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Effects of Management Practices on Grassland Birds: Mountain Plover

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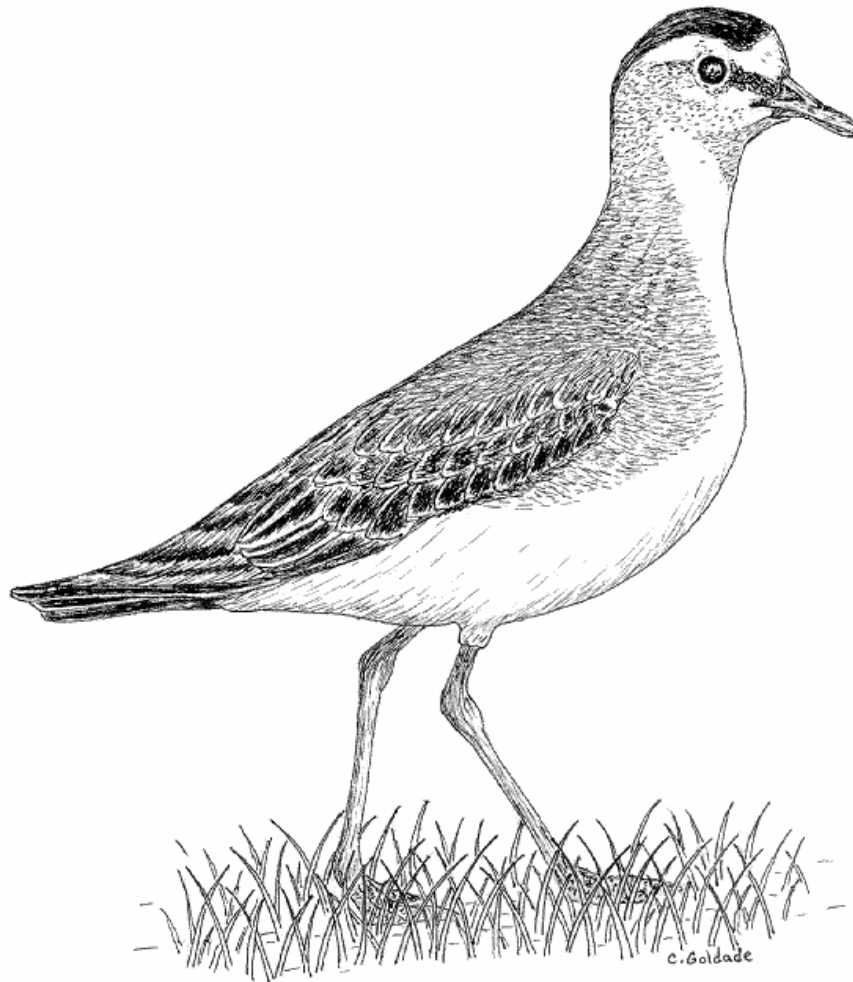
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**EFFECTS OF MANAGEMENT PRACTICES
ON GRASSLAND BIRDS:
MOUNTAIN PLOVER**



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Northern Prairie Wildlife Research Center
U.S. Geological Survey
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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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MOUNTAIN PLOVER**

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May 1998
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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.

MOUNTAIN PLOVER
(*Charadrius montanus*)

