; used heavily grazed (vegetation <10 cm tall) pastures, alfalfa (<i>Medicago sativa</i>) fields with mean height ≤ 27 cm, and small-grain fields with mean height <27 cm more often than predicted; used weedy fields, alfalfa with mean height >27 cm, and small-grain fields with mean height ≥ 27 cm less often than predicted; preferred medium-height vegetation of the shortgrass prairie and grass-like vegetation over tangled vegetation
Bowen and Kruse 1993	North Dakota	Idle mixed-grass, mixed-grass pasture	Nested in areas where grass accounts for $\geq 50\%$ canopy cover and forbs for <50% canopy cover; vegetation within 1 m of nests included Kentucky bluegrass, needle-and-thread (<i>Stipa comata</i>), green needlegrass (<i>Stipa viridula</i>), western wheatgrass (<i>Pascopyrum smithii</i>), smooth brome (<i>Bromus inermis</i>), upland sedges (<i>Carex</i> spp.), and western snowberry (<i>Symphoricarpos occidentalis</i>). Habitats in which forbs accounted for $\geq 50\%$ canopy cover and grass for <50% canopy cover, in which western snowberry with a grass understory accounted for <50% canopy cover, and in which grass accounted for $\geq 50\%$ canopy cover and forbs for <50% canopy cover were used for nesting in relation to the proportion of the vegetation type in the study area. Habitats

			<p>in which western snowberry with a grass understory accounted for $\geq 50\%$ canopy cover were avoided. Majority of nests (90% of 342 nests) were in vegetation with height/density readings in early June between 5 and 20 cm; nest density was lower on fields grazed during the nesting season (autumn-and-spring grazing, season-long, and spring grazing) than fields with autumn grazing; nest density did not differ between spring grazing with high stocking density (3.7 head of cattle/ha and grazing rate of 3.1 animal unit months [AUM]/ha) and season-long grazing with low stocking density (1.0 head of cattle/ha and grazing rate of 2.45 AUM/ha); nest density was lower in years after fields were subjected to season-long and autumn-and-spring grazing than in years before grazing treatments occurred</p>
Bowen 1976	Kansas	Burned tallgrass pasture	<p>Used clay, upland range sites more than expected, and loamy, upland range sites and limestone breaks less than expected, based on abundance of range sites; used claypan and shallow range sites in proportion to their abundance; relative abundance of clay upland was a good predictor of use; used some pastures more frequently during years when they were fertilized; preferred grazed to ungrazed pastures and pastures grazed year-round by cows and calves more than pastures grazed by steers; there was no difference in use between burned and unburned pastures; used burned, loamy upland range sites more frequently than other burned habitat; used unburned and burned shallow and claypan range sites in proportion to their abundance; used unburned and burned, loamy upland and limestone breaks less than expected based on abundance; used unburned and burned clay, upland range sites more than expected based on abundance</p>

Buhnerkempe and Westemeier 1988	Illinois	Burned/hayed/seed-harvested tame/native grassland; idle tame; tame hayland; pasture	Preferred to nest in seeded grasses invaded by forbs, such as young, rotary-mowed seedings and older, grass-seed meadows, fields that were rotary mowed or burned the previous season, and fields >5 yr after seeding, especially those >8 yr old; nested in fields containing a mixture of medium-height, narrow-leaved grasses, and forbs; nest cover ranged from 17 to 33 cm high. Did not nest in brome (<i>Bromus</i>) or wheat stubble/legume fields, fields that were homogeneous in terms of vegetation, grass meadows harvested for seed the previous year, vegetation >60 cm high, and tall, rank prairie grasses. Broods used wheat stubble, recently hayed legumes, redtop (<i>Agrostis stolonifera</i>) fields intermixed with weeds, and moderately grazed pastures
Buss and Hawkins 1939	Wisconsin	Cropland, idle tallgrass, tallgrass pasture, tallgrass/tame hayland, tame pasture, tame hayland	Nested in pastures planted to Junegrass (<i>Koeleria</i> sp.) and canary grass (<i>Phalaris</i> sp.), in haylands planted to timothy (<i>Phleum pratense</i>) or to a mixture of Junegrass, timothy, and quackgrass (<i>Agropyron repens</i>), and in clumps of long, dense grass arched over nests; two nests were placed in alfalfa and sweet clover (<i>Melilotus</i> sp.) hayland; other nests were placed at the base of forbs or shrubs in prairies; early nests were in pasture and later nests in idle native grassland; territories included loafing, nesting, and feeding sites; suitable loafing areas were pastures with low-growing clumps, sparsely vegetated grassland, and open hayland
Cole and Sharpe 1976	Nebraska	Idle, pasture	Preferred grazed over ungrazed areas
Colwell and Oring 1990	Saskatchewan	Mixed-grass/tame pasture, wet-meadow pasture, wetland	Nested in tall, dense, homogeneous upland vegetation >15 cm in height

