

Section-based Monitoring of Breeding Birds in Eastern Colorado

February 28, 2003



Prepared by:

David Hanni

Rocky Mountain Bird Observatory
14500 Lark Bunting Lane
Brighton, Colorado 80601
Ph. (303) 659-4348
david.hanni@rmbo.org

In cooperation with:

Gary Skiba & Francie Pusateri

Colorado Division of Wildlife
6060 Broadway
Denver, Colorado 80216
Ph. (303) 291-7466
gary.skiba@state.co.us
francie.pusateri@state.co.us



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Suggested Citation:

Hanni, D. J. 2003. Section-based Monitoring of Breeding Birds in Eastern Colorado.
 Rocky Mountain Bird Observatory. Brighton, CO. 84pp.

EXECUTIVE SUMMARY

In 2001, Rocky Mountain Bird Observatory (RMBO), in cooperation with the Colorado Division of Wildlife (CDOW), assessed field techniques to determine the most effective technique(s) for monitoring shortgrass prairie birds in eastern Colorado. Our results suggested that the road-based point count technique was the most efficient (Hanni 2002).

The road-based point count technique was implemented in 2001 in native prairie and expanded in 2002 to include dry-land agriculture, and land in the Conservation Reserve Program (CRP); in Weld County only. This study area includes 24 counties located in eastern Colorado. Within the study area, 1,274 randomly selected sections were surveyed using the road-based point count technique: 1,133 in native habitats, 94 in dry-land agriculture, and 47 in CRP. Due to the potential road bias in the methodology, I selected 17 of these sections, contingent on the ability to access private land, to conduct paired interior point transects to calculate a correction factor for the road-based point count technique.

I calculated density estimates for individual species in each of the habitat types: 38 species in native prairie, 10 species in dry-land agriculture, and 6 species in CRP. I compared density estimates calculated from data collected in the native prairie with the estimates calculated from the 2001 study (Hanni 2002). I also conducted 17 point transects and derived density estimates for two species using this data. Species accounts depict density estimates among years (2001 and 2002), habitats (native, CRP in Weld County, and dry-land agriculture) and structure (percent shrub cover).

There are several advantages of using the road-based point count technique to monitor birds in the shortgrass prairie of eastern Colorado: 1) it can be used to monitor not only population trends, but changes in distribution and abundance of individual species; 2) it can be implemented at a variety of scales; 3) it can provide information on vegetation characteristics and management practices that could be compared to the bird community; and 4) it can aid us in determining areas in eastern Colorado in which to focus conservation efforts.

This section-based monitoring technique can potentially monitor 65% of the upland breeding species in the Shortgrass Prairie Bird Conservation Region (BCR 18). Included in this list are 13 of 16 species that are declining significantly in this region (Partners in Flight Species Assessment and Prioritization Database 2003). This same technique is currently being implemented in several states that include portions of Shortgrass Prairie Bird Conservation Region (NE, CO, KS, and OK) which will allow us to document population and distribution changes across an entire ecoregion.

INTRODUCTION

In 2001, Rocky Mountain Bird Observatory (RMBO), in cooperation with the Colorado Division of Wildlife (CDOW), assessed field techniques to determine the most effective technique(s) for monitoring shortgrass prairie birds in eastern Colorado. We evaluated four techniques that were randomly allocated across the shortgrass prairie of eastern Colorado: 1) Road-based point counts, conducted at the section level (1mi. x 1mi., as delineated by the Public Land Survey System) from roads (n = 1237 sections); 2) Interior line transects, conducted at the section level away from roads (n = 48 sections); 3) *Monitoring Colorado's Birds (MCB)* point transects, conducted irrespective of sections and roads (n = 22 point transects); and 4) 30-mile driving line transects, conducted along roads, through all habitat types in Colorado (n = 87 line transects). Program DISTANCE was used to estimate densities of birds using each of the four techniques. Our results suggest that the road-based point count technique was the most efficient in monitoring birds in eastern Colorado (Hanni 2002).

Road-based point counts provide us with data that can reveal changes in distribution and population trend for individual species. Road-based point count data also allows us to focus conservation efforts in areas of high species richness and/or contain species experiencing population declines. We can also focus limited conservation dollars to effect conservation of desired prairie bird species. These continued efforts will yield valuable information on the conservation of prairie birds. The potential of this technique led to cooperation between RMBO and CDOW to conduct this section-based monitoring technique that would monitor changes in distribution and population trends of individual species in eastern Colorado.

RMBO and CDOW have similar interests regarding the conservation of prairie birds. The 2002 CDOW strategic plan identifies desired achievements shared by both partners (CDOW 2002).

- Identify areas of high priority prairie bird habitat.
- Identify and prioritize prairie bird habitat inventory needs.
- Develop best management practices for the shortgrass prairie to assist landowners in enhancing or restoring the habitat to support prairie birds.
- Develop a long-term monitoring system for a variety of species in the shortgrass prairie to ensure populations remain healthy and to detect possible population declines.

The shortgrass prairie is a unique ecosystem that is increasingly a topic of conservation discussion. Several species found in this ecosystem are endemic (found nowhere else) or are closely associated with the Great Plains grasslands (Mengel 1970). Grassland birds have experienced steeper, more consistent, and geographically more widespread declines than any other guild of North American species, including neotropical migrants (Sampson and Knopf 1996). One reason for these declines is loss of native prairie on both the breeding and wintering grounds to urban sprawl and conversion of prairie to cropland. According to the Partners in Flight Species Assessment and Prioritization

Database, 11% of upland species breeding in the Shortgrass Prairie Bird Conservation Region (BCR 18) are declining, and 85% lack sufficient data to address current population trends (Partners in Flight Species Assessment Database, 2003).

Furthermore, there are few data that tie common management practices on grasslands to communities of grassland birds. Scientifically sound data that address this problem would allow public land managers and private landowners to better manage grasslands with shortgrass prairie bird communities in mind. To date, resource managers have relied on data derived from the Breeding Bird Survey (BBS), currently the most extensive bird-monitoring program in North America, to monitor bird populations (Robbins et al. 1989, Sauer 1993). Land managers in the shortgrass prairie make management decisions that are based on BBS data. However, these data do not reliably predict population trends at small geographic scales (Sauer 2000) and do not incorporate vegetation characteristics. Thus, the BBS data are insufficient to guide local and regional management decisions. Several authors have suggested the implementation of regional habitat-based bird monitoring programs to complement data generated by BBS (Butcher 1992, Butcher et al. 1993, Sauer 2000, Sauer and Cooper 2000).

Road-based point counts are a habitat based technique that should be able to monitor 32 species in the future. The technique will also yield data on where to focus limited conservation dollars to have the greatest impact on prairie bird conservation.

METHODS

Study area:

This study was conducted in the Colorado portion of the Shortgrass Prairie Bird Conservation Region (BCR18) including 24 counties (Figure 1). This arid region receives 300 - 500 mm of precipitation per year, and is characterized by two dominant grass species, buffalo grass (*Buchloe dactyloides*) and blue grama (*Bouteloua gracilis*) (Lauenroth and Milchunas 1992).

Within the study area, habitat types were stratified into three categories: native prairie, land in the Conservation Reserve Program (CRP) in Weld County, and dry-land agriculture. CRP was only surveyed in Weld County because that it is the only county for which a GIS layer delineating this habitat type was available. The combined study area was calculated to be approximately 8,700 km² using the GAP 2000 GIS vegetation layer. This total includes 5,400 km² of native prairie, 3,200 km² of dry-land agriculture, and 70 km² of Weld County CRP.

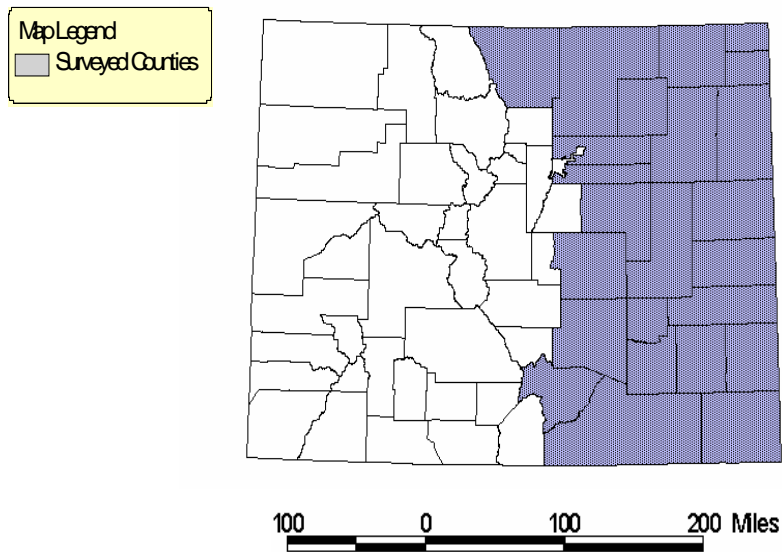


Figure 1. Counties in eastern Colorado where surveys were conducted in 2002.

Section Selection:

Road-based point counts and interior line transects use the section (1mi. x 1mi.), not the point count, as the sampling unit. This unit was selected based on it being the common unit of land management in Colorado, the layout of roads in Colorado, and for the ease of location. Candidate sections of native prairie, dry-land agriculture, and CRP were identified using ArcView. In ArcView, we combined GIS layers to identify 10,334 sections of native prairie, 319 of CRP, and 8008 sections of dry-land agriculture. All of the candidate sections contained between 600 and 700 acres of the specified habitat type and were bordered by at least one road. From these candidate sections, 1,274 were randomly selected to survey (Figs. 2, 3, and 4). If a section was not accessible from at least one road, or the section did not contain between 600 and 700 acres of the specified habitat type, it was replaced with the closest section, in a randomly selected direction, that met the above criteria.

The randomly selected sections were surveyed between 14 May and 5 July 2002, to include the main period of breeding activity exhibited by grassland birds. The start date was determined by the widespread arrival and courtship displays of a late-breeding species, the Lark Bunting (*Calamospiza melanocorys*). We began surveys in the southern latitudes and ended in the north so as to follow the seasonality of breeding activities as they progressed from south to north. Surveys were terminated when birds started congregating in post-breeding flocks and the frequencies of courtship displays were noticeably reduced.

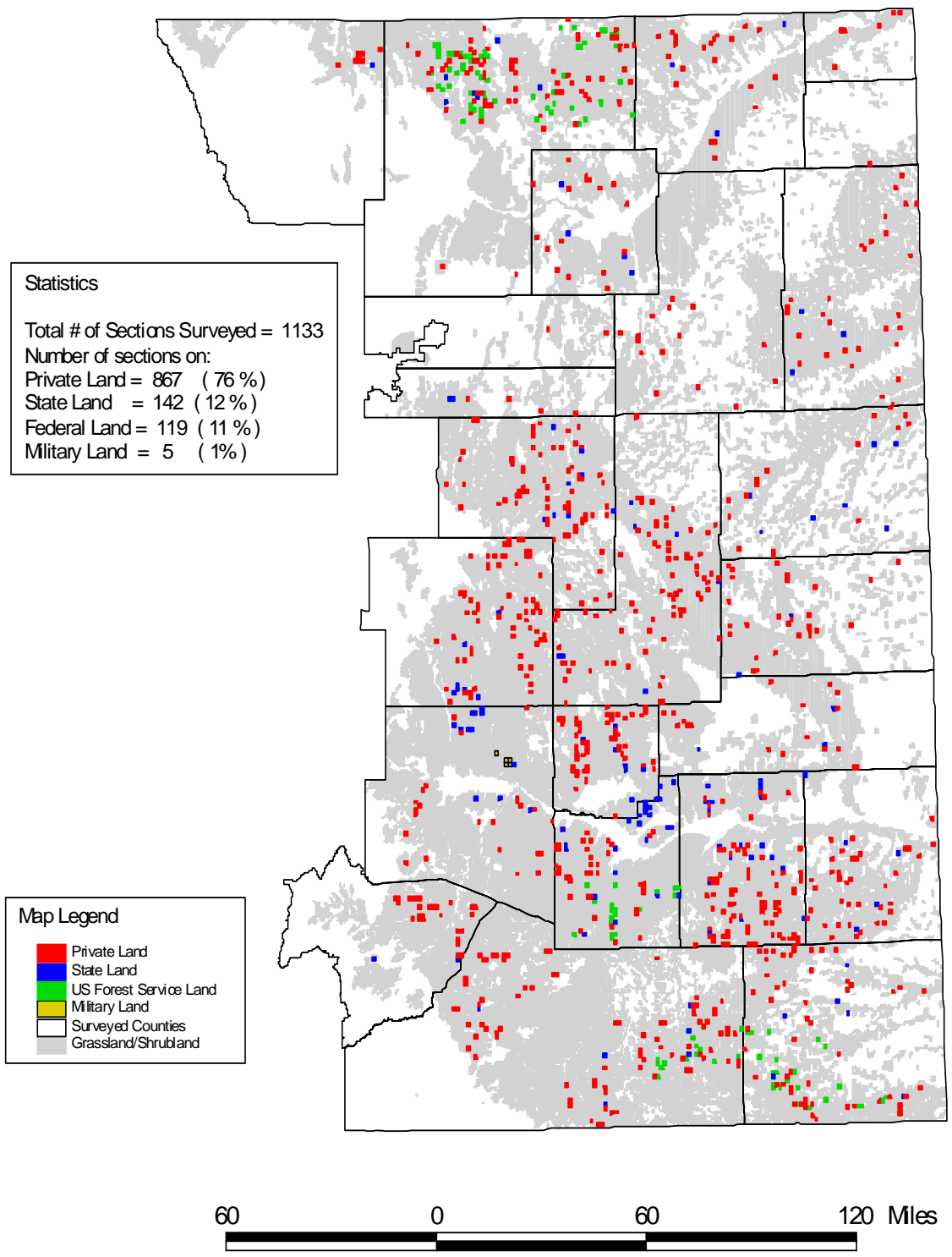


Figure 2. Sections containing native prairie that were surveyed using the road-based point count technique.