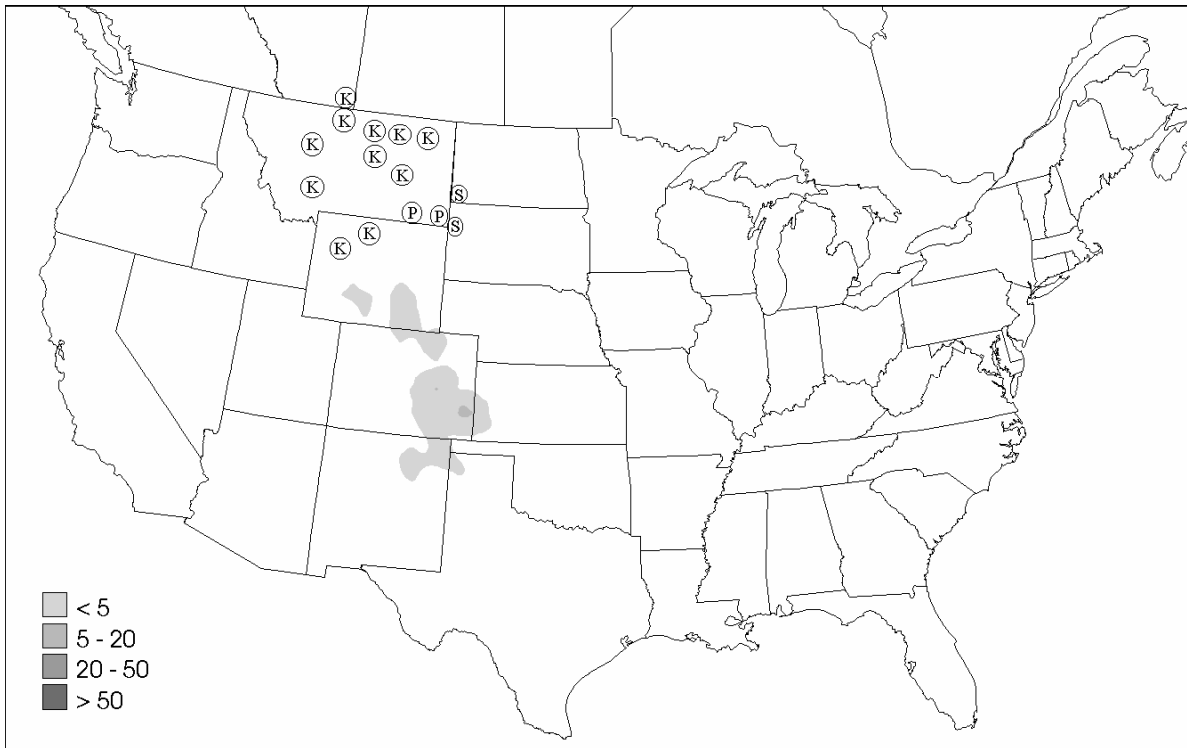


Figure. Shaded areas indicate breeding distribution of the Mountain Plover in the United States and southern Canada, based on Breeding Bird Survey data, 1985-1991. Scale represents average number of individuals detected per route per year. Map from Price, J., S. Droege, and A. Price. 1995. The summer atlas of North American birds. Academic Press, London, England. 364 pages. Circles indicate other locations with known breeding populations (K), locations used by Mountain Plovers but where breeding has not yet been documented (P), and locations with apparently suitable habitat for Mountain Plovers that have not been surveyed (S). Information courtesy of Craig J. Knowles.

Keys to management include providing short, sparse grasslands of adequate size. Mixed-grass areas can be made suitable for breeding Mountain Plovers by preserving large prairie dog (*Cynomys* spp.) towns and, in some situations, implementing heavy grazing.

Breeding range:

Mountain Plovers breed from southeastern Alberta and southwestern Saskatchewan through central Montana, south to southcentral Wyoming, eastcentral Colorado and northeastern New Mexico, and east to northern Texas and western Kansas (National Geographic Society 1987). (See figure for the relative densities of Mountain Plovers in the United States and southern Canada, based on Breeding Bird Survey data.)

Suitable habitat:

Mountain Plovers prefer large, flat grassland expanses with sparse, short vegetation, and bare ground (Giezentanner 1970; Graul 1973, 1975; Knowles et al. 1982; Olson 1984; Olson and Edge 1985; Shackford 1987; Wershler and Wallis 1987; Leachman and Osmundson 1990;

Parrish et al. 1993; Knopf and Miller 1994; Knowles 1996). Areas disturbed by prairie dogs, heavy grazing, or fire can provide suitable habitat (Finzel 1964, Wallis and Wershler 1981, Knowles and Knowles 1984, Olson 1984, Shackford 1987, Wershler and Wallis 1987). Plowed land also may be used by adults and broods in some areas (Shackford 1987, 1996; Shackford and Leslie 1994; Knopf and Rupert 1999, Shackford et al. 1999). Mountain Plovers may continue to nest in cropland as vegetation increases in height to about 35 cm (Shackford and Leslie 1994). Knopf and Rupert (1999) found that adults with broods moved from cultivated land to grazed shortgrass prairie when vegetation in the field reached 20 cm tall. Within semidesert habitat, Mountain Plovers use sparsely vegetated flat areas with cacti, low shrubs, and an open understory (Tolle 1976, Day 1994).

