

MOUNTAIN PLOVER SURVEYS
LARAMIE, CARBON, SWEETWATER COUNTIES, WYOMING

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September 25, 2000

INTRODUCTION

In February 1999, the USFWS proposed listing mountain plover (*Charadrius montanus*) as a threatened species under the Endangered Species Act (FR 64(30):7587-7601). Most research on mountain plovers has occurred in northeast Colorado and central Montana (e.g., Baldwin 1971, Graul 1975, Olson-Edge and Edge 1987, Knopf and Miller 1994, Knopf and Rupert 1996, Knopf 1996), while little research has occurred in Wyoming. However, it is believed by some people, including the authors, that Wyoming may contain more nesting mountain plovers than any other state (e.g., Scott 1993, p. 173). It is also generally believed that mountain plover habitat affinity and breeding chronology in Wyoming are similar to those found in Colorado and Montana. Laun (1957) described general life history traits for mountain plovers on the Laramie plains and Parrish (1988) studied their habitat selection and breeding ecology in the Powder River Basin. Based on these studies and other unpublished work (e.g. Johnson et al 2000) mountain plovers may arrive in Wyoming and initiate the breeding season slightly later than Colorado.

In the spring of 2000, the USFWS, Cheyenne Office initiated baseline studies to: (1) investigate use of agriculture fields by mountain plovers in Laramie County; and (2) investigate the breeding chronology of mountain plovers in Carbon County, Wyoming. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, under contract with the USFWS conducted roadside surveys for mountain plovers in eastern Laramie County and nest searching surveys at Mexican Flats and Cyclone Draw, Carbon County. Overall objectives of the studies were to: (1) document use of agriculture fields by mountain plovers; and (2) provide baseline data on the nesting chronology of mountain plovers in Wyoming.

METHODS

Laramie County

Study Area

Southeastern Laramie County, Wyoming is the northern extent of the Pawnee Grasslands physiographic region in northeast Colorado. This area is primarily private lands used for dry land and irrigated agriculture. Common crops include wheat, corn, barley, sugar beets, and alfalfa. The study area was approximately the eastern half of Laramie County which included the area from the Colorado border north to approximately Wyoming Highway 216, east to the Nebraska border and west to approximately State Highway 217 and Laramie County Road 143 (Figure 1).