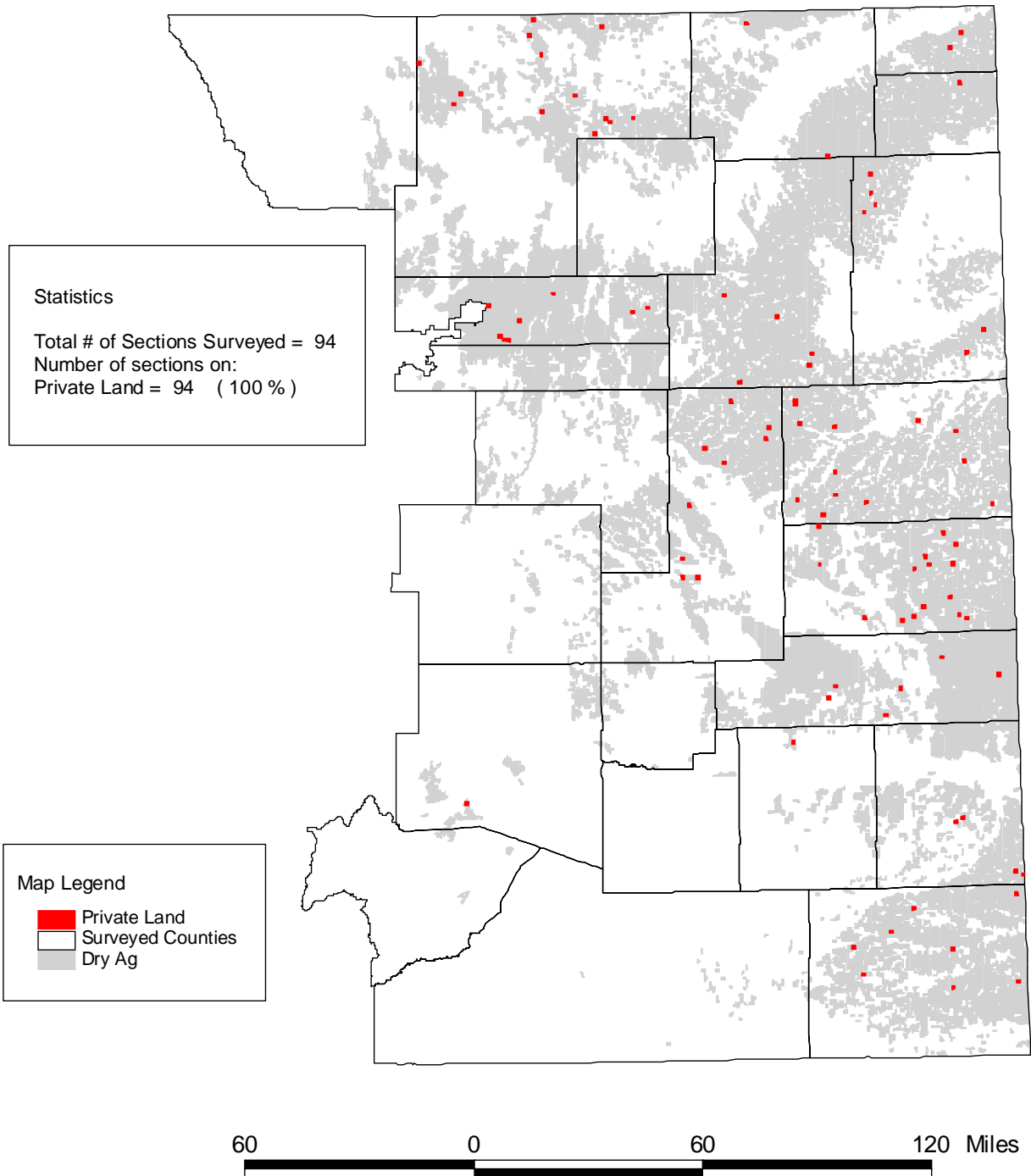


Figure 3. Sections containing dry-land agriculture that were surveyed using the road-based point count technique.

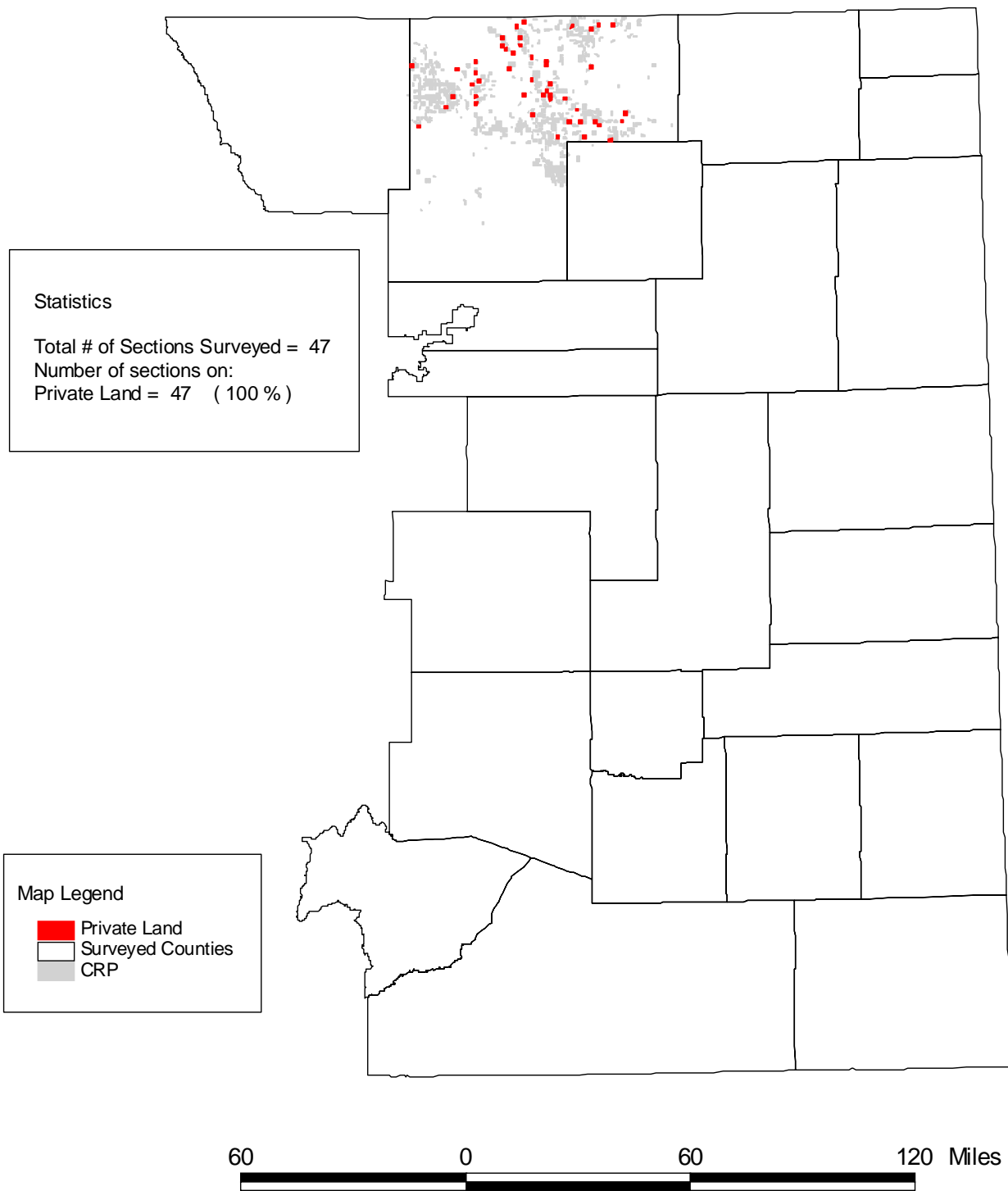


Figure 4. Sections containing CRP that were surveyed using the road-based point count technique in Weld County.

Road-based Point Counts:

Three, five-minute, 180° point counts were conducted from the road looking into the focal section. Distance between the point count stations was at least 0.322 km and were established randomly along section perimeters. We conducted surveys from one 30 minutes before sunrise until 1100 hrs, when bird activity, and thus detectability, was highest. Observers recorded habitat and weather conditions; surveys were postponed during heavy rains, dense fog, and/or winds exceeding 18 miles/hour. We recorded all individual bird seen and/or heard within the focal section and determined the distance to each bird at the point of first detection (measured using a Bushnell Yardage Pro 500 Rangefinder). Finally, we permanently marked the location of each point count for future reference using a Garmin *etrex* global positioning system (GPS) unit.

Interior Point Transects:

We established 17 interior point transects to attempt to correct for the potential road bias of the road-based point count technique. All transects contained 12 point count stations 250 m apart; six points along the road and six points placed in 4 random distance categories spaced at 0.322 km intervals, from the road so it was parallel to the road. The observer initiated the point transect at either edge of the section conducting the 180° point counts along the road first. Secondly, the observer completed the interior portion of the point transect which consisted of 360° counts. Observers recorded all birds seen or heard during the count period, recording birds, radial distances, how birds were detected, sex, and habitat type. Weather, time, and point count locations of individual surveys were also recorded.

Data Analyses:

Program DISTANCE (Thomas 1998-99) was used to analyze the point count and point transect data from both techniques using data collected during the 2002 field season. The notation, concepts, and analysis methods of DISTANCE were developed by Buckland et al. (1993). I used program DISTANCE to estimate density (D) on species that had a minimum of 25 observations and/or had a CV of less than 50% indicating robust data. During analyses, DISTANCE assigns a unique detection function, thus avoiding some potential problems associated with traditional analyses of point counts (e.g., varying detectability among habitats, species, and different years). Analysis using program DISTANCE assumes that 1) all birds at distance 0 are detected, 2) distances of the birds close to the points or line are measured accurately, and 3) birds do not move in response to the observer's presence.

In the analyses of road-based point count data, the sampling effort was set to 0.5 instead of one because birds were recorded only in 180° of the circle. This was done so as to include only those birds using the focal section.

The indices of abundance presented in the attached distribution maps were calculated from data collected using the road-based point count technique. Index of abundance, represented by graded symbols, was defined as the total number of a species detected on the section divided by the number of point counts conducted on that section. The index

of abundance was created to adjust for the amount of effort on each of the sections between years (2001 and 2002). In 2001 we conducted between one and four point counts per section compared to 2002 where three point counts were conducted on each section.

Bird taxonomy and nomenclature in this report follow that of the American Ornithological Union (1998,2002).

RESULTS

Road-based point counts: In 2002, we conducted 3,822 point counts on 1,274 sections (1,133 native prairie, 94 dry-land agriculture, and 47 CRP) (Figs. 2, 3, and 4). I calculated density estimates for 38 species in native prairie, 10 species in dry-land agriculture, and six species in CRP (Tables 1, 2, and 3). Density estimates for species in native prairie are compared with the 2001 density estimates (Hanni 2002) in the species accounts section.

Four species had less than 25 detections; However, for these species the detection function formulated in program DISTANCE appeared to indicate a normal distribution and CVs generated by the distance were less than or equal to 50%, indicating robust data.

Table 1: Estimated densities and population estimates for species detected by road-based point counts in native prairie. Asterisks indicate species for which I obtained <25 detections but with CVs of <50%.