Mountain Plovers often are associated with blue grama (*Bouteloua gracilis*) or buffalo grass (*Buchloe dactyloides*) (Bradbury 1918; Laun 1957; Finzel 1964; Giezentanner 1970; Graul 1973, 1975; Graul and Webster 1976; Wallis and Wershler 1981, Parrish 1988, Parrish et al. 1993). However, none of 147 nests in Colorado shortgrass prairie were associated with buffalo grass (Knopf and Rupert 1999). The species often nests near cow pies, rocks, or clumps of vegetation (Graul 1975, Wallis and Wershler 1981, Olson and Edge 1985, Knopf and Miller 1994, Knopf 1996a, Parrish 1988, Parrish et al. 1993). Litter cover near nests in Montana was greater than that in the surrounding habitat (Olson 1984, Olson and Edge 1985). In northeastern Wyoming, Mountain Plovers nested in areas with higher shrub density, lower distance to vehicle and animal ruts, and shorter grasses, forbs, and shrubs than random sites (Parrish 1988, Parrish et al. 1993). Shrubs, primarily birdsfoot sagebrush (*Artemisia pedatifida*), in the nesting habitat grew in a mat-like fashion and were small (2-20 cm) in diameter (Parrish et al. 1993). In Colorado, nest sites had 68% grass cover and 32% bare ground (Knopf 1996a). In a later study in the same area, brood-rearing occurred in areas with more bare ground and less grass cover than areas used for nesting (Knopf and Rupert 1999). Mean percent bare ground and grass cover on brooding areas was 15% and 84%, respectively, compared to 9% and 87% on nesting areas, respectively. Differences were significant. Cover of forbs, prickly pear, and cow manure were similar between the two areas. In Alberta, the dominant vegetation at nest sites was grasses and sedges (*Carex filifolia*) (Wershler and Wallis 1987). Bare ground at unburned and burned sites was 15-25% and 45-50%, respectively. Within cultivated fields in Colorado, Kansas, Oklahoma, and Wyoming, nests were located on bare or fallow ground, in fields of growing cropland (primarily wheat), or in wheat stubble (Shackford et al. 1999).

In mixed-grass prairie and other areas where vegetation is otherwise too tall, thick, or shrubby, prairie dog towns that are moderately to heavily grazed on a 4-yr rest-rotation grazing system provide the mixture of short grass and bare ground suitable for Mountain Plovers (Knowles and Knowles 1984, Olson 1984, Olson and Edge 1985). In Montana, Mountain Plovers rarely were seen outside of prairie dog towns, and towns <10 ha were considered marginal habitat (Knowles et al. 1982, Olson 1984). Towns also may provide greater food resources and more vulnerable prey for Mountain Plovers (Olson 1985). Towns occupied by Mountain Plovers often are associated with cattle pastures and stock ponds (Knowles et al. 1982, Olson and Edge 1985). In Montana, nest sites on prairie dog towns had lower mean plant cover, grass cover, vegetation height, big sagebrush (*Artemisia tridentata*) cover, and plains prickly pear (*Opuntia polyacantha*) density than adjacent areas (Olson 1984). Within prairie dog towns, Mountain Plovers chose nest sites with shorter vegetation, more bare ground, and higher forb density (Olson 1984, Olson and Edge 1985).

Knopf and Rupert (1999) examined presence of Mountain Plovers around stock tanks used by cattle and stock tanks not used by cattle. Plovers used 11 of the 28 tanks where cattle were present and were absent at all 28 tanks without cattle. Plovers probably were attracted either to cattle presence or recent land disturbance created by cattle. A table near the end of the account lists the specific habitat characteristics for Mountain Plovers by study.

Area requirements:

In Colorado, the minimum area needed to raise a brood was at least 28 ha and three males defended territories averaging 16 ha (Graul 1973, Knopf and Rupert 1996). Broods often used overlapping areas (Graul 1973, Knopf and Rupert 1996). In areas where Mountain Plovers are associated with prairie dog towns, the size of towns is an important factor. Mountain Plovers in Montana occurred at highest densities on towns 6-50 ha and were less abundant on smaller towns (Knowles et al. 1982, Olson 1984, Olson-Edge and Edge 1987). Average size of towns used by Mountain Plovers in northcentral Montana was 57.5 ha (Knowles and Knowles 1984).

Brown-headed Cowbird brood parasitism:

No known records of brood parasitism by Brown-headed Cowbirds (*Molothrus ater*) exist.

