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***Charadrius montanus*—Montane, Grassland, or Bare-ground Plover?**

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The Mountain Plover (*Charadrius montanus*) is an aridland member of the Charadriidae. This plover is generally considered an associate of the North American shortgrass prairie, which is dominated by blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*; Graul 1975). The species breeds at many locations across the western Great Plains plus at isolated locales in western Colorado, Wyoming, and New Mexico (Leachman and Osmundson 1990) and recently in eastern Utah (K. S. Day pers. comm.). Continental populations of the Mountain Plover declined 63% from 1966 to 1991 (Knopf 1994), with the historic and current breeding stronghold being the Pawnee National Grassland in Weld County, Colorado (Graul and Webster 1976). Currently, a second major breeding population of Mountain Plovers is on the Charles M. Russell National Wildlife Refuge, Phillips County, Montana. Unlike when found on the grassland landscape of Weld County, Mountain Plovers in Phillips County selectively nest in prairie dog (*Cynomys* spp.) towns (Knowles et al. 1982, Olson and Edge 1985) in vegetative settings that include prickly pear (*Opuntia polyacantha*), fringed sagewort (*Artemisia frigida*), big sagebrush (*A. tridentata*), western wheatgrass (*Agropyron smithii*), and blue grama. Collectively, Weld and Phillips counties provide nesting habitat for approximately one-half of the continental population of Mountain Plovers.

Despite the differences in vegetation associations at the two major nesting locales, both Graul (1975) and Olson and Edge (1985) have described the tendency of plovers to place nests in areas of low herbaceous vegetation, reduced shrub cover, and near prominent objects such as cow-manure piles or similar-sized rocks. However, plover nests on Montana prairie dog towns also occur in areas of approximately 27% bare ground, a descriptor not mentioned by Graul (1975). The bare-ground variable may have some significance in light of recent findings of plovers sometimes nesting on plowed fields (Shackford 1991, pers. comm.) and descriptions of wintering habitats of plovers that mention use of freshly plowed ground in the San Joaquin and Imperial valleys of California (Grinnell and Miller 1944). We used a methodology similar to that employed in the Montana studies to ascertain if nest sites of Mountain Plovers also include a component of bare ground in native habitats on the

relatively prairie-dog-free Pawnee National Grassland of Colorado.

The Pawnee National Grassland encompasses 78,130 ha of shortgrass prairie on loamy, clayey, and sandy soils. Historically, the area supported uncountable numbers of bison (*Bison bison*; Frémont 1845, Voorhees 1920, and many accounts in Mattes 1988); hundreds of wallows remain clearly visible and mostly unvegetated. Besides the shortgrasses, common woody plants include prickly pear, yucca (*Yucca* spp.), and rabbitbrush (*Chrysothamnus* spp.).

We located 43 Mountain Plover nests on the Grassland during the 1991 and 1992 breeding seasons. A half-meter (1.0 × 0.5 m) rectangular frame was centered over each nest in a northwest-to-southeast orientation, after which the site was photographed. Comparison sites (also 0.5 m², referred to as "control" sites hereafter) were located by stretching a fiberglass tape oriented to the north for the 1992 nests ($n = 18$), and placing the half-meter frame on the ground in a northwest-to-southeast orientation at marked intervals of 10, 25, and 50 m from the nest. Control sites also were photographed.

During analysis of vegetative cover, a clear dot grid was overlaid on each photograph to estimate the percentage of area in shortgrass vegetation or bare ground. We also recorded frequency of cow-manure piles and prickly-pear plants within each plot.

A Kruskal-Wallis test with a correction factor for tied ranks and chi-square tests (Zar 1984) indicated no differences in percentages of vegetation cover and prickly-pear presence among the 10-, 25-, and 50-m control sites. A chi-square test comparing cow-manure piles in the three groups could not be employed because more than 20% of the expected frequencies were less than 5.0% (observed values in the three groups were 3, 2, and 2, respectively).