Species	D	D LCL	D UCL	D CV	n
Swainson's Hawk	0.52	0.40	0.68	13%	62
Red-tailed Hawk	0.28	0.16	0.52	31%	25
Ferruginous Hawk	0.20	0.12	0.33	26%	33
American Kestrel	0.44	0.28	0.69	23%	28
Ring-necked Pheasant*	0.07	0.03	0.15	42%	20
Scaled Quail	0.73	0.48	1.11	22%	54
Killdeer	2.15	1.49	3.09	19%	185
Mountain Plover*	0.13	0.07	0.24	32%	15
Long-billed Curlew	0.15	0.09	0.27	29%	30
Mourning Dove	24.54	21.87	27.53	6%	1114
Burrowing Owl	0.73	0.50	1.06	19%	91
Common Nighthawk	2.08	1.60	2.71	13%	168
Western Kingbird	11.51	9.84	13.45	8%	564
Eastern Kingbird	0.58	0.37	0.90	23%	28
Loggerhead Shrike	1.27	0.91	1.76	17%	60
Black-billed Magpie	0.26	0.16	0.43	26%	31
Chihuahuan Raven	0.25	0.18	0.33	15%	72
Horned Lark	138.01	131.84	144.47	2%	5768
Cliff Swallow	9.18	6.59	12.77	17%	222
Barn Swallow	3.77	2.42	5.87	23%	63
American Robin	0.71	0.42	1.18	26%	34
Northern Mockingbird	2.00	1.59	2.53	12%	181

European Starling	0.57	0.31	1.03	31%	33
Cassin's Sparrow	17.96	16.13	19.99	5%	989
Brewer's Sparrow	3.08	2.14	4.41	19%	104
Vesper Sparrow	2.08	1.38	3.14	21%	60
Lark Sparrow	16.56	14.39	19.06	7%	766
Lark Bunting	10.58	8.52	13.14	11%	793
Grasshopper Sparrow	6.59	5.26	8.25	11%	188
McCown's Longspur	3.50	2.91	4.21	9%	381
Chestnut-collared Longspur	0.47	0.25	0.90	34%	36
Red-winged Blackbird	2.90	2.02	4.18	19%	171
Western Meadowlark	43.15	41.04	45.35	3%	3508
Brewer's Blackbird	1.41	0.98	2.04	19%	111
Common Grackle	1.95	1.33	2.84	19%	97
Brown-headed Cowbird	2.45	1.84	3.27	15%	109
Bullock's Oriole	0.98	0.57	1.71	29%	30
House Sparrow	0.82	0.48	1.42	28%	46

D=Density estimate expressed in birds/km², DLCL & DUCL = lower and upper 95% confidence limits of D, n = number of detections used to calculate D.

Table 2: Estimated densities and population estimates for species detected on point counts in dry-land agriculture. Asterisks indicate species for which I obtained <25 detections but with CVs of <50%.

Species	D	D LCL	D UCL	D CV	n
Ring-necked Pheasant	1.62	0.96	2.74	27%	34
Mourning Dove	32.66	25.05	42.59	14%	182
Western Kingbird	5.54	3.13	9.81	29%	27
Horned Lark	137.83	118.88	159.80	8%	472
Cassin's Sparrow*	4.40	2.42	8.02	31%	21
Lark Sparrow	9.55	5.09	17.95	33%	43
Lark Bunting	27.84	20.32	38.14	16%	149
Grasshopper Sparrow	24.52	17.03	35.29	19%	72
Red-winged Blackbird	7.80	4.24	14.36	32%	28
Western Meadowlark	55.18	47.63	63.92	8%	388

D=Density estimate expressed in birds/km², DLCL & DUCL = lower and upper 95% confidence limits of D, n = number of detections used to calculate D.

Table 3: Estimated densities and population estimates for species detected on point counts in CRP. Asterisks indicate species for which I obtained <25 detections but with CVs of <50%.

Species	D	D LCL	D UCL	D CV	n
Mourning Dove	24.99	16.84	37.07	20%	50
Horned Lark	118.58	92.10	152.68	13%	145
Brewer's Sparrow*	16.16	8.30	31.46	35%	15
Lark Bunting	20.06	13.31	30.23	21%	56
Chestnut-collared Longspur*	10.87	4.81	24.55	43%	15
Western Meadowlark	66.50	49.36	89.59	15%	109

D=Density estimate expressed in birds/km², DLCL & DUCL = lower and upper 95% confidence limits of D, n = number of detections used to calculate D.

Interior point transects: I conducted 17 point transects and detected 376 individuals of 14 species. I derived density and population estimates for two species from transects conducted along the road in addition to four separate categories (0.322 km., 0.644 km., 0.966 km., and 1.288 km. from the road)(Table 4).

Table 4: Estimated densities and population estimates for species detected on interior point transects.

Species	D	D LCL	D UCL	D CV
Horned Lark (Road)	146.28	122.18	175.13	9%
Horned Lark (0.322 km)	20.36	12.93	32.05	23%
Horned Lark (0.644 km)	42.26	28.66	62.31	20%
Horned Lark (0.966 km)	11.60	6.40	21.02	31%
Horned Lark (1.288 km)	7.45	3.77	14.74	35%
Western Meadowlark (Road)	18.18	13.20	25.05	16%
Western Meadowlark (0.322 km)	1.64	0.97	2.77	27%
Western Meadowlark (0.644 km)	6.13	3.57	10.50	28%
Western Meadowlark (0.966 km)	1.51	0.66	3.47	43%
Western Meadowlark (1.288 km)	5.37	2.63	11.00	37%

D=Density estimate expressed in birds/km², DLCL & DUCL = lower and upper 95% confidence limits of D, n = number of detections used to calculate D.

SPECIES ACCOUNTS

This section shows the distribution and estimated densities of selected species as calculated from the road-based point count technique. This technique yielded data on 100 different species, of which I present results for 32 species. I derived density estimates for both 2001, and 2002 and report on species that we can potentially monitor in the future. I created species accounts to graphically report the data for individual species.

I provide distribution maps for the selected species derived from data collected from the road-based point count technique. The distribution maps for each species shows locations of all observations, graded by the index of abundance, for individual species on each section on which it was detected.

Graphs comparing density estimates among years (2001 and 2002), habitats (native, CRP in Weld County and dry-land agriculture) and structure (percent shrub cover) are also included in the species accounts section. Density estimates for 2001, used in the comparison are from Hanni (2002). Differences between density estimates, in this report, are considered to be significant if the 95% confidence limits do not overlap.

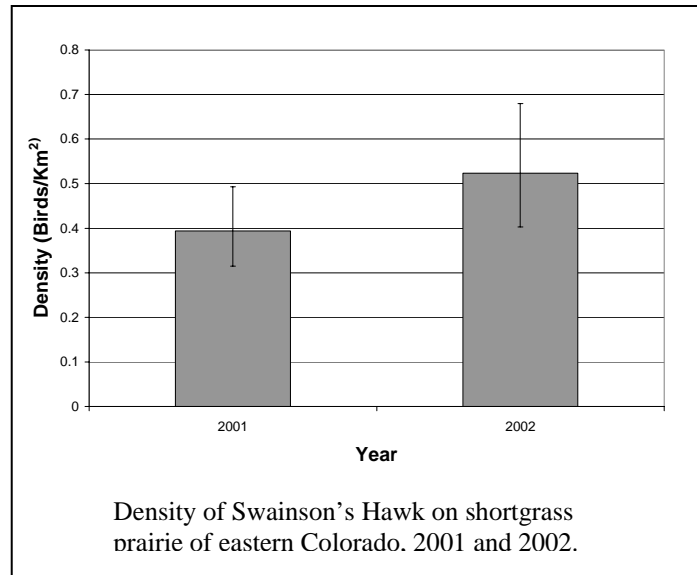
Swainson's Hawk
(*Buteo swainsoni*)

The Swainson's Hawk is distributed fairly evenly throughout the shortgrass prairie of eastern Colorado, and is often sympatric with Red-tailed and Ferruginous Hawks. I calculated density estimates for this species in years 2001 and 2002.

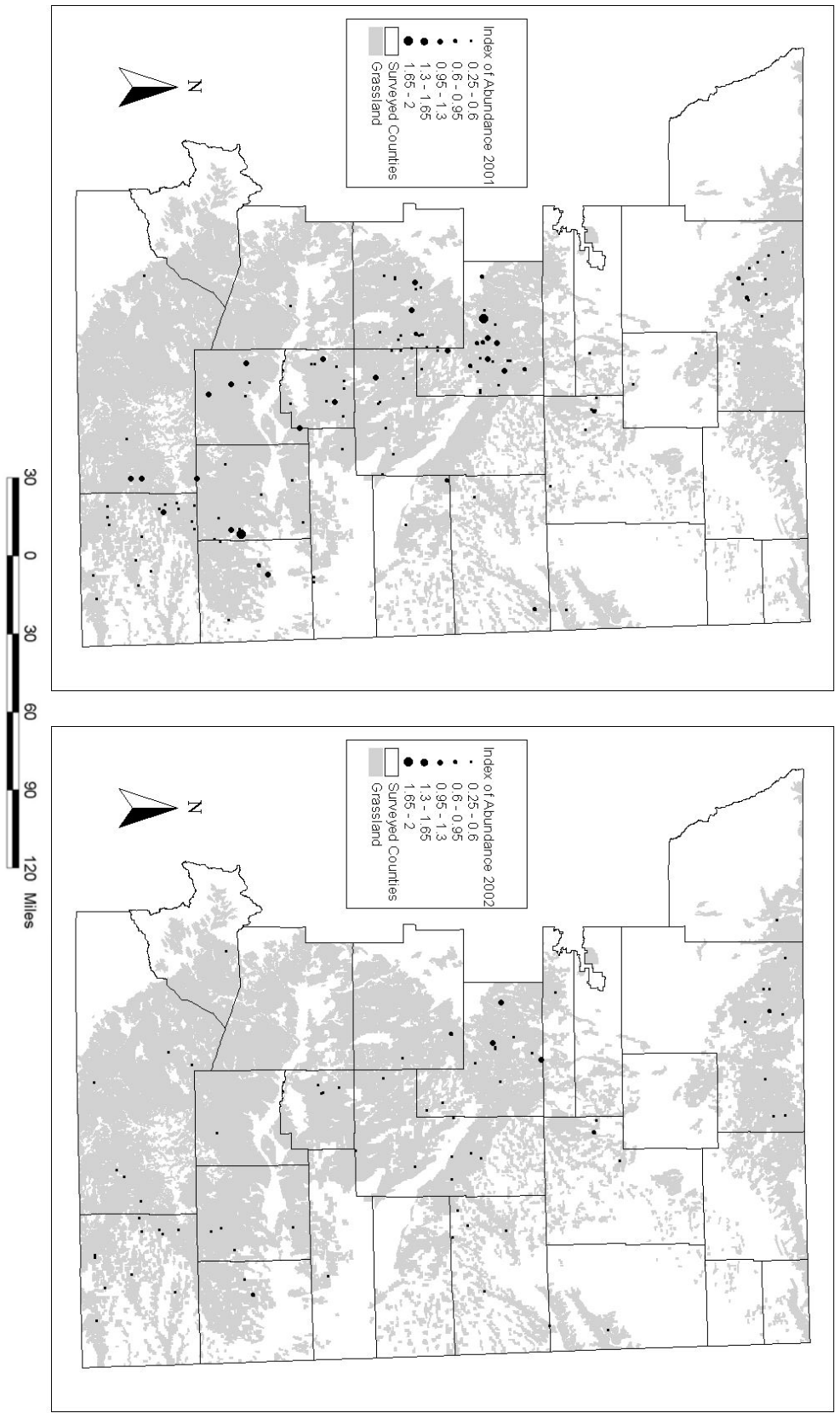
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.39 birds/km² (CV=11%)
- 2002 density estimate
D = 0.52 birds/km² (CV=13%)

One hundred and three individuals were detected on 92 of the sections surveyed (7%). We should be able to monitor this species using the road-based point count technique.



Swainson's Hawk
(*Buteo swainsoni*)



Maps show the distribution and relative abundance of the Swainson's Hawk throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

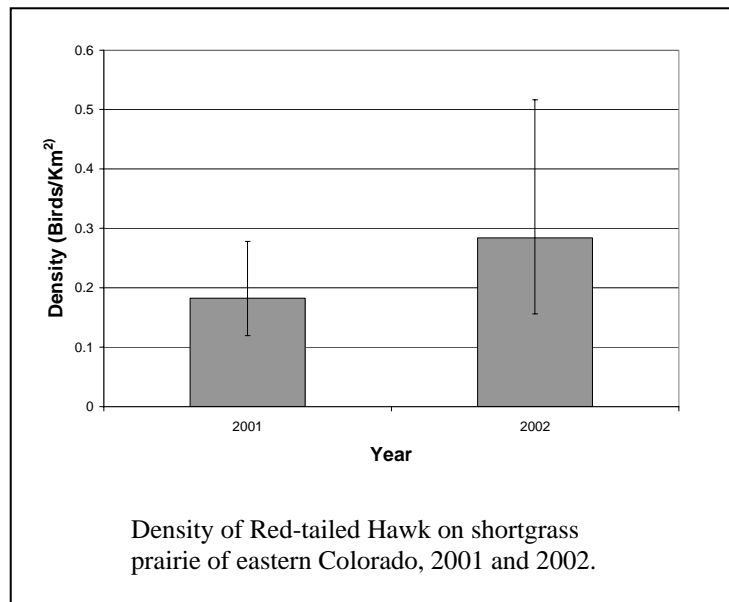
Red-tailed Hawk
(*Buteo jamaicensis*)

The Red-tailed Hawk is distributed throughout the shortgrass prairie of eastern Colorado and is usually sympatric with Swainson's and Ferruginous Hawks. I calculated density estimates for this species in years 2001 and 2002.