Breeding-season phenology and site fidelity:

Generally, Mountain Plovers arrive on the breeding grounds from mid-March to mid-April and depart for fall migration in early August to late October (Graul 1973, 1975; Wallis and Wershler 1981; Olson 1984; Leachman and Osmundson 1990; Knopf 1996*a,b*). In Colorado, the peak breeding season is mid-April to mid-July (Ball 1996).

If the first nest fails before June, the female may attempt to renest (Knopf 1996*b*). Multiple nesting (the male incubates a first clutch while the female incubates a second clutch simultaneously) has been reported (Graul 1973, Knopf 1996*a*). Mountain Plovers exhibit fidelity to nest sites used the previous year (Graul 1973, 1975).

Species' response to management:

Burning can benefit Mountain Plovers when used to maintain areas of shorter grass within mixed grassland (Wallis and Wershler 1981, Knopf 1996*b*).

Mountain Plovers prefer heavily grazed grasslands (Ryder 1980, Knowles et al. 1982, Kantrud and Kologiski 1982, Wershler and Wallis 1987, Bock et al. 1993). In central Montana, Mountain Plovers are usually associated with prairie dog towns (Knowles 1996). Prairie dogs within shrub-grassland pastures can control sagebrush growth and provide suitable nesting habitat (Olson 1984, Olson and Edge 1985). On a northern Montana shrub-grassland, cattle grazing alone, without prairie dog towns, did not provide suitable habitat (Olson and Edge 1985). Grazing activities that maintain short vegetation and low litter also attract Mountain Plovers; they have been reported following sheep herds, inhabiting areas around stock tanks, and increasing in numbers where American bison (*Bison bison*) are pastured (Knowles 1996). In Alberta, heavy grazing in summer or late winter improved habitat for Mountain Plovers by providing short grass in mixed-grass areas (Wallis and Wershler 1981, Wershler and Wallis 1987). In Colorado, shortgrass pastures grazed heavily in summer were used for foraging and

nesting (Giezentanner 1970). However, Mountain Plovers may be excluded by extreme or long-term overgrazing (Laun 1957, Wallis and Wershler 1981).

Mountain Plovers have been found to nest in cultivated fields in Colorado, Kansas, Oklahoma, and Wyoming (Shackford 1987, 1996; Shackford and Leslie 1994; Knopf and Rupert 1999; Shackford et al. 1999). In Oklahoma, Mountain Plovers may prefer plowed fields over shortgrass prairie unless prairie dog towns are present (Shackford 1991, 1996). In Colorado, Mountain Plovers preferred a cultivated field over shortgrass prairie after April (Knopf and Rupert 1999). In April, number of Mountain Plovers within the two habitats did not differ. However, after the field had been planted and chemically treated for weed control in early May, detections of Mountain Plovers were significantly higher on the cultivated field than on prairie. Although a few nests were found, Mountain Plovers appeared to be mainly foraging in prairie and were nesting primarily in the field. However, planting and weed control operations probably destroyed nests, as Mountain Plovers began courtship activities for a second time. Broods moved from prairie to fields, as did adults that were unsuccessful breeders.

Mountain Plovers are found in saltbush (*Atriplex*)-dominated habitats in central Montana; the seeding of saltbush habitats to crested wheatgrass (*Agropyron cristatum*) and the creation of weedy mudflats due to damming, caused Mountain Plovers to disappear from the area (Knowles 1996).

Oil and gas extraction activities may be compatible with Mountain Plover needs. In Utah, disturbed areas around oil well pads create open habitat with high amounts of bare ground suitable for Mountain Plovers (Day 1996). Ball (1996) recommended curtailing or prohibiting activities during the peak breeding period; however, Mountain Plovers in southeastern Wyoming did not seem to be disturbed by nearby mining activity (Parrish 1988).

Management Recommendations:

Protect Mountain Plover habitat from disturbance, especially during the breeding season (Wershler 1991, Ball 1996, Knopf 1996b). Plowing of nesting areas during the breeding season should be avoided (Knopf 1996b). To minimize length of disturbance, preparation of fields for planting should be done right before planting rather than a month in advance (Knopf and Rupert 1999). Use chemical rather than physical treatments on fields to control weeds between 1 May and 15 July.

Areas traditionally used by Mountain Plovers should be protected, as some individuals return to the same sites year after year (Graul 1973, 1975).

