

RANGE-WIDE USE OF CULTIVATED FIELDS BY MOUNTAIN PLOVERS DURING THE BREEDING SEASON

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Abstract.—During six summers from 1986 through 1995, we searched cultivated fields in Montana, Wyoming, Nebraska, Colorado, Kansas, Oklahoma, New Mexico, and Texas for Mountain Plovers (*Charadrius montanus*) during the breeding and premigratory seasons. We observed 2208 Mountain Plovers on 416 cultivated fields, 96.9% of which were observed in seven counties in four states. We located 52 nests on cultivated fields: 50% on fallow or bare fields ($\geq 95\%$ bare), 23.1% on wheat fields, 1.9% on both wheat and forb stubble fields, and the remainder on fields of milo (13.5%), forbs (7.7%), and corn (3.8%). Of 46 nests found on cultivated fields, 31 failed; 70.9% were destroyed by farm machinery, and known losses to predation were only 3.3%. Mountain Plovers nested and appeared to rear young (30 chicks observed) on cultivated fields in southern latitudes, particularly on fields used for winter wheat. Cultivated fields will play an important role in the conservation of the Mountain Plover, as it is considered for threatened or endangered status, but comparative research is needed to clarify that role relative to use of native habitat.

USO AMPLIO DE CAMPOS CULTIVADOS POR *CHARADRIUS MONTANUS* DURANTE LA ÉPOCA DE REPRODUCCIÓN

Sinopsis.—Estudiamos individuos de *Charadrius montanus* en los campos cultivados de Montana, Wyoming, Colorado, Kansas, Oklahoma, New Mexico y Texas en las temporadas reproductivas y pre-migratorias durante seis veranos, desde 1986 hasta 1995. Observamos 2208 individuos en 416 campos cultivados, 96.9% de los cuales se observaron en siete condados de cuatro estados. Localizamos 52 nidos en campos cultivados, 50% en campos limpios o abandonados (≥ 95 limpios), 23.1% en campos sembrados de *Triticum*, 1.9% en campos de *Triticum* y retoños de Euphorbiaceae, y el resto en campos de *Panicum* (13.5%), Euphorbiaceae (7.7%), y *Zea* (3.8%). De los 46 nidos hallados en campos cultivados, 31 fallaron; 70.9 fueron destruidos por maquinaria de la granja, y las pérdidas atribuidas a la depredación fueron de tan solo 3.3%. Los individuos de *Charadrius montanus* anidaron y aparentaron criar pichones (30 pichones notados) en campos de las latitudes del sur, principalmente en campos utilizados para cultivar *Triticum* en el invierno. Los campos cultivados jugarán un rol importante en la conservación de esta especie, ya que se considera modificar su estatus a amenazado o en peligro, pero estudios comparativos se necesitan para clarificar este rol relativo al del uso de habitat nativo.

The Mountain Plover (*Charadrius montanus*) is one of many avian species that is declining (Knopf 1994) in endangered grasslands of the Great Plains in the central United States (Samson and Knopf 1994). The overall population of Mountain Plovers declined 63% from 1966 to 1993 (Knopf 1994), leading to a petition to list the species as threatened or endan-

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gered under the Endangered Species Act (Knopf 1996; Knopf and Rupert 1996, in press).

Mountain Plovers have been considered short- to mixed-grass prairie obligates during the breeding season (Graul and Webster 1976, Olson-Edge and Edge 1987, Knopf 1996) and historically nested in association with prairie herbivores such as bison (*Bison bison*) and prairie dogs (*Cynomys* spp.) (Knopf and Miller 1994, Knopf 1996). A substantial loss of native nesting habitat for Mountain Plovers and other grassland species has occurred because native herbivores have been replaced by cattle, and dryland farming in the short-grass prairie ecosystem has increased (Samson and Knopf 1994). Knopf and Rupert (in press) speculated that mechanical working of fields during nesting and early chick rearing of Mountain Plovers could be responsible for the range-wide population decline of the species.

Knopf and Rupert's (in press) observations of breeding Mountain Plovers on cultivated fields were limited to eastern Colorado, and no range-wide survey of nesting by Mountain Plovers on cultivated habitat has been undertaken. Our objectives were to evaluate use of cultivated fields by Mountain Plovers throughout their breeding range and assess consequences of their selection of dryland agricultural fields as breeding habitat.

METHODS

In 1986, 1990 (Shackford 1991, unpubl. data), and 1992–1995, we searched cultivated fields for breeding Mountain Plovers in north-central to south-central Montana, north-central to southeastern Wyoming, southwestern Nebraska, eastern Colorado, southwestern Kansas, the Oklahoma Panhandle, northeastern to east-central New Mexico, and the western part of the Texas Panhandle. Potential habitat to search was not based solely on the known breeding range of the Mountain Plover (Knopf 1996) but included cultivated land east of that range, particularly in Kansas.