Roadside Surveys

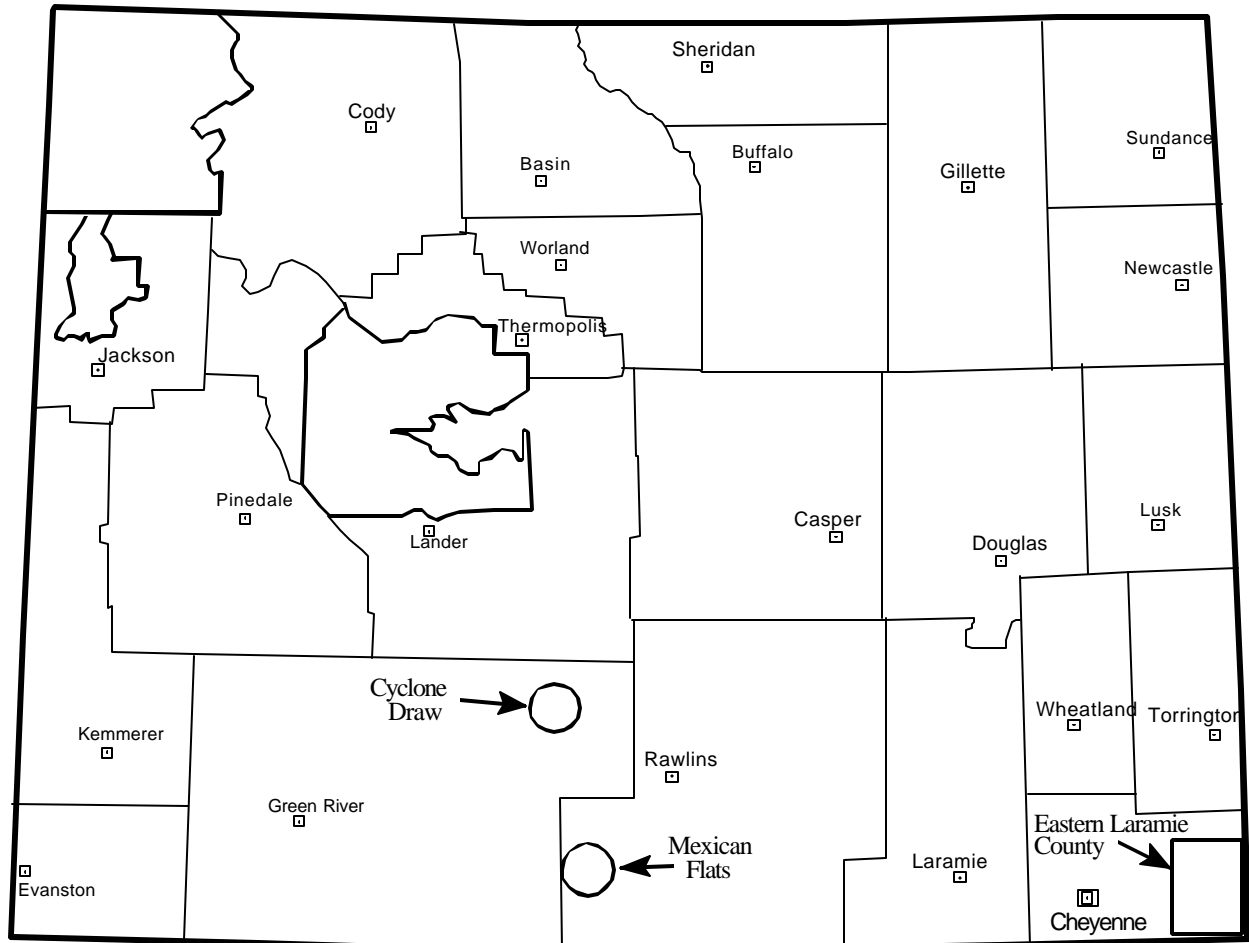
A total of eight days were spent driving roads in eastern Laramie County and conducting point counts for mountain plovers. In general, routes were chosen to provide thorough coverage of the area south of the I-80 corridor and extensive coverage in the area north of the I-80 corridor (see attached map). Routes varied in length depending on the location and suitability of habitat. In general, survey points were located

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at 0.5 mile intervals along routes and three minute counts were conducted at each stop. No counts were conducted at survey points that fell in areas un-suitable for mountain plovers (e.g., points adjacent to or within ranches, town limits, riparian areas, cut draws and ravines, thick vegetative cover such as CRP fields).

Surveys focused on locating mountain plovers. Generally the surveys were conducted in the morning hours. At each point the observer scanned all fields and suitable habitat with binoculars while listening for plover vocalizations and breeding calls.

Figure 1. Approximate study area locations.



Carbon & Sweetwater Counties

Study Areas

Two areas were searched for mountain plover nests: Mexican Flats in Carbon County and Cyclone Draw in Sweetwater County. These study areas are located within 50 miles of Rawlins, Wyoming and are north and south of the “checkerboard” corridor along I-80 respectively (Figure 1). The areas consist primarily of low shrubs and shortgrass prairie. All areas surveyed were lands administered by the Bureau of Land Management (BLM).