Maintain prairie dog towns in areas where Mountain Plovers require them, such as in Montana (Knowles et al. 1982, Olson and Edge 1985). Cattle grazing in these areas should be encouraged, as prairie dog towns often are associated with grazed areas (Knowles et al. 1982, Olson and Edge 1985). Promote large prairie dog towns. In Montana, Mountain Plovers occurred at highest densities on towns 6-50 ha, and they avoided smaller towns (Knowles et al. 1982, Olson 1984, Olson-Edge and Edge 1987).

Protect large continuous natural grasslands from tillage and from seeding to exotic grasses (Wershler 1987, 1991). Encourage use of native seeds on Conservation Reserve Program areas (Knopf and Rupert 1999).

Maintain large areas of short grass within native mixed-grass areas (Wallis and Wershler 1981). Disturbances such as prairie dog towns, grazing, or burning can provide these areas (Finzel 1964, Wallis and Wershler 1981, Knowles and Knowles 1984, Knopf 1996b).

In Colorado shortgrass, manage grasslands to maintain vegetation <25 cm in height (Ball 1996). In Oklahoma cropland, birds have been found nesting in vegetation as tall as 38 cm (Shackford 1991).

Improve habitat for Mountain Plovers in native grassland by conducting prescribed burns (Wallis and Wershler 1981, Eldridge 1992, Knopf 1996b). In Alberta, burns should be conducted in late summer or early fall to promote vegetation that is associated with Mountain Plover habitat (Wershler 1991). In Colorado, attract Mountain Plovers to grasslands by conducting winter or spring burns (Knopf and Rupert 1999).

Graze shortgrass or mixed-grass pastures at moderate to heavy intensities (Knowles et al. 1982, Eldridge 1992). Graze at heavy intensities in summer or late winter (Wallis and Wershler 1981, Wershler 1987).

Vary grazing pressure by interspersing areas of heavy, light, and non-grazing. This may simulate historic grazing by American bison (Wallis and Wershler 1981). In Alberta and Saskatchewan, avoid long-term overgrazing, which may exclude Mountain Plovers (Wallis and Wershler 1981). To enhance nesting habitat in Colorado, allow intensive, long-term grazing on rangeland adjacent to cultivated fields (Knopf and Rupert 1999). Because plovers appear near areas disturbed by cattle, allow cattle into native pastures by early May.

Restrict oil, gas, and recreational activities near Mountain Plover habitat during the peak breeding season (April-July) (Ball 1996).

Table. Mountain Plover habitat characteristics.

Author(s)	Location(s)	Habitat(s) Studied*	Species-specific Habitat Characteristics
Bradbury 1918	Colorado	Shortgrass pasture	Used open, rolling upland prairie, grazed by cattle
Finzel 1964	Wyoming	Mixed-grass pasture, shortgrass pasture, woodland	Bred in flat areas dominated by blue grama (<i>Bouteloua gracilis</i>)/buffalo grass (<i>Buchloe dactyloides</i>) or blue grama/needle-and-thread (<i>Stipa comata</i>)
Giezentanner 1970	Colorado	Idle, cropland, hayland, shortgrass pasture	Were most common in heavily grazed blue grama/buffalo grass pastures with sparse vegetation; preferred low areas and short grasses
Graul 1973, 1975	Colorado	Shortgrass pasture	Nested on flat areas (≤ 2 degrees) near short patches of blue grama/buffalo grass (< 10 cm high); often nested near cow pies
Graul and Webster 1976	Colorado	Shortgrass pasture	Preferred heavily grazed blue grama/buffalo grass pastures
Kantrud and Kologiski 1982	Colorado, Montana, Nebraska, North Dakota, South Dakota, Wyoming	Mixed-grass pasture, shortgrass pasture, shrubsteppe	Used heavily grazed areas with aridic ustoll soils; these areas were characterized by vegetation height of 10 cm and bare ground cover of 17%
Knopf 1996a	Colorado	Cropland, shortgrass pasture	Nested in areas with 68% grass cover and 32% bare ground; 49% of nests were near cow pies and 7% were near plains prickly pear (<i>Opuntia polyacantha</i>); nesting was also attempted in fallow cropland
Knopf and Miller 1994	Colorado	Semidesert grassland,	Nested on areas with $\geq 30\%$ bare ground, disturbed areas, or