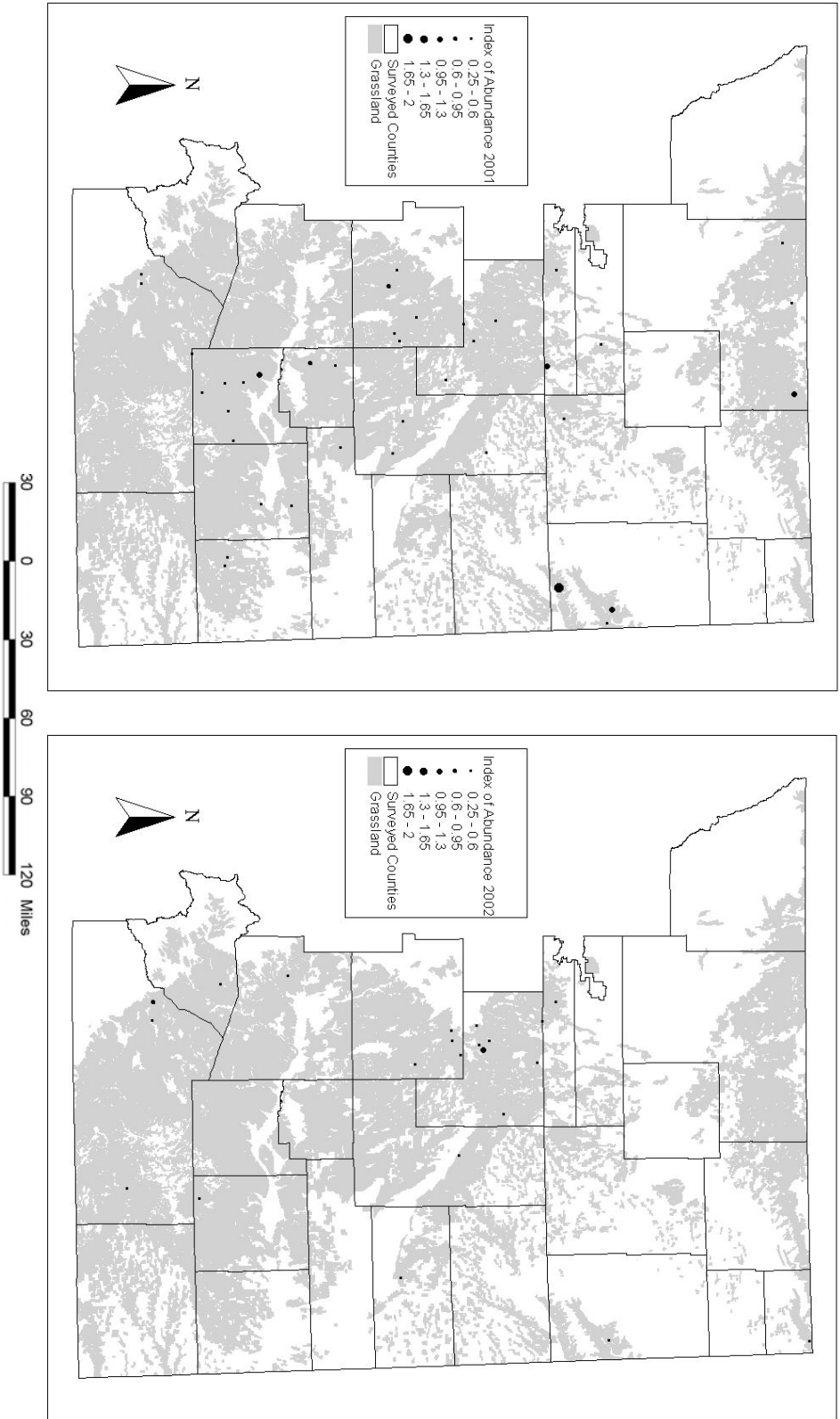
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.18 birds/km² (CV=22%)
- 2002 density estimate
D = 0.28 birds/km² (CV=31%)

Twenty nine individuals were detected on 27 of the sections surveyed (2%). We should be able to monitor this species using the road-based point count technique. The density is higher in year 2002.



Red-tailed Hawk
(*Buteo iamaicensis*)



Maps show the distribution and relative abundance of the Red-tailed Hawk throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

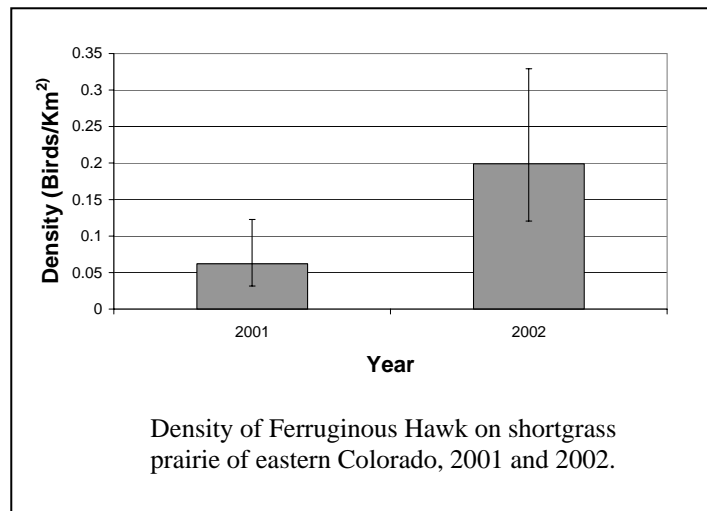
Ferruginous Hawk
(*Buteo regalis*)

The Ferruginous Hawk is distributed in low densities throughout the shortgrass prairie in eastern Colorado. This species has historically nested on the ground, but will also use trees and similar structures. I calculated density estimates for this species in years 2001 and 2002.

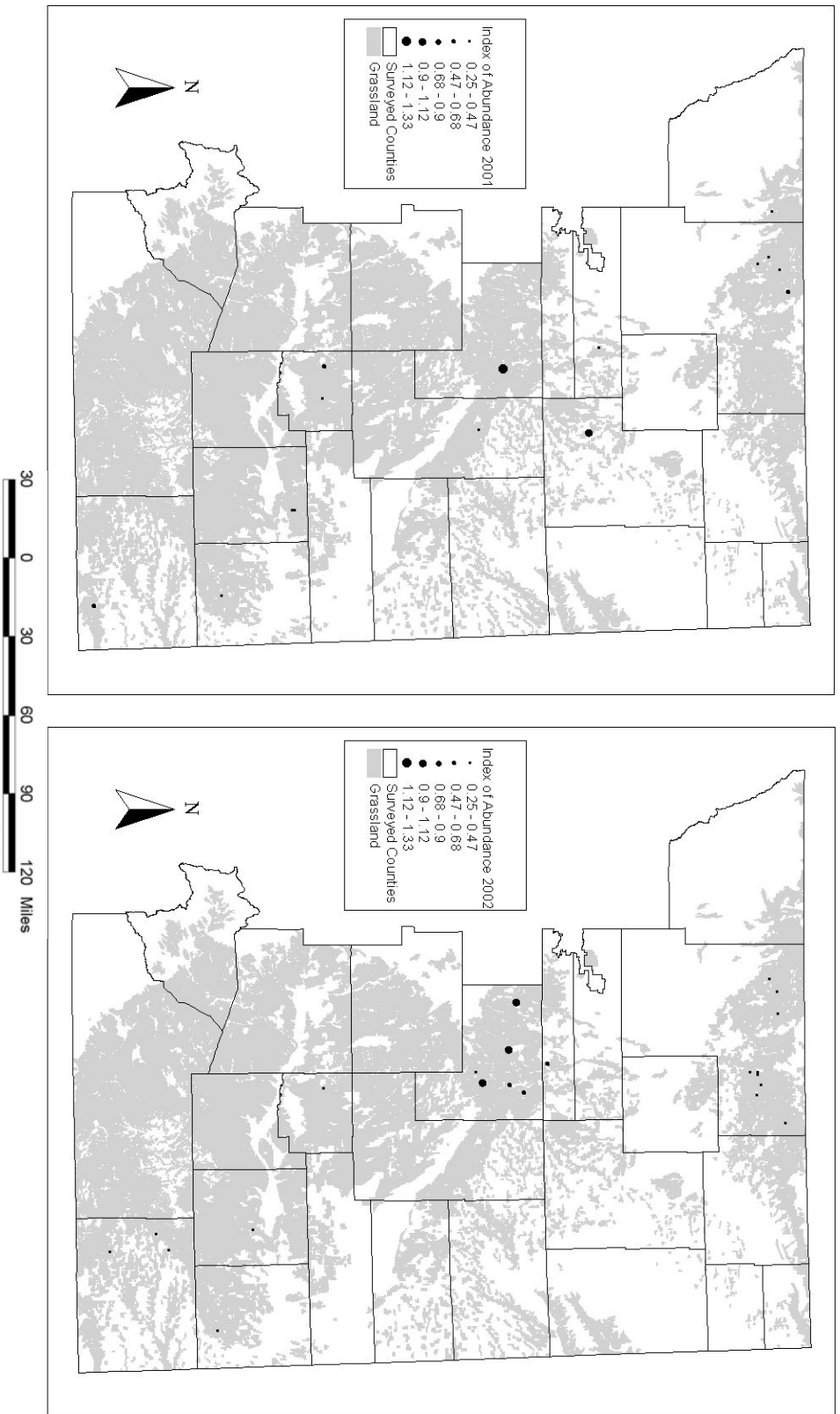
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.06 birds/km² (CV=35%)
- 2002 density estimate
D = 0.20 birds/km² (CV=26%)

Thirty eight individuals were detected on 35 of the sections surveyed (3%). We should be able to monitor this species using the road-based point count technique.



Ferruginous Hawk
(*Buteo regalis*)



Maps show the distribution and relative abundance of the Ferruginous Hawk throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

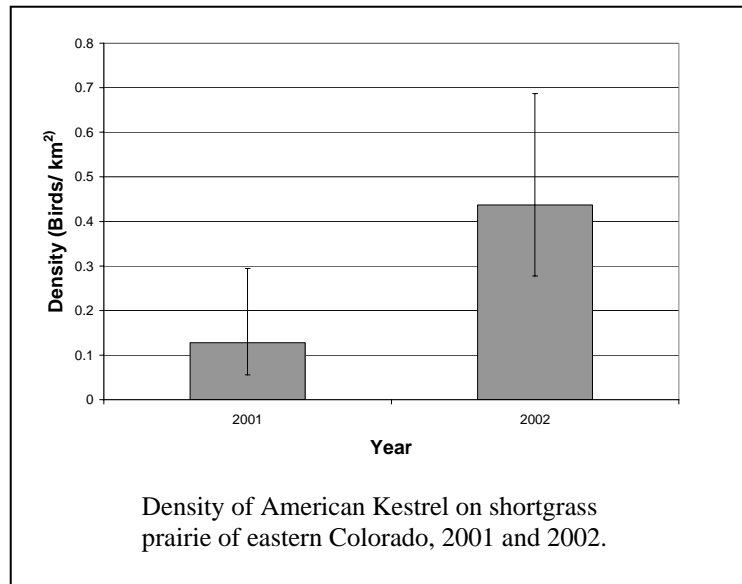
American Kestrel
(*Falco sparverius*)

The American Kestrel is sparsely distributed throughout eastern Colorado. This species nests in cavities throughout the shortgrass prairie and needs perches from which they hunt. This species is usually associated with human habitation on the prairie. I calculated density estimates for this species in years 2001 and 2002.