Dale 1984	Saskatchewan	Idle mixed-grass, mixed-grass pasture	Nested in grazed but not ungrazed plots
Dorio 1977, Dorio and Grewe 1979	Minnesota	Cropland, idle tame, tame pasture, wet-meadow hayland, wetland, woodland	Foraged in overgrazed pastures, sedge/grass meadows, and plowed and seeded fields; during May and June, used overgrazed pastures; in May, used sedge/grass meadow; used mowed red clover (<i>Trifolium pratense</i>) fields for late summer foraging (vegetation 2.5-15.0 cm tall). Nested in oldfields, pastures of smooth brome, and wet meadow (annually mowed sedge, timothy, and Canada bluegrass [<i>Poa compressa</i>]); and in quackgrass, yarrow (<i>Achillea millefolium</i>), and goldenrod (<i>Solidago</i> sp.); nests were found in live vegetation ranging from 22.5 to 35.0 cm tall, and in dead and matted vegetation; nests had a mean cover frequency of 25.2% litter and 12.0% bare ground; Broods used oldfields (Canada bluegrass, timothy, quackgrass, western sagewort [<i>Artemisia campestris</i>], horse-weed [<i>Conyza canadensis</i>], yarrow, and goldenrod), open areas within oldfields, and overgrazed pastures; young and adults foraged in vegetation <10 cm tall; dry conditions allowed marginal land, including open areas within oldfields, to be plowed and planted to corn, reducing much of the brood-rearing area and forcing broods to move to the edge
Ducey and Miller 1980	Nebraska	Cropland, idle, mixed-grass pasture, tame hayland	Preferred untilled areas such as alfalfa and pasture; foraged in pasture and in corn fields before corn emerged or when corn still was short
Eddleman 1974	Kansas	Burned tallgrass, burned tallgrass pasture, idle tallgrass, tallgrass pasture, wet	Used heavily grazed/annually burned pasture, moderately grazed/unburned pasture, and ungrazed/burned areas

		meadow	
Faanes and Lingle 1995	Nebraska	Cropland, idle mixed-grass, idle shortgrass, idle tallgrass, pasture, sand-sage grassland, tame hayland, wet meadow, wetland, woodland	Nest density was highest in wet prairie, followed by domestic hayland, upland prairie, wheat, alfalfa, and prairie wetland; woody encroachment into wet prairie and conversion of upland prairie to cropland negatively impacted Upland Sandpipers
Goering 1964	Kansas	Burned tallgrass pasture, idle, idle native/tame, idle pasture, pasture tallgrass pasture	Foraged within burned pasture. Nested within dense stands of ungrazed big and little bluestem (<i>Andropogon gerardii</i> , <i>Schizachyrium scoparium</i> , respectively); in spring-burned three-awn (<i>Aristida</i> sp.); in heavily grazed smooth brome; in clumps of yellow sweet clover (<i>Melilotus officinalis</i>) within weedy, ungrazed brome; in burned bluestem (<i>Schizachyrium</i>) meadow; in clumps of dropseed (<i>Sporobolus</i> sp.) within weedy, heavily grazed bluestem; and in ungrazed but spring-burned bluestem
Graber and Graber 1963	Illinois	Cropland, hayland, idle, idle grassland, tame pasture, wetland, woodland	Nested in pasture and hayland, and foraged in cropland and idle fields
Higgins 1975	North Dakota	Burned/hayed idle, cropland, idle, idle mixed-grass, mixed-grass pasture, tame pasture, tame hayland	Commonly nested on untilled habitats, but also in summer fallow, mulched stubble, standing stubble, and growing grain