Nest Surveys

Six days were spent searching for mountain plover nests. Cyclone Draw and Mexican Flats were searched on three days each from May 29 - June 6, 2000. Nest searches were conducted by driving slowly through suitable habitat. When a mountain plover was observed, the vehicle was backed up 50-100 m and the plover observed with binoculars. Each plover was observed until: (1) the bird returned to the nest and resumed incubating; (2) the bird exhibited behavior indicating a nest was not present (e.g., it flew away); or (3) 15 minutes had elapsed since the bird was first observed. If the bird sat down, observers walked from the truck keeping close watch on the plover location until it flushed from the nest thus revealing its location. Nests were marked on two sides with rock, bones, and/or manure piles approximately 5 m from the nest for relocating it on future dates.

Nesting Chronology and Success

Two eggs from each nest found were floated in a small jar of water to determine approximate nest age and hatching dates. Nest fates were checked on June 28 and 29, 2000 during habitat surveys. Approximate nest age (and hatching dates) were determined using the following criteria (F. Knopf, USGS, pers. comm.):

Approximate Nest Age Egg Floating Characteristics

Fresh to 3-4 days	- eggs sink and lay on side
4-17 days	- eggs sink, but stand on end
15-28 days	- eggs float vertically (more out of water with age)
26-29 days	- eggs float and tilt at an angle

During habitat measurements nest cups were carefully checked for pipped egg shell fragments. Adult mountain plovers carry away large egg shell fragments after hatching (Knopf 1996), but small egg shell fragments from the initial chick pipping remain in the nest material. If pipped egg shell fragments were present, the nest was considered successfully hatched. If no pipped egg shell fragments were present, the nest was considered to have failed (i.e., predated).

Habitat Measurements

Habitat characteristics were measured within 1 m² plots centered on the nest from June 28-29, 2000. Within the plots habitat characteristics were recorded at a grid of 50 points using the line intercept method. Habitat characteristics measured included: bare ground, rock (> 7 cm), pebbles (< 7 cm), shrub, grass, forb, manure and other. Vegetation was recorded to species where possible, and vegetation height at

points where vegetation was present was measured. Other variables recorded were slope, aspect, nest material contents, presence of pipped egg shell fragments, and a description of habitat within 10 m of the nest.

Brood Surveys

Brood surveys were conducted at night and during the morning from June 28-30, 2000 at Mexican Flats and Cyclone Draw. Mountain plovers were not spotlighted at night, rather adults and broods were counted in headlights. In Utah, mountain plover broods are captured by driving roads at night and spotting them in vehicle headlights (Clayton White, BYU, pers. comm.). During morning surveys the vehicle was stopped every 0.5 miles and areas were scanned for mountain plovers. Surveys were conducted by driving roads and two tracks at 15-20 mph through areas which contained mountain plover nests and or suitable habitat. Twenty six and eighteen miles of roads were surveyed for broods at Mexican Flats and Cyclone Draw respectively.

RESULTS

Laramie County

Roadside Surveys

Approximately 320 miles of roads were driven over 8 different days. A total of 34 mountain plovers were located in 19 different agriculture and native grass fields in eastern Laramie County (Table 1). Most plover locations were in plowed fields (58%) or fields with very short crops (32%). Two plover locations were in heavily grazed native grass areas (10%). The average number of plovers detected per occupied field was less than two ($\bar{O}=1.7$). Six mountain plovers were detected in one plowed field which was approximately one square mile in size.

Carbon County

Nest Abundance

Nine nests were found at Mexican Flats and two nests were found in Cyclone Draw (Table 2). One additional adult mountain plover with one downy chick was observed at Cyclone Draw during nest searches indicating the presence of at least one additional nest.

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Table 1. Mountain plover locations in eastern Laramie County.