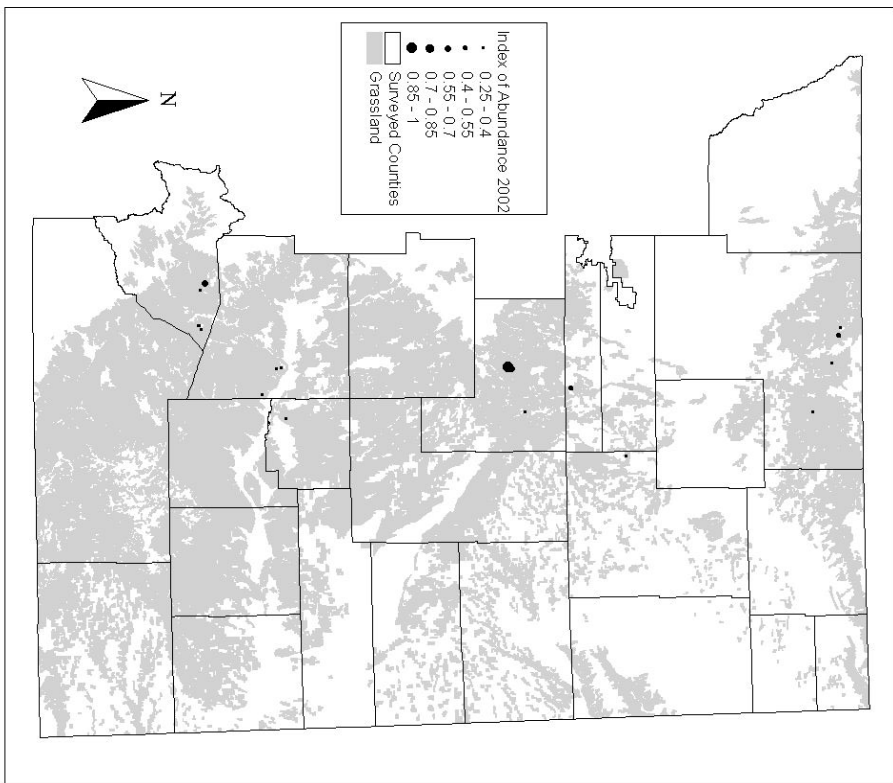
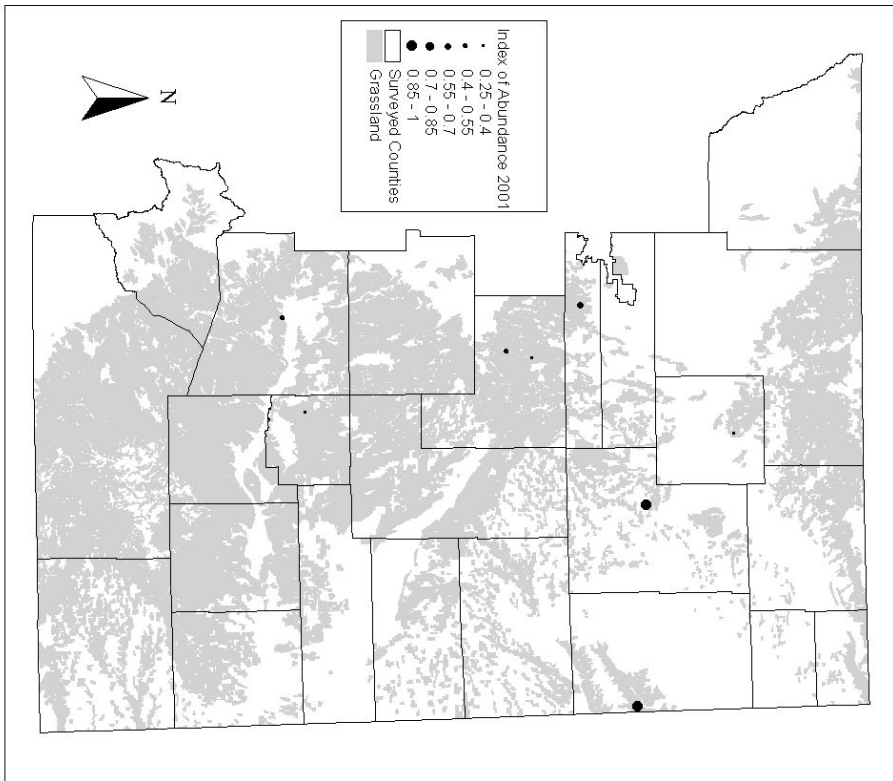
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.13 birds/km² (CV=43%)
- 2002 density estimate
D = 0.44 birds/km² (CV=23%)

Twenty two individuals were detected on 20 of the sections surveyed (2%). We should be able to monitor this species using the road-based point count technique.



American Kestrel
(*Falco sparverius*)



Maps show the distribution and relative abundance of the American Kestrel throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

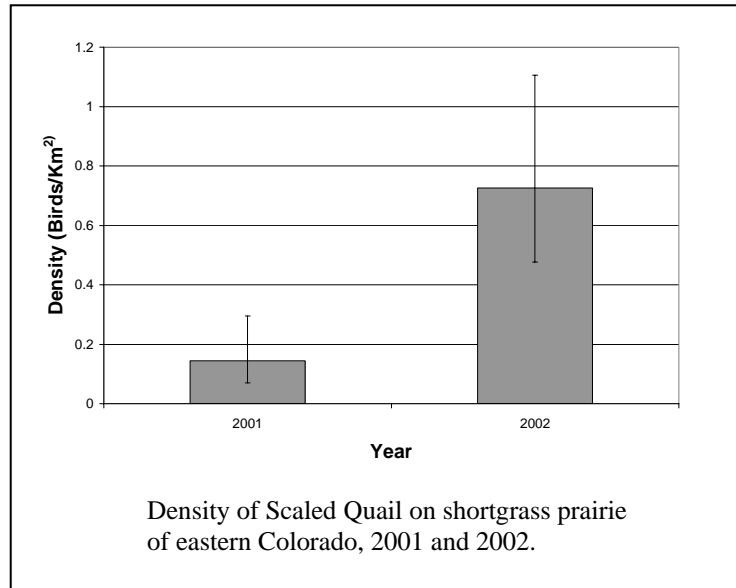
Scaled Quail
(*Callipepla squamata*)

The Scaled Quail appears to be sparsely distributed in the southern portion of the shortgrass prairie in eastern Colorado. The species usually inhabits grasslands scattered with cacti and shrubs. I calculated density estimates for this species in years 2001 and 2002.

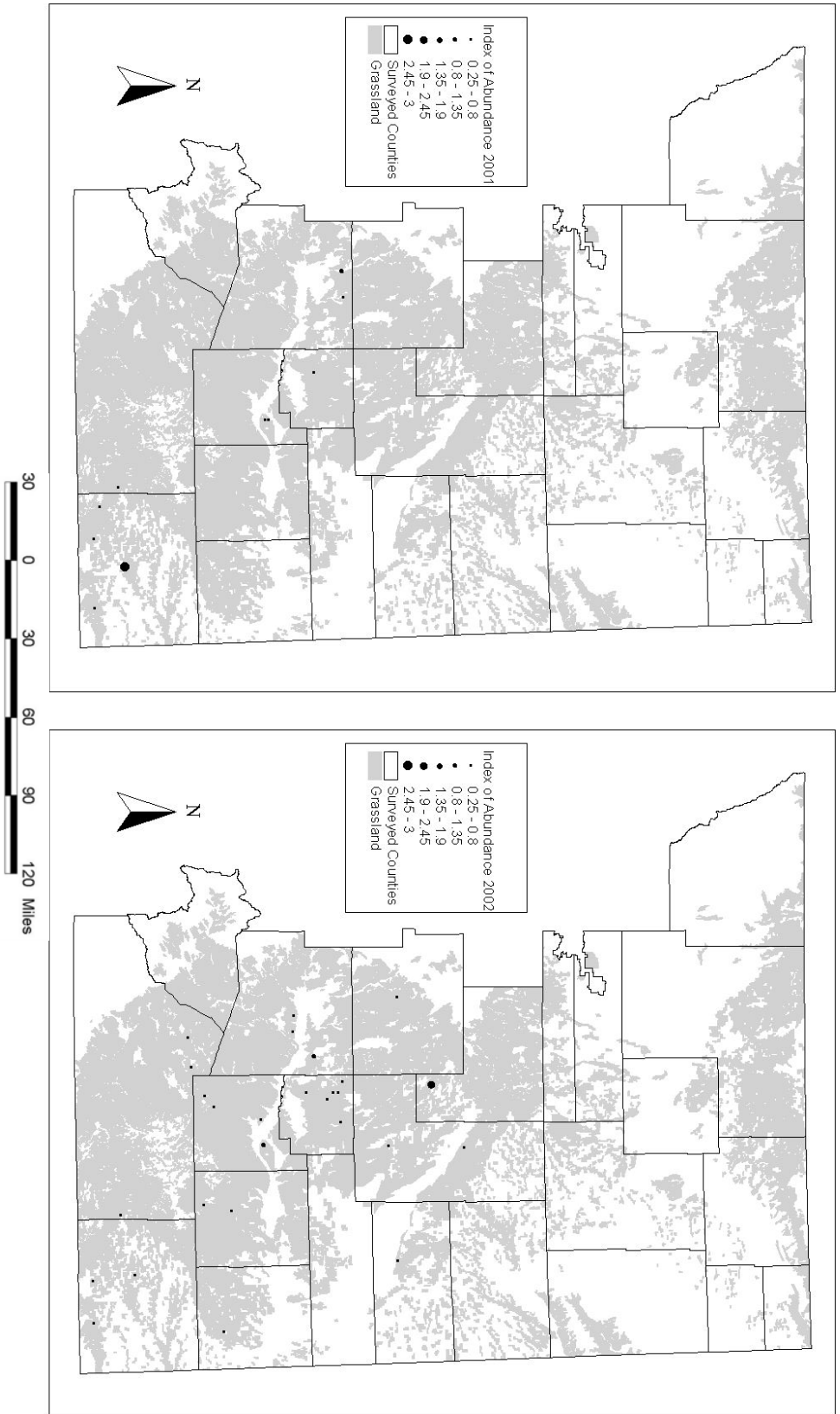
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.14 birds/km² (CV=38%)
- 2002 density estimate
D = 0.73 birds/km² (CV=22%)

Fifty seven individuals were detected on 34 of the sections surveyed (3%). We should be able to monitor this species using the road-based point count technique.



Scaled Quail
(*Callipepla squamata*)



Maps show the distribution and relative abundance of the Scaled Quail throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

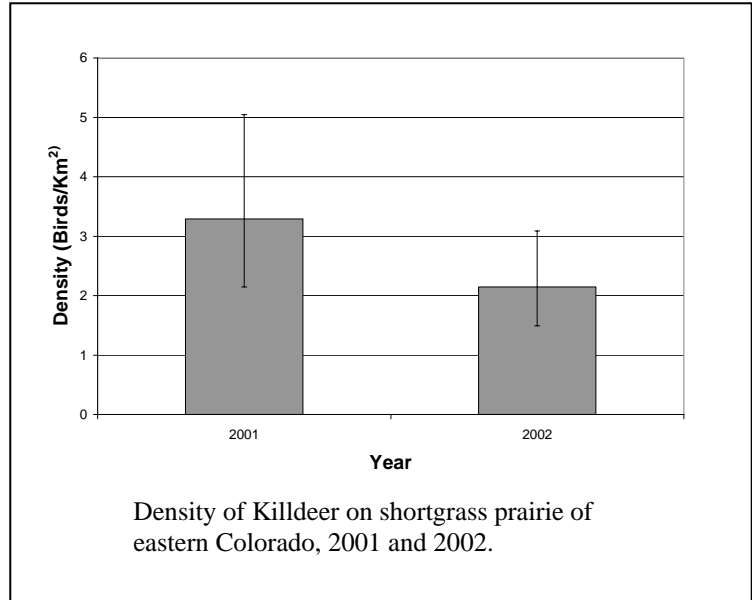
Killdeer
(*Charadrius vociferus*)

The Killdeer is distributed throughout the shortgrass prairie, usually near water (e.g., stock tanks). However, it can easily adapt to nest in smaller patches that other shortgrass prairie bird species, like the Mountain Plover, do not prefer. I calculated density estimates for this species in years 2001 and 2002.

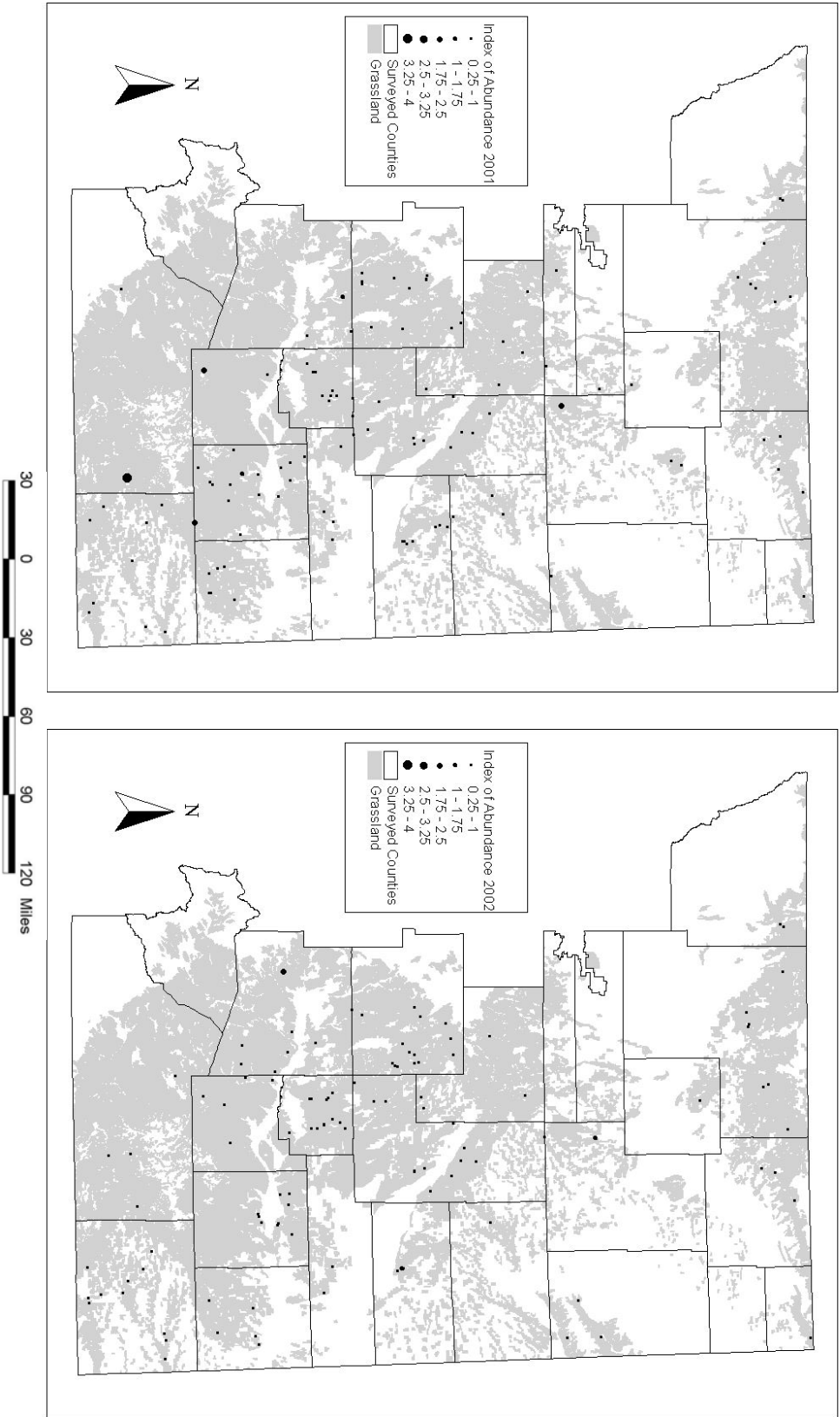
Density estimates (D) for this species by year:

- 2001 density estimate
D = 3.30 birds/km² (CV=22%)
- 2002 density estimate
D = 2.15 birds/km² (CV=19%)

One hundred ninety two individuals were detected on 147 of the sections surveyed (12%). We should be able to monitor this species using the road-based point count technique.