Higgins et al. 1969	North Dakota, South Dakota	Cropland, hayland, idle tame, idle mixed-grass, pasture	Nested in idle or intermittently hayed grassland (pastures or highway rights-of-way) characterized by grasses ranging from 15 to 61 cm in height, with medium density, and abundant ground litter; one nest was found in alfalfa and smooth brome; grasses used as nesting cover were little bluestem, needle-and-thread, porcupine-grass (<i>Stipa spartea</i>), green needlegrass, Junegrass (<i>Koeleria pyramidata</i>), blue grama (<i>Bouteloua gracilis</i>), smooth brome, Kentucky bluegrass, quackgrass, and crested wheatgrass (<i>Agropyron cristatum</i>)
Huber and Steuter 1984	South Dakota	Burned mixed-grass pasture, mixed-grass pasture	Used burned areas more than unburned areas
Hull et al. 1996	Kansas	CRP (burned seeded- native, idle seeded- native)	Were present in fields with medium frequency of occurrence (mean of 50.1%) of forbs
Johnsgard 1980	Nebraska	Cropland, hayland, idle, idle mixed- grass, idle shortgrass, idle tallgrass, mixed- grass pasture, tallgrass pasture, tame hayland, wet meadow	Used native mixed- and tallgrass prairie, wet meadows, hayland, retired croplands, and small grain
Johnson and Igl 1995, Johnson and Schwartz 1993	Minnesota, Montana, North Dakota, South Dakota	Cropland, CRP (idle seeded-native, idle tame)	Were fairly common in CRP throughout the northern Great Plains study area, but more common in cropland than CRP in North Dakota

Kaiser 1979	South Dakota	Idle mixed-grass, idle mixed-grass/tallgrass, idle tallgrass, idle tame, mixed-grass pasture, mixed-grass/tallgrass pasture, tallgrass pasture, tame hayland	Preferred to nest on climax mixed-grass and tallgrass prairie, although nests were found in Kentucky bluegrass, native forbs, western wheatgrass, and green needlegrass; nest success did not differ between matted and upright residual vegetation; nests occurred in vegetation between 12.7 and 63.5 cm tall with $\geq 50\%$ vertical concealment by residual and living vegetation; 33% of nests were concealed on all sides, 55% were concealed on two sides, and 12% had no side concealment; avoided nesting in areas where vegetation height was >60 cm; nest success did not differ between nests in tallgrass, mixed-/tallgrass transition, or mixed-grass; nest densities did not differ between idle sites and sites that were grazed in May (20-80% of the current year's growth removed); nested in grazed areas with varying grazing pressure, ranging from 1.0 to 2.5 AUM
Kantrud 1981	North Dakota	Mixed-grass hayland, mixed-grass pasture	Highest densities in heavily grazed areas
Kantrud and Higgins 1992	Manitoba, Montana, North Dakota, South Dakota	Burned mixed-grass, cropland, hayland, idle mixed-grass, idle tame, mixed-grass pasture	Commonly nested in native grasslands, but readily nested in tame grasses; nested in idle and grazed native grasslands, in hayland, cropland, and burned areas; nested in grass-dominated sites with 100% visual obstruction at <15 cm, vegetation height <30 cm, and litter cover 30-99%; avoided nesting where visual obstruction was >40 cm or height was >85 cm; dominant nest vegetation included Kentucky bluegrass, smooth brome, needle-and-thread, and quackgrass; forbs and shrubs were dominant at very few nests; nest success was higher in idle than in grazed fields
Kantrud and Kologiski 1982	Colorado, Montana, North Dakota,	Mixed-grass pasture, shortgrass pasture,	Occurred at highest densities on moderately grazed typic ustoll soils; areas considered to be the best habitat for Upland Sandpipers were dominated by wheatgrass