Site	Date	Number	Location	Road ²	Crop/Field	Activity
1	4/28/00	1	T14N, R62W, Sec 32, NW1/4	WY 214	plowed	courtship calls
2	4/28/00	3	T14N, R61W, Sec 21, NW1/4	CR 212	plowed	courtship displays
3	4/28/00	3	T14N, R61W, Sec 23, NE1/4	CR 212	1-2" wheat	foraging, flying
4	5/1/00	1	T12N, R61W, Sec. 5, NE1/4	CR 156	plowed	courtship displays, foraging
5	5/1/00	1	T12N, R61W, Sec. 9, NW1/4	CR 156	native grass	courtship calls
6	5/1/00	1	T12N, R61W, Sec. 3, NW1/4	CR 203	plowed	preening
7	5/2/00	6	T13N, R63W, Sec. 13, all	CR 206	plowed wheat	courtship calls, displays
8	5/2/00	2	T12N, R63W, Sec. 15, NE1/4	CR 146	plowed	courtship calls, foraging
9	5/2/00	2	T12N, R63W, Sec. 13, SW1/4	CR 147	planted unknown	courtship calls, foraging
10	5/5/00	1	T13N, R61W, Sec. 36, SW1/4	CR203	native grass	courtship calls
11	5/7/00	1	T14N, R60W, Sec. 4, NE1/4	WY 215	planted corn	foraging
12	5/15/00	1	T14N, R62W, Sec. 24, SW1/4	CR 211	plowed	foraging, flying
13	5/15/00	2	T16N, R62W, Sec. 12, SE1/4	CR 154	planted unknown	courtship displays, foraging
14	5/15/00	1	T15N, R60W, Sec. 33, SW1/4	CR 215	planted unknown	courtship calls, foraging
15	5/15/00	2	T14N, R60W, Sec. 4, NW1/4	CR 215	planted unknown	courtship calls, foraging
16	5/15/00	2	T14N, R60W, Sec. 20, SW1/4	CR 161	plowed	courtship displays, foraging
17	5/28/00 ¹	1	T13N, R62W, Sec. 34, SW1/4	CR 203	plowed	courtship calls
18	5/28/00 ¹	1	T12N, R61W, Sec. 8, NE1/4	CR 156	plowed	courtship calls, foraging
19	5/28/00 ¹	2	T14N, R60W, Sec. 21, NW1/4	CR 212	plowed	courtship calls, foraging

¹ Found during rechecks of previous locations.

² WY = Wyoming State Highway; CR = County Road

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Table 2. Mountain plover nest locations at Cyclone Draw and Mexican Flats, Carbon county, Wyoming.

Nest	Date of Discovery	Legal Description	Approximate UTM Coordinates
Cyclone Draw 1	6/2/00	T24N, R94W, Sec. 15, NW1/4 of SW1/4	746325, 4659575
Cyclone Draw 2	6/5/00	T25N, R95W, Sec. 23, SE1/4 of NE1/4	737425, 4667400
Mexican Flats 1	5/29/00	T15N, R92W, Sec. 20, SE1/4 of NE1/4	268200, 4570950
Mexican Flats 2	5/29/00	T15N, R93W, Sec. 1, SW1/4 of SW1/4	263900, 4575225
Mexican Flats 3	5/29/00	T15N, R93W, Sec. 2, SW1/4 of SW1/4	362600, 4575500
Mexican Flats 4	6/1/00	T15N, R92W, Sec. 9, SE1/4 of SW1/4	268950, 4573200
Mexican Flats 5	6/1/00	T15N, R92W, Sec. 9, SE1/4 of SW1/4	269050, 4573250
Mexican Flats 6	6/1/00	T15N, R93W, Sec. 2, NW1/4 of SE1/4	263700, 4575625
Mexican Flats 7	6/1/00	T15N, R93W, Sec. 2, NW1/4 of NW1/4	262375, 4576500
Mexican Flats 8	6/6/00	T15N, R92W, Sec. 3, SW1/4 of SE1/4	261775, 4575200
Mexican Flats 9	6/6/00	T16N, R92W, Sec. 34, NW1/4 of NW1/4	261050, 4578250

Nest Chronology

Mountain plover nests exhibited a wide range of age (and hatching dates) at both Cyclone Draw and Mexican Flats. Projected hatching dates were based on egg floatation characteristics (see above) at the time of nest discovery. Project hatching dates for all nests ranged between May 30 and June 29, 2000 (Table 3). During nest searches an adult mountain plover with a downy chick was observed on June 5, 2000 at Cyclone Draw. The other two nests at Cyclone Draw were projected to hatch between June 3 and 18, 2000. Projected hatching dates at Mexican Flats ranged from May 30 to June 29, 2000. Six of the nine Mexican Flats nests were projected to hatch by June 15, 2000 at the latest.