Killdeer
(*Charadrius vociferus*)



Maps show the distribution and relative abundance of the Killdeer throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

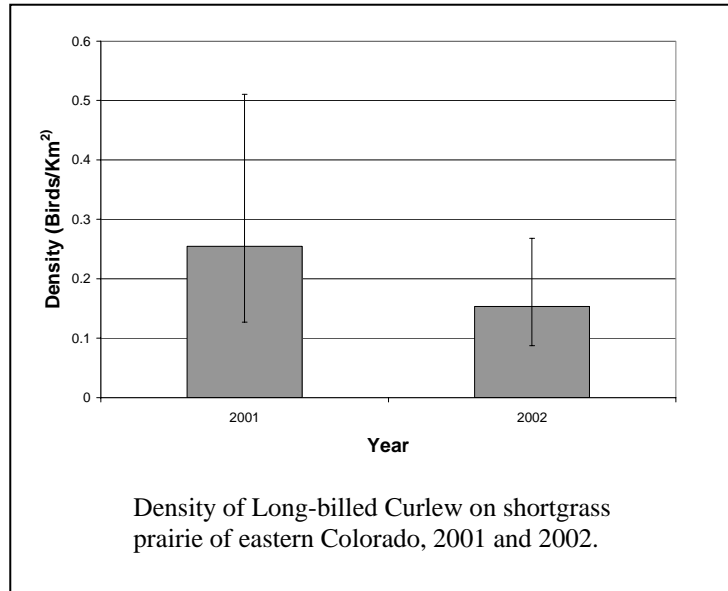
Long-billed Curlew
(*Numenius americanus*)

In Colorado, Long-billed Curlew breeding distribution is nearly restricted to the southeastern corner. However, there were a few individuals detected in the north central portion of the state. I calculated density estimates for this species in years 2001 and 2002.

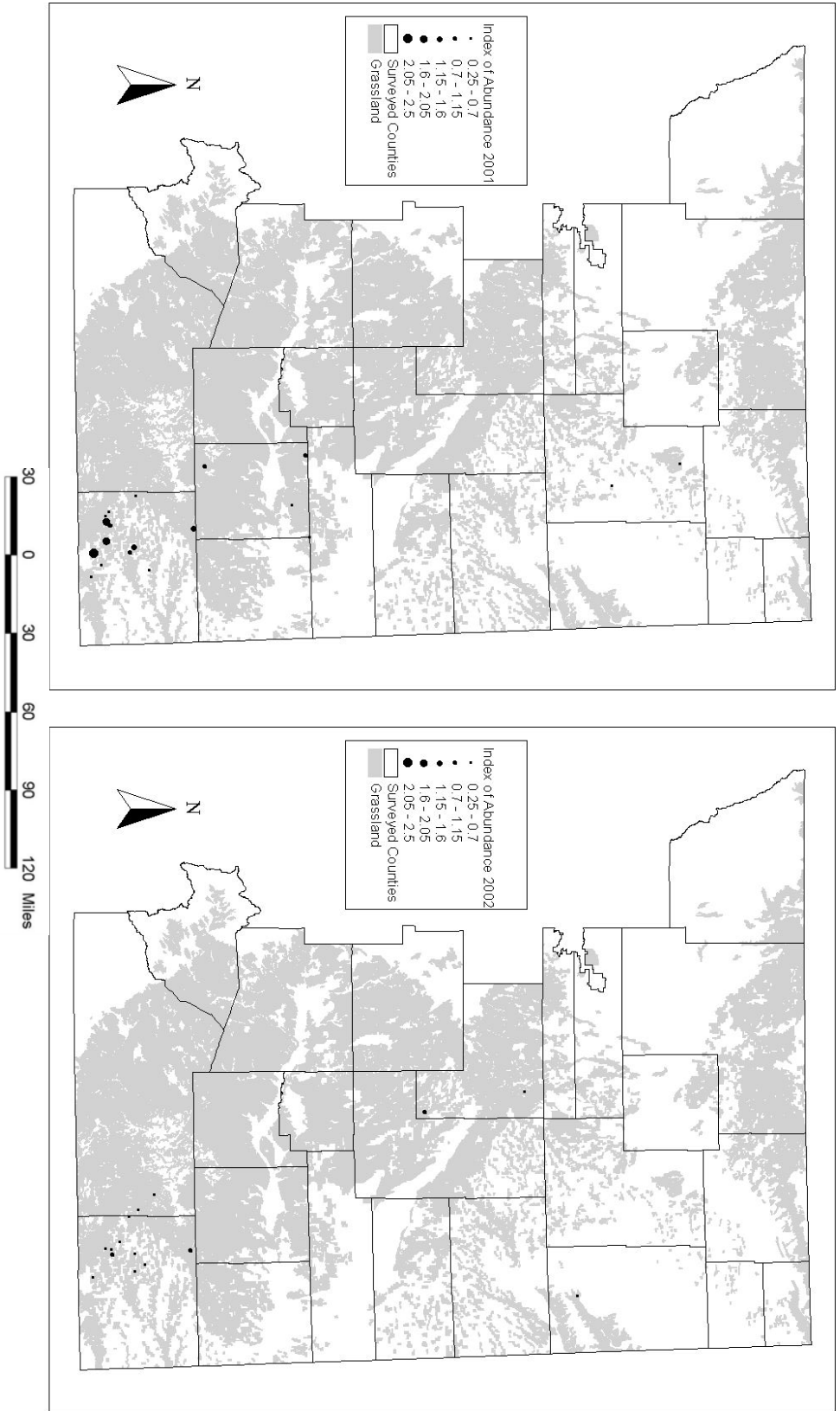
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.30 birds/km² (CV=37%)
- 2002 density estimate
D = 0.15 birds/km² (CV=29%)

Thirty one individuals were detected on 20 of the sections surveyed (2%). We should be able to monitor this species using the road-based point count technique.



Long-billed Curlew
(*Numenius americanus*)



Maps show the distribution and relative abundance of the Long-billed Curlew throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Mourning Dove
(*Zenaida macroura*)

The Mourning Dove is distributed throughout the shortgrass prairie of eastern Colorado. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure and habitat.

Density estimates (D) for this species by year:

- 2001 density estimate
D = 11.90 birds/km² (CV=11%)
- 2002 density estimate
D = 24.54 birds/km² (CV=6%)

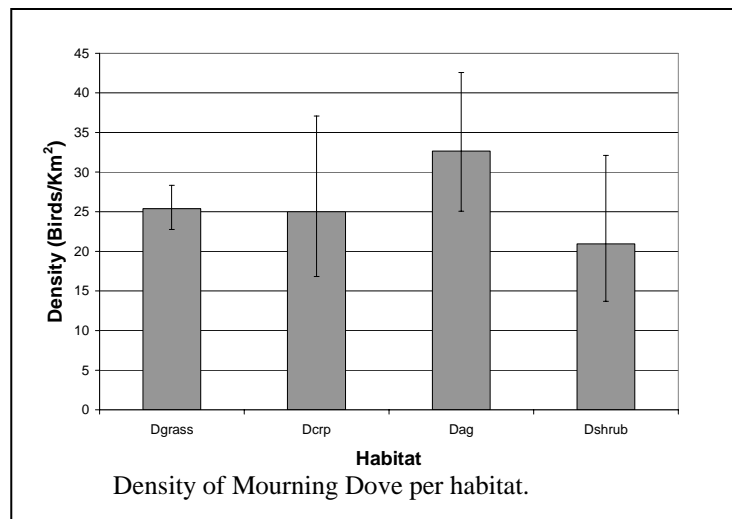
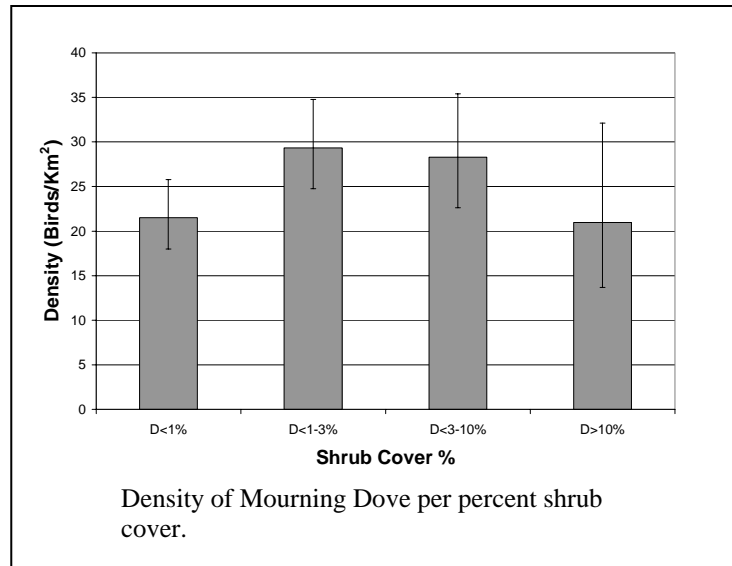
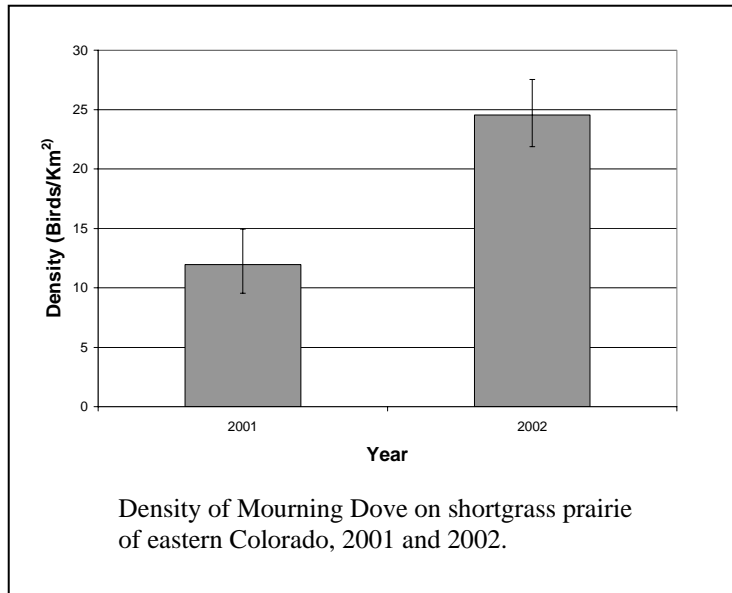
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 21.52 birds/km² (CV=9%)
- Between 1 and 3 % shrub cover
D = 29.32 birds/km² (CV=9%)
- Between 3 and 10 % shrub cover
D = 28.30 birds/km² (CV=11%)
- Greater than 10% shrub cover
D = 20.96 birds/km² (CV=22%)