	Nebraska, South Dakota, Wyoming	shrubsteppe	(<i>Agropyron</i>) and Kentucky bluegrass, followed by green needlegrass, buffalo grass (<i>Buchloe dactyloides</i>), western snowberry, and slimspike three-awn (<i>Aristida longiseta</i>)
Kendeigh 1941	Iowa	Idle tallgrass (restored)	Occurred in annually mowed prairie dominated by porcupine-grass
King and Savidge 1995	Nebraska	Cropland, burned tallgrass; CRP (burned seeded-native, idle seeded-native, idle tame, tame hayland), idle tallgrass, tallgrass hayland	Were found in native prairie and in CRP planted to native grasses
Kirsch and Higgins 1976	North Dakota	Cropland, burned mixed-grass, idle mixed-grass, idle tame, mixed-grass pasture	Concealed nests in grassy vegetation; preferred nesting in vegetation 15.4-30.8 cm in height and avoided nesting in vegetation >61.5 cm tall; production, or mean number of nests hatched/40.5 ha, was highest on burned grassland, followed by undisturbed and grazed grassland; there was no production on annually tilled croplands; production was comparatively low on former cropland fields seeded to grass-legume mixtures
Klute 1994, Klute et al. 1997	Kansas	Burned tallgrass pasture; CRP (burned seeded-native)	Preferred large, unfragmented grassland areas; nested in grazed pastures but not in CRP; preferred burned pasture to burned CRP
Lindmeier 1960	Minnesota	Cropland, hayland, idle tallgrass, wetland	Nested in grassy depressions, in short grasses (little bluestem, Junegrass, and muhly [<i>Muhlenbergia</i> spp.]), in completely undisturbed areas, and in alfalfa; vegetation height within 10 d after the first egg was laid averaged 25.4

			cm, and consisted largely of residual vegetation; standing vegetation over Upland Sandpiper nests was fairly thin, with a light intensity average of 222 candles/m ² ; fire reduced Upland Sandpiper numbers from about 35 to about 25 birds, perhaps due to about 75% reduction in nesting cover
Lokemoen and Beiser 1997	North Dakota	Cropland, idle	Nested mainly in growing wheat when its form was similar to open grassland; nested in minimum-tillage and organic fields but not fields subjected to conventional tillage
Lokemoen and Duebbert 1974	South Dakota	Burned mixed-grass, idle mixed-grass, mixed-grass hayland, mixed-grass pasture	Nested in high density on idle, mowed, and burned prairie
Luttschwager and Higgins 1992	South Dakota	CRP (idle seeded-native, idle tame, seeded-native hayland, tame hayland)	Nest in hayed strips and idle fields
Messmer 1985	North Dakota	Idle mixed-grass/tame, mixed-grass/tame pasture	Highest nesting densities and nesting success on twice-over deferred (pastures grazed twice per season with 2-mo rest between grazing) pastures and season-long (leaving cattle on the same pasture all season) pastures (with some undisturbed nesting cover during the nesting season) than idle pastures
Messmer 1990	North Dakota	Idle mixed-grass/tame, mixed-grass/tame hayland, mixed-grass/tame pasture, wet-meadow pasture	Highest densities found in short-duration grazed (system of pastures rotated through a grazing schedule of about 1 wk grazed and 1 mo ungrazed, repeated throughout the season) pastures, followed by twice-over deferred and season-long; as range conditions on the short-duration pasture improved and cover increased, density decreased; used previously

			idled areas only after mowing
Musselman 1935	Illinois, Missouri	Idle tame	Nested in abandoned clover (no scientific name provided) fields and grass
Niemi and Hanowski 1983	Minnesota	Idle tallgrass, peatland, shrub carr, wetland	Predominant forbs within territories were bedstraw (<i>Galium</i> spp.), goldenrod, and clover (<i>Trifolium</i> spp.); mean habitat measurements from 40 sampling points within four territories were 79 cm vegetation height, 35% ground cover, (coverage of live vegetation with a total height of ≤ 10 cm), and 24 cm phanerophyte (shrubs, forbs, or graminoids > 40 cm high and present each year) height
Oetting and Cassel 1971	North Dakota	Idle tame	Nested in road rights-of-way
Patterson 1994, Patterson and Best 1996	Iowa	Cropland, CRP (idle tame, tame hayland)	Nested in CRP fields but not in cropland
Prescott and Wagner 1996	Alberta	Mixed-grass pasture, tame pasture	Occurred only in deferred-grazed (grazed after 15 July) native pastures, but not in continuously grazed native pastures, native grassland grazed in early summer, or in tame pastures of crested wheatgrass grazed in spring from late April to mid-June
Pylypec 1991	Saskatchewan	Burned mixed-grass, idle mixed-grass	Occurred in recently burned areas 2-3 yr postburn
Renken 1983, Renken and Dinsmore 1987	North Dakota	Dense nesting cover (DNC ; idle tame), idle mixed-grass, mixed-grass pasture	Used idle and grazed native grassland, and alfalfa-wheatgrass dense nesting cover, and areas 1 yr postgrazing; used plots with less grass, less forb cover, less tall and dense vegetation, and with a thinner litter layer than unused plots; used areas characterized by 57.4% grass cover, 23.5% forb