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Table 3. Chronology of mountain plover nests located in Carbon County based on egg floatation.

Nest	Date of Discovery	Egg Floating Characteristics	Estimated Nest Age (days)	Projected Hatching Date	Nest Outcome
Cyclone Draw 1	6/2/00	float vertically at surface with much of egg out of water	15-28 days, closer to 28	6/3-7/00	hatched
Cyclone Draw 2	6/5/00	float vertically at surface, none out of water	15-28 days, closer to 15	6/11-18/00	unknown ¹
Mexican Flats 1	5/29/00	eggs sink but stand upright on end	4-17 days	6/10-23/00	hatched
Mexican Flats 2	5/29/00	float vertically at surface with approx. 1/8-1/4" out of water	15-28 days	5/30/00-6/7/00	hatched
Mexican Flats 3	5/29/00	float vertically at surface, approx. 1/8" out of water	15-28 days	5/30/00-6/7/00	hatched
Mexican Flats 4	6/1/00	float vertically at surface, none out of water	15-28 days, closer to 15	6/7-15/00	hatched
Mexican Flats 5	6/1/00	eggs sink and lay on side, only two eggs present	fresh to 3-4 days	6/24-29/00	failed
Mexican Flats 6	6/1/00	float vertically at surface with approx. 1/8-1/4" out of water	15-28 days	6/2-7/00	hatched
Mexican Flats 7	6/1/00	float vertically at surface, approx. 1/8" out of water	15-28 days	6/2-7/00	hatched
Mexican Flats 8	6/6/00	eggs float at angle at surface, pipping could be heard	26-29 days	6/6-7/00	hatched
Mexican Flats 9	6/6/00	float vertically at surface, none out of water ²	15-28 days	6/12-20/00	failed

¹ nest cup could not be relocated

² all three eggs floated: one floated at surface on it's side approximate half out of the water; two floated vertically

Nest Success

Eight of 11 nests, or 73% were considered successful. Two of 11 nests were determined to have failed (no pipped egg shell fragments present), and one nest's fate was unknown. Both of the failed nests had one and two eggs (see file photos) remaining in or near the nest and contained very little nest material. One of the eggs had a crack along the longitudinal length of the egg and had fluid seeping from the crack. Both of the failed nests had the latest projected hatching dates (approx. June 20 and 29). Nest fates were checked on June 29, near the projected hatching date of the latest nest. However, the poor condition of the nest (almost no nest material was present) may indicate it had not been attended by the adult for a significant period of time. One successfully hatched nest also had one egg in the nest when checked.

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The fate of one nest was undetermined. The nest cup was not found and the nest material most likely had blown away. It is unlikely the observer missed the nest since the markers surrounding the nest were intact and in their original position.

Nest Habitat

Areas immediately surrounding nests were dominated (58.2 %) by bare ground (Table 4). Low shrubs and grass made up 33.2 %, and forbs, rocks, pebbles, and manure were less than 10% collectively. Vegetation height was low, averaging 5.0 cm for all nests (Table 5). Grass (5.7 cm) was generally greater in average height than shrubs (4.2 cm) for all nests. The most common shrubs present were saltbush (*Atriplex gardneri*) and bud sagebrush (*Artemisia spinescens*) (Table 6). The most common grasses present were *Festuca spp* and *Poa spp*.

Table 4. Percent coverages of habitat categories in 1 m² plots centered on mountain plover nests in Cyclone Draw and Mexican Flats, Carbon County, Wyoming.