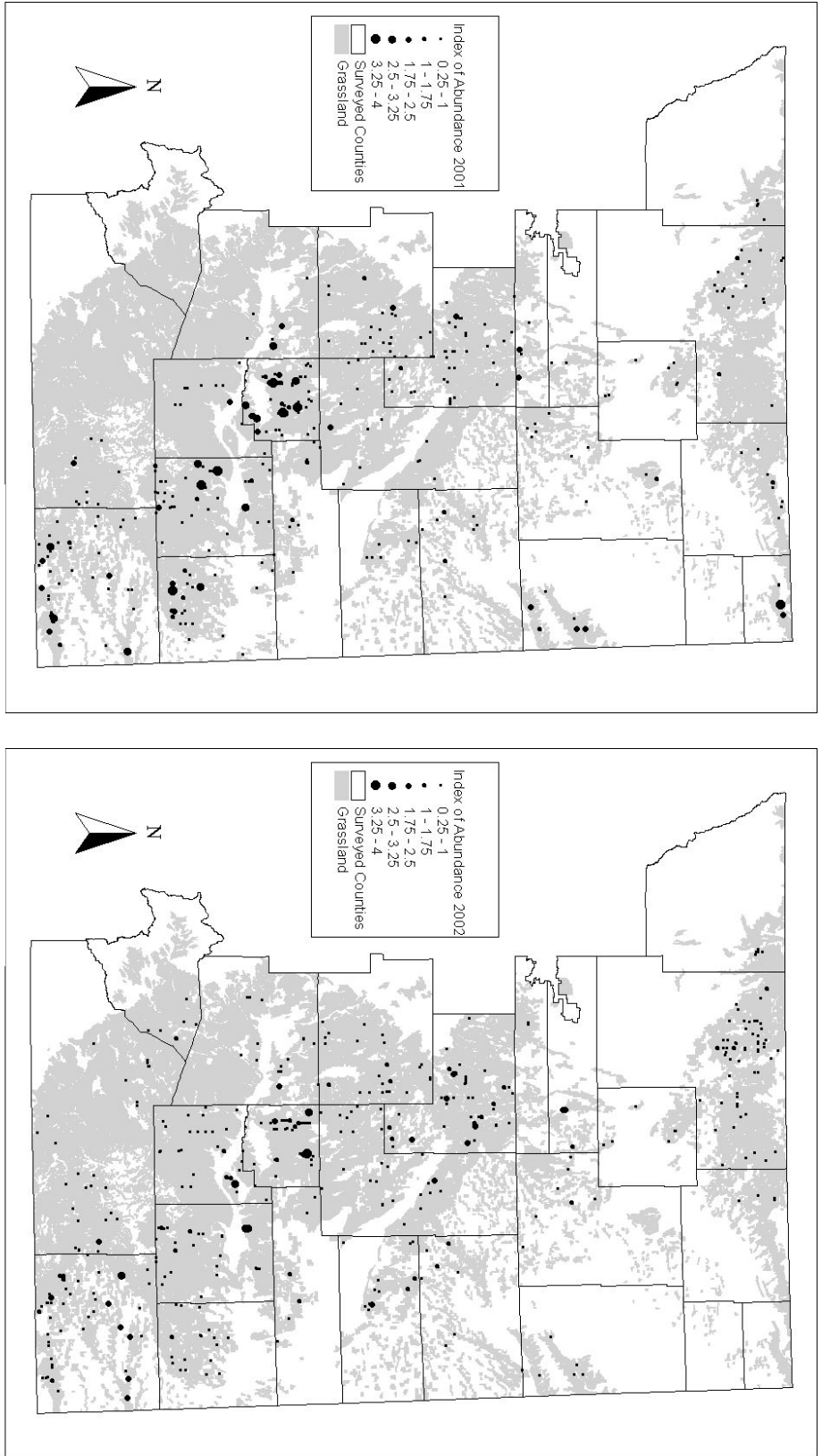
Density estimates (D) for this species categorized by habitat type:

- Grassland
D = 25.40 birds/km² (CV=6%)
- CRP in Weld County
D = 24.99birds/km² (CV=20%)
- Dry-land agriculture
D = 32.66 birds/km² (CV=14%)
- Shrubland (>10% shrub cover)
D = 20.96 birds/km² (CV=22%)

One thousand three hundred and ten individuals were detected on 564 of the sections surveyed (45%). We should be able to monitor this species using the road-based point count technique.



Mourning Dove
(*Zenaida macroura*)



Maps show the distribution and relative abundance of the Mourning Dove throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

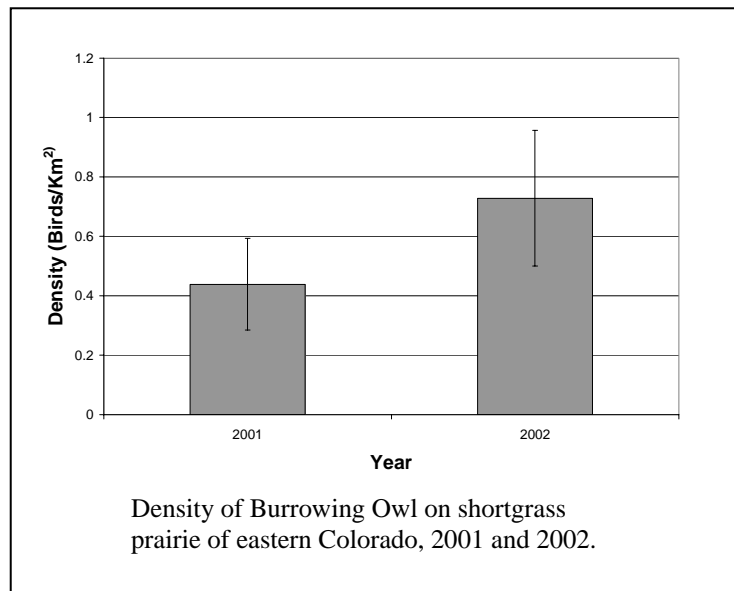
Burrowing Owl
(*Athene cunicularia*)

The distribution of the Burrowing Owl is tightly tied with the distribution of black-tailed prairie dog colonies. These maps show that most of the birds were discovered in the southern half of the state. I calculated density estimates for this species in years 2001 and 2002.

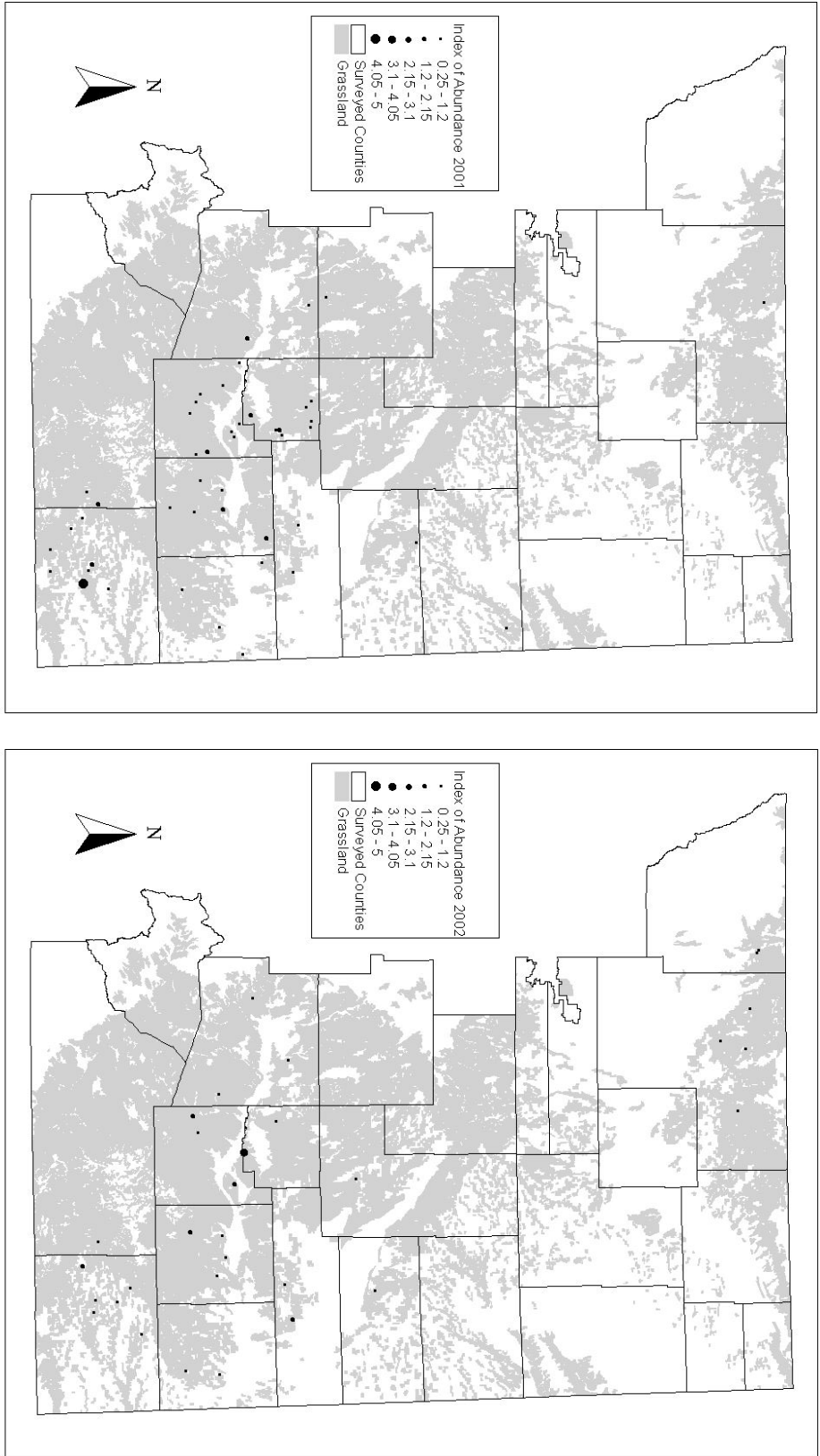
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.44 birds/km² (CV=22%)
- 2002 density estimate
D = 0.73 birds/km² (CV=19%)

One hundred and four individuals were detected on 44 of the sections surveyed (4%). We should be able to monitor this species using the road-based point count technique.



Burrowing Owl
(*Athene cucularia*)



Maps show the distribution and relative abundance of the Burrowing Owl throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Common Nighthawk
(*Chordeiles minor*)

The Common Nighthawk is distributed throughout the shortgrass prairie of eastern Colorado, nesting commonly on bare ground. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure.

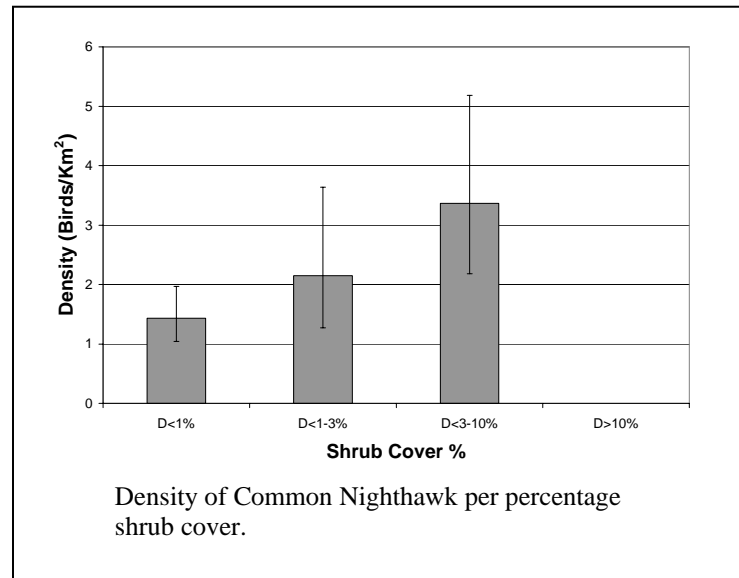
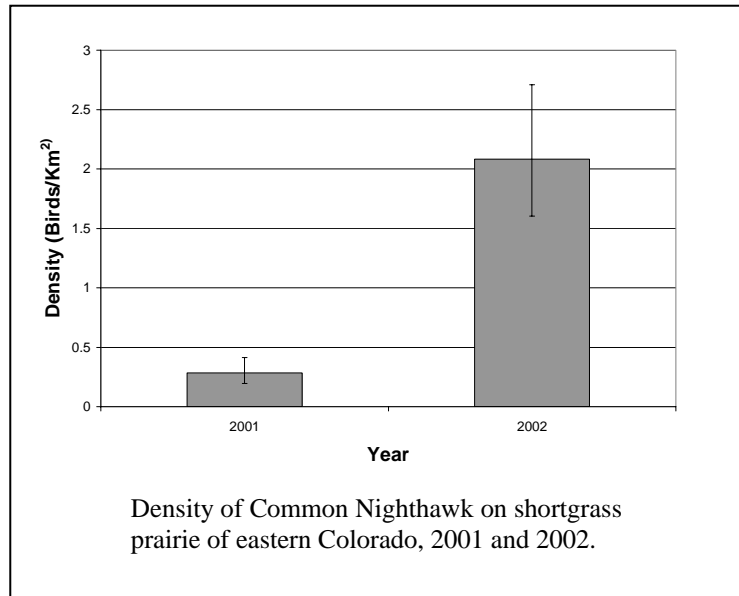
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.28 birds/km² (CV=19%)
- 2002 density estimate
D = 2.08 birds/km² (CV=13%)