			cover, 98.8% litter cover, 5.7% shrub cover, 0.5% bare ground, 11 cm effective vegetation height, and 2.3 cm litter depth
Robel et al. 1998	Kansas	CRP (burned seeded-native, idle seeded-native)	Were present only on spring-burned CRP fields but not on unburned CRP fields
Rotenberry and Wiens 1980	Colorado, Kansas, Montana, Nebraska, Oklahoma, Oregon, South Dakota, Texas, Washington, Wisconsin, Wyoming	Idle mixed-grass, idle shortgrass, idle shrubsteppe, idle tallgrass, montane meadow	Abundance was positively correlated with total number of vertical vegetation hits, and negatively correlated with percent bare ground
Sample 1989	Wisconsin	Burned tallgrass, cropland, DNC (idle seeded-native, idle tame), idle, idle seeded-native, idle tallgrass, idle tallgrass/tame, idle tame, tame hayland, tame pasture, tame savanna pasture, wet meadow, wet-meadow pasture	Preferred hayland and managed or disturbed grasslands; avoided sites with woody vegetation; used areas with an average of 0.5% woody cover, 81% herbaceous cover, 15% litter cover, 8% bare ground, maximum vegetation height of 45 cm, and vegetation height/density of 14 cm; sandpiper density was highest with a medium density (medium density defined as <3 cm deep with >50% coverage) of prostrate residual vegetation; density was negatively correlated to total percent woody cover, total number of dead stems, maximum vegetation height, and height/density values

Sedivec 1994	North Dakota	Idle mixed-grass, mixed-grass pasture	Used grazed areas for nesting more often than ungrazed areas; nested in vegetation with average height/density of 11.8 cm
Skinner 1974, 1975	Missouri	Idle tallgrass, idle tame, tallgrass hayland, tallgrass pasture, tame hayland, tame pasture	Nest density was highest under moderate grazing (vegetation 10.2-30.4 cm tall) and heavy grazing (0-10.2 cm tall); also present in hayland, combined fields, and lightly grazed pasture (>30.4 cm tall); not present in idle fields
Skinner 1982, Skinner et al. 1984	Missouri	Burned tallgrass, idle tallgrass, tallgrass hayland, tallgrass pasture, tame pasture	Were found in short cover typical of heavily grazed areas (low grass and forb cover); nested in pasture among small clumps of grass and forbs (grasslands with this vegetation structure occurred on moderately to heavily grazed prairie and on April-burned prairie)
Snyder et al. 1987	Indiana	Cropland, idle tallgrass, idle tame	Used oat fields in spring until fields were harvested; foraged in mowed areas and idle tallgrass areas; bred in idle tallgrass; perched on utility and light poles
Speirs and Orenstein 1967	Ontario	Cropland, idle, pasture, tame hayland	Used lightly grazed pasture
Sutter and Brigham 1998	Saskatchewan	Mixed-grass pasture, tame pasture	Were present in low abundances in both mixed-grass pasture and pastures of crested wheatgrass
White 1980, 1983	Wisconsin	Cropland, hayland, idle tallgrass, burned pasture, pasture, woodland	Preferred non-forested areas, smooth terrain, presence of fence posts (or other areas for display, such as tree stumps and rock piles), unfragmented agricultural fields, and fields of hay, oats, or pasture rather than corn; nested in pastures, both burned and unburned, in prairie, and in hayfields

Wilson and Belcher 1989	Manitoba	Idle mixed-grass, idle tame	Abundance was positively correlated with presence of native vegetation and negatively correlated with presence of tame vegetation
Zimmerman 1993	Kansas	Burned tallgrass, idle, idle tallgrass, woodland	Nested in watersheds that were not burned in spring; greatest frequency of relative abundance and mean relative abundance were in annually burned grassland, probably due to foraging use; was common on unburned grassland

*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.

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