		shortgrass pasture	semidesert grasslands; nest sites had lower percent vegetative cover, more cow pies, and fewer prickly pears than nearby random sites; 49% of nest sites contained manure piles or conspicuous rocks
Knopf and Rupert 1999	Colorado	Cropland, shortgrass pasture	Nested and raised broods primarily on cultivated field although a few nests were found in prairie; broods moved from the field to prairie when vegetation in the field reached 20 cm tall; in prairie, brood-rearing activities occurred in areas with more bare ground and less grass cover than areas used for nesting: mean percent bare ground and grass cover on brooding areas was 15% and 84%, respectively, compared to 9% and 87% on nesting areas; cover of forbs, prickly pear, and cow manure were similar between the two habitats; none of 147 nests found were in buffalo grass; preferred area around stock tanks that were used by cattle over stock tanks not used by cattle
Knowles 1996	Montana	Colonies of burrowing mammals, shortgrass pasture	Used areas with short vegetation and low amounts of litter; were often found near stock tanks and on prairie dog (<i>Cynomys</i> spp.) towns; typical habitat consisted of a plant community dominated by saltbush (<i>Atriplex</i>), but plovers were also found in wild buckwheat (<i>Eriogonum</i>) with 70% bare ground and glacial till and rocks present
Knowles and Knowles 1984	Montana	Colonies of burrowing mammals, burned mixed-grass, mixed-grass pasture	Used habitat with short vegetation and flat ground, such as that provided by prairie dog towns, heavy grazing, and/or burning in mixed-grass prairie; average size of occupied prairie dog town was 57.5 ha
Knowles et al. 1982	Montana	Colonies of burrowing mammals, mixed-	Used active, upland prairie dog towns (81% of towns used were ≥ 10 ha in size), characterized by sparse shrub cover,

		grass pasture, shortgrass pasture	low slope (12%), and heavy grazing
Laun 1957	Wyoming	Shortgrass pasture	Nested in shortgrass pasture dominated by needle-and-thread grass, Junegrass (<i>Koeleria pyramidata</i>), and Sandburg's bluegrass (<i>Poa sandbergii</i>)
Leachman and Osmundson 1990	Rangewide	Colonies of burrowing mammals, cropland, idle, pasture	Nested on level ground with short, sparse vegetation; may be restricted to prairie dog towns in areas with taller vegetation; nesting habitat often is heavily grazed; cropland usually is avoided
Olson 1984, Olson and Edge 1985	Montana	Colonies of burrowing mammals, shortgrass pasture	Nested on prairie dog towns; nest sites had less bare ground and mean vegetation height than non-nest sites within towns; nest sites had higher fringed sagewort (<i>Artemisia frigida</i>) and litter cover densities, lower mean vegetation height, and lower total plant, grass, prickly pear, and big sagebrush (<i>Artemisia tridentata</i>) cover than sites adjacent to towns
Parrish 1988, Parrish et al. 1993	Wyoming	Colonies of burrowing mammals, shortgrass pasture	Used flat (<3% slope) areas in clay soil with short, sparse vegetation, mainly birdsfoot sagebrush (<i>Artemisia pedatifida</i>) and blue grama; nested near cow pies and near animal or vehicle tracks or ruts; nest sites had higher shrub density (average density of 12.3 shrubs per m ²), shorter grasses (average height of 8.4 cm), shorter forbs (average height of 4.3 cm), shorter shrubs (average height of 3.67 cm), taller cacti (average height of 6.73 cm), and less distance to animal or wheel tracks than random sites; average percent cover at nest sites was 13.89% grass, 2.11% forb, 10.39% shrub, 71.77% bare ground, and 1.85% litter. Nest sites had lower forb density and more grass cover than sites where chicks were located

Shackford 1987, 1991	Oklahoma	Colonies of burrowing mammals, cropland, idle shortgrass	Nested in native grassland (60% of 25 nests) as well as plowed and cultivated fields (40%); one nest was found in a maize field where vegetation was 20 cm high; one nest was found in a prairie dog (<i>Cynomys</i>) colony; nest sites occurred most commonly on clay loams on slopes of 0-1%
Shackford 1996	Colorado, Kansas, Montana, Oklahoma, Wyoming	Cropland, idle	In Oklahoma, nested in idle fields (52 nests in 42 fields); in Colorado, nested in cultivated fields, especially if native prairie was nearby; in Wyoming, nested in plowed river bottom fields. Weed cover of 1% was adequate to meet shade requirement
Shackford and Leslie 1994	Colorado, Kansas, Oklahoma	Cropland, idle	Fields attractive to plovers were large (>30 ha), of fine, loamy soil with sparse vegetation, flat topography, and uniform, flat plowing; tall vegetation may harbor nests: one nest remained active until vegetation was 38 cm high; plovers sought shade beneath whatever sparse vegetation was available; soil near nests contained an average of 55% sand and 43% silt/clay, whereas soil on cultivated fields unoccupied by plovers contained an average of 80% sand and 20% silt/clay
Shackford et al. 1999	Colorado, Kansas, Montana, Nebraska, New Mexico, Oklahoma, Wyoming, Texas	Cropland, idle	Of 52 nests found in cultivated fields, 26 were on bare or fallow ground, 13 were in growing wheat, seven were in milo fields, four were in fields of forbs or forb stubble, and two were in fields of sprouting corn
Tolle 1976	New Mexico	Desert grassland	Nested on gently rolling ground with sparse, heavily grazed,