Nest	Percent Cover						
	Bare Ground	Rock	Pebble	Shrub	Grass	Forb	Manure
Cyclone Draw 1	40	0	0	0	26	0	34
Mexican Flats 1	62	0	0	34	4	0	0
Mexican Flats 2	56	0	2	24	18	0	0
Mexican Flats 3	66	0	0	18	16	0	0
Mexican Flats 4	24	6	32	30	2	6	0
Mexican Flats 5	58	0	6	36	0	0	0
Mexican Flats 6	78	0	0	14	8	0	0
Mexican Flats 7	64	0	0	28	8	0	0
Mexican Flats 8	62	0	0	26	12	0	0
Mexican Flats 9	70	0	0	14	16	0	0
Average	58.2	0.6	4.2	22.4	10.8	0.6	4

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Table 5. Average vegetation heights (cm) for vegetation categories found in 1 m² plots centered on mountain plover nests in Cyclone Draw and Mexican Flats, Carbon County, Wyoming.

Nest	Shrub	Grass	Forb	Total
Cyclone Draw 1	NA	8.2	NA	8.2
Mexican Flats 1	3.6	6.5	NA	3.9
Mexican Flats 2	3.8	6	NA	4.7
Mexican Flats 3	4.2	4.2	NA	4.2
Mexican Flats 4	3.7	7	1.7	3.5
Mexican Flats 5	3.2	4	NA	3.2
Mexican Flats 6	6.0	3.3	NA	5.0
Mexican Flats 7	4.9	3.3	NA	4.8
Mexican Flats 8	4.3	6.3	NA	4.9
Mexican Flats 9	4.3	8.4	NA	6.5
Average	4.2	5.7	1.7	5.0

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Table 6. Average heights and percent coverages of vegetation within 1 m² plots centered on mountain plover nests in Cyclone Draw and Mexican Flats, Carbon county, Wyoming.

Nest	Species	Average Height (cm)	% of plot
Cyclone Draw 1	<i>Sitanion hystrix</i>	8.2 (n=13)	26
Mexican Flats 1	<i>Artemisia spp</i>	3.3 (n=16)	32
	<i>Gutierrezia sarothrae</i>	9 (n=1)	2
	<i>Festuca spp</i>	6.5 (n=2)	4
Mexican Flats 2	<i>Festuca spp</i>	6.9 (n=9)	18
	<i>Atriplex gardneri</i>	2.9 (n=10)	20
	Unknown Dead Shrub	8 (n=2)	4
Mexican Flats 3	<i>Festuca spp</i>	3.8 (n=8)	16
	<i>Atriplex gardneri</i>	4.2 (n=18)	18
Mexican Flats 4	<i>Artemisia spp</i>	3.1 (n=6)	12
	<i>Phlox hoodii</i>	2.8 (n=4)	8
	<i>Atriplex gardneri</i>	3 (n=2)	4
	<i>Gutierrezia sarothrae</i>	6 (n=3)	6
	<i>Antennaria spp</i>	1.7 (n=3)	6
	<i>Poa spp</i>	7 (n=1)	2
Mexican Flats 5	<i>Artemisia pedatifida</i>	3.3 (n=14)	28
	<i>Phlox hoodii</i>	3.3 (n=3)	6
	<i>Atriplex gardnerii</i>	3 (n=1)	2
Mexican Flats 6	<i>Atriplex gardnerii</i>	6 (n=7)	14
	<i>Festuca spp</i>	3.3 (n=4)	8
Mexican Flats 7	<i>Atriplex gardnerii</i>	4.9 (n=14)	28
	<i>Poa secunda</i>	3.3 (n=4)	8
Mexican Flats 8	<i>Poa secunda</i>	6.6 (n=5)	10
	<i>Sitanion hystrix</i>	5 (n=1)	2
	<i>Atriplex gardnerii</i>	4.3 (n=13)	26
Mexican Flats 9	<i>Festuca spp</i>	9.4 (n=8)	16
	<i>Atriplex gardnerii</i>	3.8 (n=4)	8
	<i>Artemisia spinescens</i>	5 (n=3)	6