We examined Goode's World Atlas (1990) to determine general locations of cultivated land and 38 county soil survey books of the Natural Resources Conservation Service from all eight states to identify aggregations of cultivated fields (as opposed to areas with sparse or isolated fields) in which to search for Mountain Plovers. Search effort by state was predicated on the areal extent of fields that had (1) fine loamy soils, (2) large size (>30 ha), (3) bare ground, sparse vegetation, or stubble cover (typically wheat as the current or future crop), (4) flat topography, generally in upland areas, and (5) uniform cultivation (i.e., those fields likely to attract Mountain Plovers; Shackford 1991). We scanned fields from public roads with a 10× binocular and a 15× spotting scope; some fields, particularly those with nests, were entered with permission from the landowner. We spent ≥4 h searching for Mountain Plovers in areas with suitable aggregations of cultivated fields. County-by-county tallies of Mountain Plovers on cultivated fields provided an index of the relative impor-

TABLE 1. Search effort to document Mountain Plover breeding activities on aggregations of cultivated fields in the central United States, 1986–1995.

State	No. of years of searching	Total km searched	No. of counties searched	Total km searched/county/year
Montana	1	1757	17	103.4
Wyoming	2	2019	15	67.3
Nebraska	2	1458	8	91.1
Colorado	4	7490	17	110.1
Kansas	4	3087	9	85.8
Oklahoma	6	2416	2	201.3
New Mexico ^a	2	694	4	86.8
Texas ^a	2	430	7	30.7

^a No Mountain Plovers were found on cultivated fields.

tance of specific counties, and thus regional areas, to breeding Mountain Plovers.

We tallied Mountain Plovers by county during the breeding season (mid-April to mid-July) in all years and during the premigratory flocking period (mid-July to mid-August) in 1992–1994. If Mountain Plovers were located in a field, we searched nearby fields to ascertain how common field use was in the general area. If a field was revisited, we used the highest single count in our total tally of Mountain Plovers. Searches were conducted in the morning (dawn to generally before 1100 h) and evening (1500 h to dusk) when Mountain Plovers were easiest to locate because of increased activity and less shade-seeking behavior (Shackford 1996). For each field where Mountain Plovers were located, we recorded the legal location, date, breeding activity (e.g., courtship flights and calls, scrape building, or unfledged young), most recent crop type, and estimated last tilling date based on growth of crops and weeds.

When nests were located, we visited the site ≥ 5 times during breeding and premigratory seasons to determine nest fate. Nest losses to mechanical treatment of fields were documented based on our records of farming activities on each field. Storm losses were inferred if, after a storm, whole eggs were mired in the mud, cold, and obviously not being incubated, or crushed by hail. Predation was inferred if crushed and partially removed eggs, shell fragments, yolk stains, or predator footprints were found at a nest (Koenen *et al.* 1996); $\geq 95\%$ bare soil surrounding $>50\%$ of nests aided in the detection of predator sign.

RESULTS

We drove 19,351 km and searched 2035 km around suitable aggregations of cultivated fields (Table 1). The total number of kilometers searched per county per year ranged from 30.7 in Texas, where few aggregations of cultivated fields and no Mountain Plovers were observed on aggregations of cultivated fields, to 201.3 in Oklahoma. We observed

TABLE 2. Mountain Plovers observed on cultivated fields during breeding and premigratory seasons (April–August), 1986–1995.

Year	No. nests	No. fledged chicks ^a	No. plover during breeding season ^b	No. plover during premigratory season ^c	Total plovers	No. fields with plovers	States with plovers
1986	1	0	22	— ^d	22	9	Oklahoma
1990	0	0	3	—	3	1	Oklahoma
1992	4	2	155	358	513	66	Colorado, Kansas, Nebraska, Oklahoma, Wyoming
1993	22	16	311	664	975	165	Colorado, Kansas, Oklahoma
1994	25	13	447	194	641	146	Colorado, Kansas, Oklahoma
1995	0	1	54	—	54	29	Colorado, Montana, Nebraska, Oklahoma, Wyoming
Totals	52 ^e	32	992	1216	2208	416	6

^a Fields with known nests not included.

^b 6 April through 14 July.

^c 15 July through 18 August.

^d No searches were conducted.

^e Observed on 42 cultivated fields in 4 states: Colorado, Kansas, Oklahoma, and Wyoming.

2208 Mountain Plovers on 416 cultivated fields in six states (Table 2). A total of 1216 Mountain Plovers was observed during the premigratory period on cultivated fields in 1992–1994. Seven counties in four states accounted for 96.9% of all Mountain Plovers that were observed on cultivated fields (Table 3). Observations on cultivated fields extended the known breeding range eastward into Kansas, as reported by Knopf (1996) as a personal communication from this work.

We located 52 Mountain Plover nests on 42 cultivated fields (Table 2)

TABLE 3. States and counties within the breeding range of the Mountain Plover in which >20 individuals were observed on cultivated fields, 1986–1995.