		pasture	shrubby vegetation and a high amount of bare ground
Wallis and Wershler 1981	Alberta	Burned mixed-grass, mixed-grass pasture	Nested in recently burned, heavily grazed winter pasture and on low slopes characterized by bare ground and blue grama grass
Wershler and Wallis 1987	Alberta	Burned mixed-grass, mixed-grass pasture	Nested on flat, heavily grazed mixed-grass pastures containing well-drained sandy soil; dominant vegetation at nest sites included threadleaved sedge (<i>Carex filifolia</i>), Sandburg's bluegrass, Junegrass, and blue grama; avoided areas with tall grass cover, shrubs, poorly drained soil, and rolling hills

*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

- Ball, M. 1996. Impacts of grassland uses and management practices. Pages 28-29 in D. P. Coffin, editor. Summary report - shortgrass prairie/Mountain Plover workshop. Denver Audubon Society, Aurora, Colorado.
- 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.
- Bradbury, W. C. 1918. Notes on the nesting of the Mountain Plover. *Condor* 20:157-163.
- Day, K. S. 1994. Observations on Mountain Plovers (*Charadrius montanus*) breeding in Utah. *Southwestern Naturalist* 39:298-300.
- Eldridge, J. 1992. Management of habitat for breeding and migrating shorebirds in the Midwest. U.S. Fish and Wildlife Service Leaflet 13.2.14. 6 pages.
- Finzel, J. E. 1964. Avian populations of four herbaceous communities in southeastern Wyoming. *Condor* 66:496-510.
- Giezentanner, J. B. 1970. Avian distribution and population fluctuations on the shortgrass prairie on north central Colorado. M.S. thesis. Colorado State University, Fort Collins, Colorado. 113 pages.
- Graul, W. D. 1973. Adaptive aspects of the Mountain Plover social system. *Living Bird* 12:69-94.
- Graul, W. D. 1975. Breeding biology of the Mountain Plover. *Wilson Bulletin* 87:6-31.
- Graul, W. D., and L. E. Webster. 1976. Breeding status of the Mountain Plover. *Condor* 78:265-267.
- 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.
- Knopf, F. 1996a. Review of latest data on Mountain Plover and shortgrass species in general. Pages 17-19 in D. P. Coffin, editor. Summary report - shortgrass prairie/Mountain Plover workshop. Denver Audubon Society, Aurora, Colorado.
- Knopf, F. L. 1996b. Mountain Plover (*Charadrius montanus*). In A. Poole and F. Gill, editors. *The birds of North America*, No. 211. The Academy of Natural Sciences, Philadelphia, Pennsylvania; The American Ornithologists' Union, Washington, D.C.