Ten nests were on a slope of 0-5% and one nest was on a slope estimated at 5-10%. Most nests had no discernable aspect. The single nest on a slight slope (5-10%) was on a northwest aspect. Nest material reflected the surrounding vegetation or other materials. Nest materials generally included small twigs and leaves. Three nest cups contained horse and lagomorph dung. Five nests were located in a raised position

relative to the ground such as near an *Atriplex* or other shrub. One nest was located in a raised position on a large pile of horse dung (see file photos).

No measurements were taken at random plots. Surrounding areas out to approximately 50 m appeared to generally reflect what was measured immediately around the nest.

Brood Surveys

A total of three adult mountain plovers were detected during evening surveys at both sites. No chicks were observed. One adult and two chicks were observed incidentally at 2230 outside the survey area at Cyclone Draw on County Road 63. Adjacent habitat was similar in appearance to nesting habitat. During morning surveys three observations of a total of five adults and one brood of three chicks were recorded at Cyclone Draw. During morning surveys at Mexican Flats, seven observations of a total of 18 adults, one juvenile and one brood of two chicks were recorded. No habitat measurements were taken at brood locations, however, broods observed during the morning surveys were located in habitat similar to nesting habitat.

Adult mountain plovers with broods were observed giving a low pitched call to chicks when disturbed by observers. Using the 'chick alarm call' and other behavioral cues as an indicator that broods were present but not observed, an additional four broods were documented at Mexican Flats during AM surveys and one additional brood was documented at Cyclone Draw during PM surveys.

DISCUSSION

Laramie County

Mountain plovers have been documented using agriculture fields in several states including Laramie County, Wyoming (see Knopf and Rupert 1996, Shackford and Leslie 1995). There is some concern that agriculture fields may be a sink for mountain plovers if they initiate nests where they will be destroyed by farm equipment (e.g. plowed under) or abandoned due to fast crop growth. Shackford et al. (1999) found that approximately 70% of mountain plover nests on cultivated field were destroyed by farm equipment.

This study was designed to follow-up on work conducted by Shackford and Leslie (1995). Shackford and Leslie drove 585 km (. 363 miles) in Laramie County in 1995 and observed 19 mountain plovers in 8 fields. Their surveys were conducted on May 26 and 27, 1995 which is believed to be during the plover nesting period in Wyoming. Most of our surveys were conducted between April 28 and May 15, 2000 which is closer to the courtship period (pre-nesting) when plovers are more easily detected by breeding calls and courtship displays. While our effort was similar (. 363 miles vs. . 320 miles), we detected 34 plovers in 19 different fields, indicating that plover use of plowed fields in eastern Laramie County may be common.

Carbon County

Mountain plovers in Mexican Flats and Cyclone Draw generally nested in areas dominated by bare ground. Most nest sites contained low shrubs and grasses such as *Atriplex gardneri*, *Artemisia spp.*, *Festuca* and *Poa spp.* Mountain plover habitat use was consistent with use described by other authors (see Knopf 1996). Because no random plots were measured, conclusions concerning habitat selection are limited. Within bare ground/*Atriplex* habitats, mountain plovers may be selecting nest sites based upon fine scale characteristics. Five nests were located in a raised position relative to the ground. These nests were located within or adjacent to low shrubs or, in one case, horse manure. By nesting in these positions, mountain plover may be able to better detect approaching predators while remaining relatively hidden.

All habitats within the Cyclone Draw and Mexican Flats were not sampled evenly. We searched for nests in areas 'typical' of mountain plover use in other areas. Typical mountain plover habitat includes flat areas with high percentages of bare ground, low sparse shrubs, and short grass (Knopf 1996). Additionally, some areas which looked suitable were not searched due to the presence of large amounts of prickly pear.