State	County	Years of searching	No. plovers ^a	Plovers/year	No. fields
Colorado	Kiowa	4	879	220	176
	Washington	2	22	11	6
	Weld	2	21	11	5
Kansas	Hamilton	3	130	43	40
	Morton	3	91	30	16
Oklahoma	Cimarron	6	973	162	124
Wyoming	Laramie	2	23	12	11

^a Includes all plovers during courtship, nesting, and premigratory flocking.

in four states: Colorado ($n = 29$), Oklahoma (13), Kansas (9), and Wyoming (1). Twenty-six of those nests (50%) were on bare or fallow ground; 13 (25%) were in growing wheat (23.1%) or wheat stubble (1.9%); 7 (13.5%) were in fields of milo; 4 (7.7%) were in fields of forbs (5.8%) or forb stubble (1.9%); and 2 (3.8%) were in fields of sprouting corn.

We were able to determine the fate of 46 of the 52 Mountain Plover nests; fates of the remaining six were unclear. Thirty-one (67.4% of 46) nests were lost to farm machinery (70.9% of those lost), climatic events (25.8%), or predators (3.3%); the fate of 15 (32.6% of the total) nests was unknown and possibly successful. Thirty chicks and 14 fledged young were observed on cultivated fields where the 15 fate-unknown nests occurred. Because we did not directly observe hatching or band chicks, it was impossible to know if they hatched on the field or were moved by their parents (Knopf and Rupert, in press). We observed unfledged chicks on an additional 32 fields, although we could not determine if they hatched there.

All 52 Mountain Plover nests were found in the east-central part of the breeding range where plantings of winter wheat were common. We observed one Mountain Plover engaged in courtship behavior on a cultivated field in central Montana (Judith Basin Co.), in the area typically used for production of spring wheat.

DISCUSSION

Cultivated fields, for better or worse, provide habitat for breeding Mountain Plovers in the western Great Plains. The degree to which range-wide nesting on cultivated fields has contributed to the decline of Mountain Plovers, as speculated by Knopf and Rupert (in press), is still uncertain, but our data show that a substantial number of nests in cultivated fields are lost to farming practices. Nevertheless, we have indirect evidence that some Mountain Plovers are using cultivated fields successfully for nesting, particularly in southern latitudes, where the primary crop is winter wheat and the secondary crop is milo.

We found the overwhelming majority of Mountain Plovers on cultivated fields in the southeastern part of the breeding range (Knopf 1996), particularly in eastern Colorado. The single Mountain Plover that we found on a bare field in northern latitudes was in central Montana. Upland crops, particularly spring wheat, were sparse in Wyoming and much of Montana. Extensive areas of spring wheat coincided with the breeding range only in northern Montana, which limited the amount of potential breeding habitat on cultivated fields in Wyoming and most of Montana. Perhaps Mountain Plovers in northern latitudes do not normally use cultivated fields because there is still sufficient prairie available for nesting; only 12.1% of the breeding range of the Mountain Plover in Wyoming is cropland (Knopf and Rupert, in press). The breeding range of the Mountain Plover and extensive areas of winter wheat separate in the southwestern corner of the Nebraska Panhandle.

Cultivated fields in the northern and southern parts of the breeding range of Mountain Plovers differ with regard to types (spring vs. winter wheat, respectively) and timing of cultivation, which may affect nest success. In the southeastern part of the breeding range of the Mountain Plover (Knopf 1996), a longer growing, and therefore potential breeding, season (157 d in Denver, Colorado vs. 122 d in Helena, Montana) and extensive areas of winter wheat that require less disturbance in spring and early summer may permit successful reproduction on cultivated fields. Fields of spring wheat in the northern plains may provide opportunities for breeding Mountain Plovers, but they are disturbed more frequently than winter wheat fields, because they are tilled, planted, and harvested in the relatively short growing season in spring and summer. Differing agricultural practices, lengths of the breeding season, and perhaps historically greater abundance of nesting Mountain Plovers in southern plains may be the reasons why concentrations of Mountain Plovers in eastern Colorado are apparently higher on both prairie and cultivated fields (Knopf and Rupert 1996, in press) than in the north.

Additional research on the relationship between Mountain Plovers and cultivated land clearly is warranted. We agree with Knopf and Rupert (in press) that it may be easier to find ways to decrease nest loss from mechanical treatment of fields than to restore significant acreage of native prairie with associated herbivores suitable to Mountain Plovers. Our observations suggest that mechanical treatments of fields in southern latitudes occur with relatively low frequency, lengths of the growing and breeding season are relatively long, some plantings are low-till and fields may remain fallow, predation rates appeared to be low (but see Knopf and Rupert 1996), and numbers of Mountain Plovers are relatively high. These observations suggest that breeding by Mountain Plovers on cultivated fields, particularly in certain counties of Colorado, Kansas, Oklahoma, and Wyoming, will influence future conservation of the "prairie ghost."

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