- Knopf, F. L., and B. J. Miller. 1994. *Charadrius montanus* - Montane, grassland, or bare-ground plover? *Auk* 111:504-506.
- Knopf, F. L., and J. R. Rupert. 1996. Reproduction and movements of Mountain Plovers breeding in Colorado. *Wilson Bulletin* 108:28-35.
- Knopf, F. L., and J. R. Rupert. 1999. Use of cultivated fields by breeding Mountain Plovers in Colorado. Pages 81-86 in P. D. Vickery and J. R. Herkert, editors. *Ecology and conservation of grassland birds of the Western Hemisphere. Studies in Avian Biology* 19.
- Knowles, C. 1996. Studies and observations of Mountain Plover in Montana. Pages 30-31 in D. P. Coffin, editor. *Summary report - shortgrass prairie/Mountain Plover workshop*. Denver Audubon Society, Aurora, Colorado.
- Knowles, C. J., and P. R. Knowles. 1984. Additional records of Mountain Plovers using prairie dog towns in Montana. *Prairie Naturalist* 16:183-186.
- Knowles, C. J., C. J. Stoner, and S. P. Gieb. 1982. Selective use of black-tailed prairie dog towns by Mountain Plovers. *Condor* 84:71-74.
- Laun, H. C. 1957. A life history study of the Mountain Plover, *Eupoda montana*, Townsend on the Laramie Plains, Albany County, Wyoming. M.S. thesis. University of Wyoming, Laramie, Wyoming. 67 pages.
- Leachman, B., and B. Osmundson. 1990. Status of the Mountain Plover: a literature review. U.S. Fish and Wildlife Service, Golden, Colorado. 83 pages.
- National Geographic Society. 1987. *Field guide to the birds of North America*, second edition. National Geographic Society, Washington, D.C. 464 pages.
- Olson, S. L. 1984. Density and distribution, nest site selection, and activity of the Mountain Plover on the Charles M. Russell National Wildlife Refuge. M.S. thesis. University of Montana, Missoula, Montana. 62 pages.
- Olson, S. L. 1985. Mountain Plover food items on and adjacent to a prairie dog town. *Prairie Naturalist* 17:83-90.
- Olson, S. L., and D. Edge. 1985. Nest site selection by Mountain Plovers in northcentral Montana. *Journal of Range Management* 38:280-282.
- Olson-Edge, S. L., and W. D. Edge. 1987. Density and distribution of the Mountain Plover on the Charles M. Russell National Wildlife Refuge. *Prairie Naturalist* 19:233-238.
- Parrish, T. L. 1988. Mountain Plover habitat selection in the Powder River Basin, Wyoming. M.S. thesis. University of Wyoming, Laramie, Wyoming. 60 pages.

- Parrish, T. L., S. H. Anderson, and W. F. Oelklaus. 1993. Mountain Plover habitat selection in the Powder River Basin, Wyoming. *Prairie Naturalist* 25:219-226.
- Ryder, R. A. 1980. Effects of grazing on bird habitats. Pages 51-66 in R. M. Degraff and N. G. Tilghman, compilers. Management of western forests and grasslands for nongame birds. U.S.D.A. Forest Service General Technical Report INT-86. Intermountain Forest and Range Experiment Station, Ogden, Utah.
- Shackford, J. S. 1991. Breeding ecology of the Mountain Plover in Oklahoma. *Bulletin of the Oklahoma Ornithological Society* 24:9-13.
- Shackford, J. 1996. Studies and observations of Mountain Plover in the Great Plains. Page 27 in D. P. Coffin, editor. Summary report - shortgrass prairie/Mountain Plover workshop. Denver Audubon Society, Aurora, Colorado.
- Shackford, J. S., and D. M. Leslie, Jr. 1994. Mountain Plover breeding activity on cultivated fields. Federal aid project E-26-1. Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma. 11 pages.
- Shackford, J. S., D. M. Leslie, Jr., and W. D. Harden. 1999. Range-wide use of cultivated fields by Mountain Plovers during the breeding season. *Journal of Field Ornithology* 70:114-120.
- Tolle, D. A. 1976. A westward extension in the breeding range of the Mountain Plover. *Wilson Bulletin* 88:358-359.
- Wallis, C. A., and C. R. Wershler. 1981. Status and breeding of Mountain Plovers (*Charadrius montanus*) in Canada. *Canadian Field-Naturalist* 95:133-136.
- Wershler, C. R. 1987. The Mountain Plover in Canada. Pages 259-261 in G. L. Holroyd, P. H. R. Stepney, G. C. Trottier, W. B. McGillivray, D. M. Ealey, and K. E. Eberhart, editors. Endangered species in the prairie provinces. Natural History Occasional Paper No. 9. Provincial Museum of Alberta, Edmonton, Alberta.
- Wershler, C. 1991. A management strategy for Mountain Plovers in Alberta. Pages 169-172 in G. L. Holroyd, G. Burns, and H. C. Smith, editors. Proceedings of the second endangered species and prairie conservation workshop. Natural History Occasional Paper No. 15. Provincial Museum of Alberta, Edmonton, Alberta.
- Wershler, C. R., and C. A. Wallis. 1987. Status report on the Mountain Plover, *Charadrius montanus*, in Canada. Committee on the Status of Endangered Wildlife in Canada. 34 pages.