Nine nests were found at Mexican Flats, while only two were located at Cyclone Draw. Search efforts were similar between the two sites. Greater numbers of mountain plovers were also observed at Mexican Flats. Few physiographic differences were notable between the two sites. The types and amount of suitable habitat at the two sites were similar, and both sites were grazed by domestic sheep, cattle, and wild horses. Areas immediately south of Cyclone Draw (Lost Creek dry lake bed, Lost Creek Basin, and Battle Springs Flats) were not searched but appeared to have suitable habitat. More nesting mountain plovers may have been present in the Cyclone Draw area and were simply not found. Mountain plovers at Cyclone Draw may have nested earlier than Mexican Flats, as evidenced by the brood observed on June 5, 2000 during nest searches. Mountain plovers move broods away from nests soon after hatching (Knopf and Rupert 1996), making it impossible to locate nests after hatch.

Nest success was high (73%), with most mountain plover nests hatching by mid-June. Graul (1975) reported a nest success rate of 65%. Mountain plover hatching dates ranged widely but were predominantly in the month of June. Mountain plovers usually raise only one brood per season, but may attempt to re-nest up to four times if early attempts fail (Knopf 1996). The wide range of hatching dates at Cyclone Draw and Mexican Flats may be a result of re-nesting attempts. Nests which were determined to have failed had later projected hatch dates than successful nests.

Night time brood surveys were largely unsuccessful. In Utah, mountain plover broods are observed on roads during trapping attempts at night. Vegetation in Utah where plovers are found is generally taller than in other locations and clear roads or oil drilling pads may provide some essential conditions important to plovers (e.g., bare ground). Additionally, road density is very high in Utah because of the oil drilling operations. (Clayton White, BYU, personal communication).

Morning surveys were more successful, although only two broods were actually observed. Visual observations alone would prove inadequate for conducting brood counts. Using the 'chick alarm call' as an indicator an additional five broods may have been identified. Brood size is difficult to estimate due to the cryptic nature of mountain plover chicks. However, the number of adults with broods may be counted using visual and auditory cues. By stopping every 0.5 miles and scanning and listening for mountain plover 'chick alarm calls', a measure of mountain plover reproductive success (number of adults with broods) could potentially be monitored with relatively little effort.

Recommendations for Future Research

(1) **Study mountain plover breeding success in agriculture fields.** This study as well as others (e.g., Shackford and Leslie 1995) have shown that mountain plovers will occupy agriculture fields and in particular large plowed fields during the nesting season and are presumed to be breeding. Future studies in eastern Laramie County should include nest searches and monitoring to determine nest success as well as monitoring the fate of fields used by mountain plovers.

(2) **Investigate Mountain Plover use of agriculture fields in other areas in Wyoming.** Shackford and Leslie (1995) investigated agriculture fields in 15 counties in Wyoming for mountain plovers. However, they were only documented using fields in Laramie County and their surveys were conducted between late May and early July. Other agriculture counties should be re-investigated during the late-April to early-May period when mountain plovers are easily detected due to courtship calls and displays.

(3) **Continue mountain plover breeding studies in Wyoming.** Our studies provided baseline information about mountain plover nesting chronology from two locations in Carbon and Sweetwater Counties, Wyoming. Additional information is available from studies in Albany (Laun 1957, Johnson et al. 2000) and Campbell Counties (Parrish 1988). However, mountain plovers have a statewide distribution (Luce et al. 1997) and may be locally abundant (e.g., Chapman Bench, Shirley Basin). Future studies should consider studying mountain plovers in other Wyoming locations. Additional years of data will also help solidify information about mountain plovers essential to their conservation. Wyoming undoubtedly contains areas important to the conservation and recovery of mountain plovers. Understanding the breeding biology of mountain plovers in this state is essential to this goal.

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