Data from control plots ($n = 54$) were combined for comparison with those from nest sites (Table 1). Shortgrass vegetation averaged $86 \pm$ SD of 11% of the area within those plots, 13% had dried cow-manure piles, and 28% contained prickly pear. Comparing nest sites to the pooled control sites, percentage of vegetative cover was significantly lower ($U = 1931.5$, $df = 42$ and 53 , $Z = 5.59$, $P < 0.001$ in a two-tailed test of normal approximation), and there were more cow manure piles ($X^2 = 12.2$, $P \leq 0.001$) and fewer prickly pears ($X^2 = 11.48$, $P \leq 0.001$) at nest sites.

These data further characterize structural subtleties at nest sites selected by Mountain Plovers and support previous observations that some plovers nest near a conspicuous object. Graul (1975) reported 55% of nests

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TABLE 1. Mean percentage grass cover (\pm SD) of 0.5-m² plots, and percentage of plots with dried cow manure and prickly pear.

Plot	Grass	Dried cow manure	Prickly pear
Nest	68 \pm 17	49 ^a	7
Control			
10 m	88 \pm 10	17	28
25 m	85 \pm 11	11	22
50 m	86 \pm 11	11	33
Subtotal	86 \pm 11	13	28

^a Includes count of one large flat rock.

located within 30 cm of a manure pile, and Olson and Edge (1985) reported 27% of nests on prairie dog towns were near a rock 8 cm or more in diameter. We observed 49% of plover nests placed near either a manure pile or a rock.

Relative to physical objects near nests, the only contradiction between our data and observations from earlier studies was the lower prickly-pear densities near nest sites on the grasslands. Olson and Edge (1985) saw no difference in prickly-pear densities at nest sites and random sites on prairie dog colonies, but both nest sites and control sites on those prairie dog towns had lower prickly-pear densities than control sites located outside the area impacted by prairie dogs. Sordahl (1991) noted that Mountain Plover chicks also occur at sites of decreased prickly-pear densities on the Pawnee National Grassland.

Graul (1975) speculated that Mountain Plovers nest near a prominent object to make themselves less conspicuous to predators. This hypothesis has been advanced for many plover species (e.g. Haig 1990), but specific tests for any one species are rare (Grover and Knopf 1982). We wonder, however, why manure piles and rocks would reduce predation on nests when the equally sized, structurally more complex, and physically more ominous prickly pear would not be selected for this purpose. The biological (in addition to statistical) significance of why some birds place nests near objects merits further inquiry.

Olson and Edge (1985) reported 27% bare ground at nest sites in Montana, which is similar to the 32% unvegetated area around nests on the Pawnee National Grassland. Four additional observations suggest that 30% bare ground is likely closer to a minimum habitat requirement than an optimal one in Mountain Plover ecology. First, Mountain Plovers nest in the more xeric landscapes west of the shortgrass prairie province. Second, most nesting attempts by plovers on the Pawnee National Grassland are initiated from late April through May (Graul 1975), a period when the shortgrass species remain dormant. Third, plovers often raise broods in the vicinity of excessive, local disturbance as at cattle watering or loafing areas. Fourth, Mountain Plovers definitely

winter, and occasionally nest and raise chicks, on plowed ground.

Since first collected by J. K. Townsend (1839) near the Sweetwater River (Wyoming), the name of the Mountain Plover has always been considered a misnomer in that the species does not actually occur in montane settings. Rather, most field biologists think of it as either the "you-can-see-the-mountains-from-here" plover or the "prairie" plover. Based on the constancy of bare ground across habitats within the annual cycle of the Mountain Plover, and its former cohabitation with 30 million bison (Roe 1951) and even more prairie dogs (Marsh 1984) on the western Great Plains, we offer that this species is a disturbed-prairie or semidesert species rather than a specific associate of grassland, an interpretation that brings the species more in accord with the bare-ground habitat preferences of other charadriids.

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