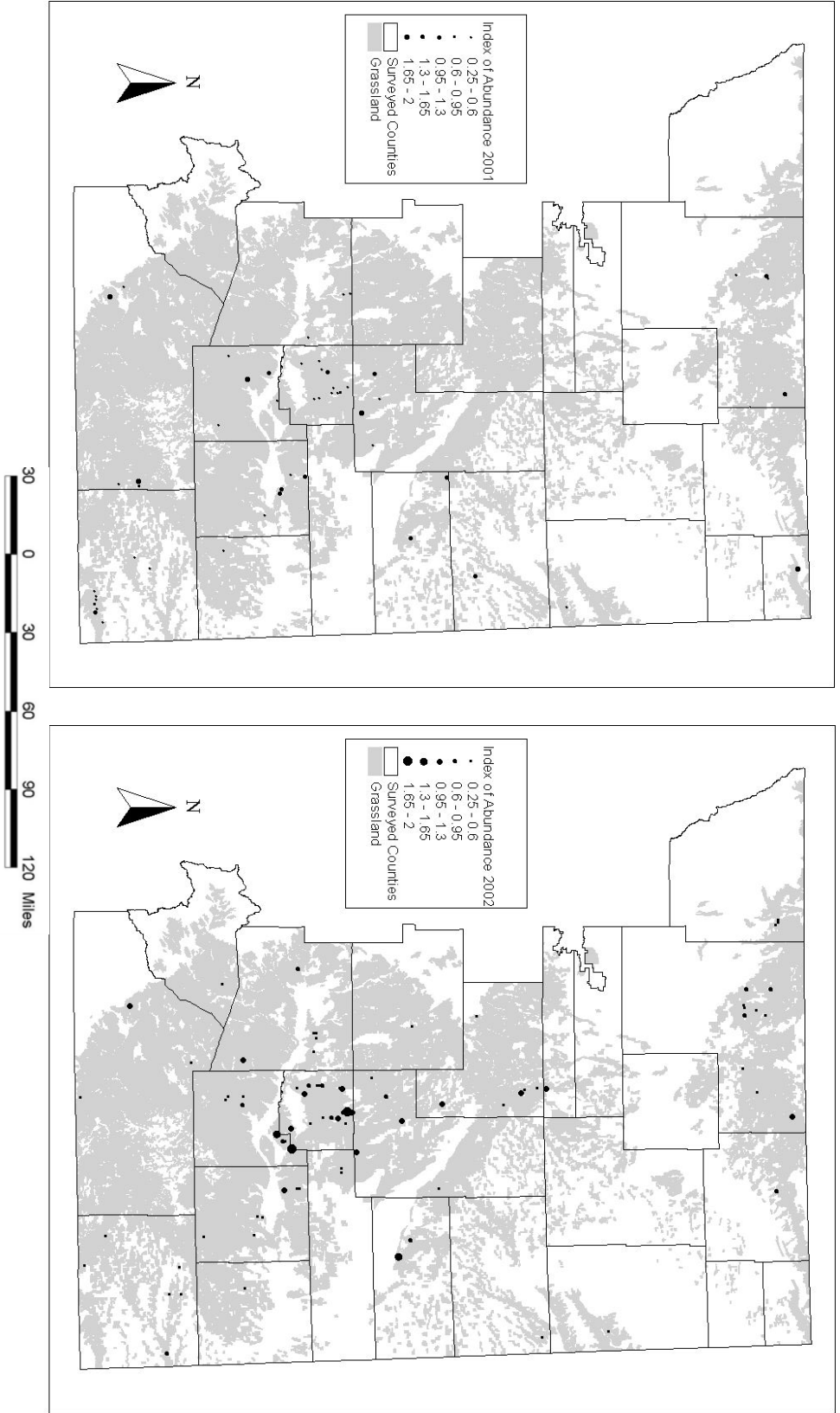
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 1.43 birds/km² (CV=16%)
- Between 1 and 3 % shrub cover
D = 2.15 birds/km² (CV=27%)
- Between 3 and 10 % shrub cover
D = 3.36 birds/km² (CV=22%)
- Greater than 10% shrub cover
Insufficient data for analysis.

One hundred eighty individuals were detected on 105 of the sections surveyed (8%). We should be able to monitor this species using the road-based point count technique.



Common Nighthawk
(*Chordeiles minor*)



Maps show the distribution and relative abundance of the Common Nighthawk throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Western Kingbird
(*Tyrannus verticalis*)

The Western Kingbird is distributed throughout the shortgrass prairie of eastern Colorado, where it is usually found nesting in trees in and around human habitation. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in differing habitat.

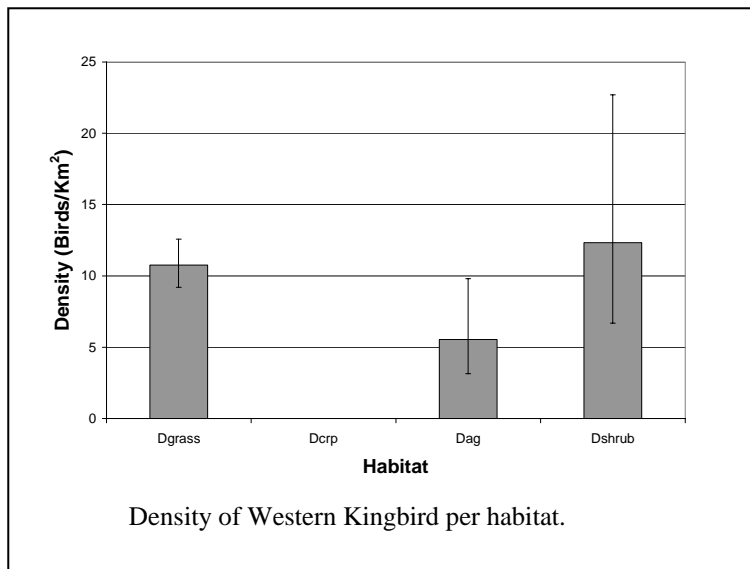
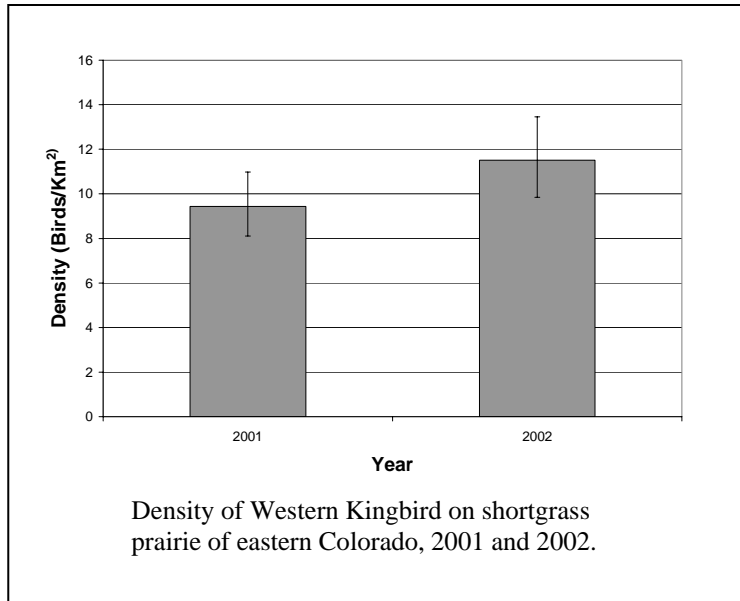
Density estimates (D) for this species by year:

- 2001 density estimate
D = 9.40 birds/km² (CV=8%)
- 2002 density estimate
D = 11.51 birds/km² (CV=8%)

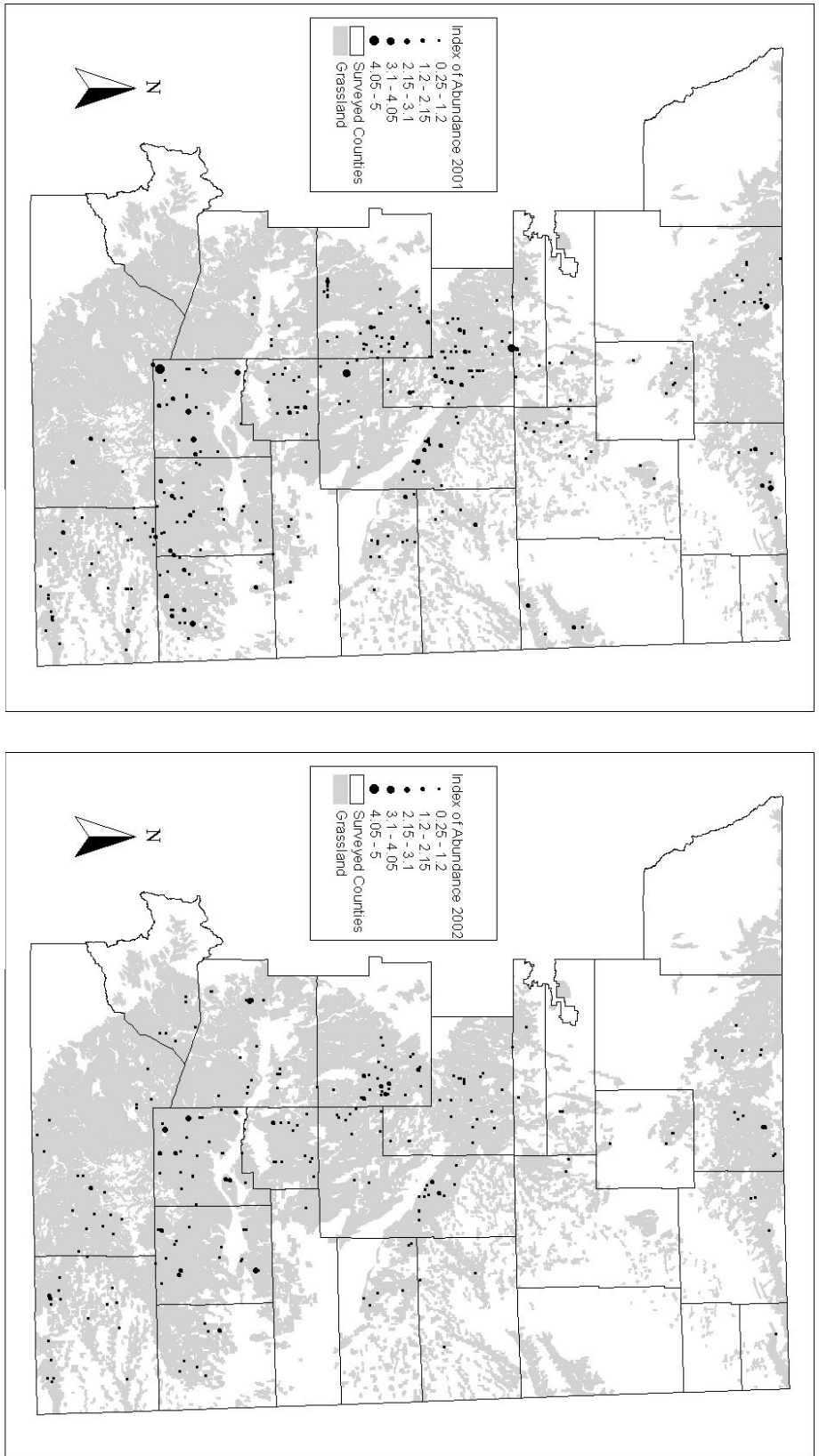
Density estimates (D) for this species categorized by habitat type:

- Grassland
D = 10.77 birds/km² (CV=8%)
- CRP in Weld County
Insufficient data for analysis
- Dry-land agriculture
D = 5.55 birds/km² (CV=30%)
- Shrubland (>10% shrub cover)
D = 12.32 birds/km² (CV=32%)

Five hundred and eighty one individuals were detected on 293 of the sections surveyed (23%). We should be able to monitor this species using the road-based point count technique.



Western Kingbird
(*Tyrannus verticalis*)



Maps show the distribution and relative abundance of the Western Kingbird throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

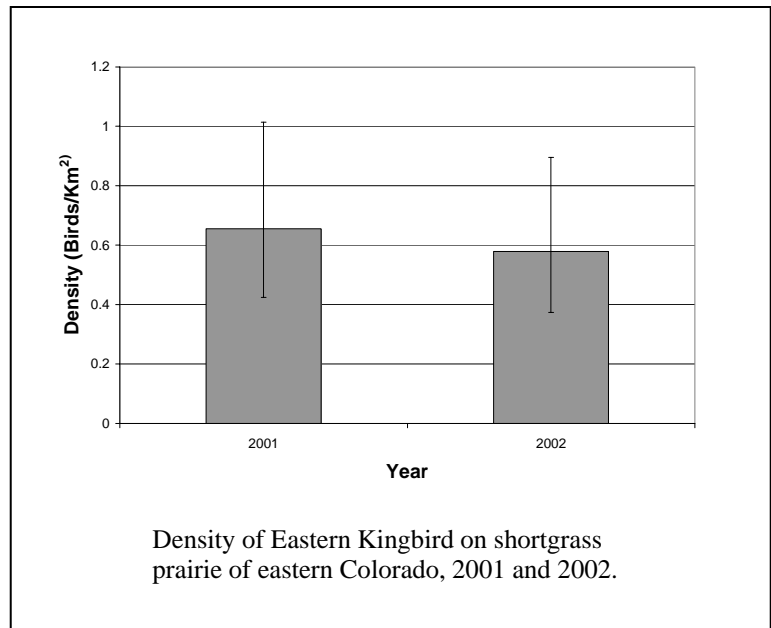
Eastern Kingbird
(*Tyrannus tyrannus*)

The Eastern Kingbird is distributed throughout eastern Colorado, usually nesting in wooded areas. I calculated density estimates for this species in years 2001 and 2002.

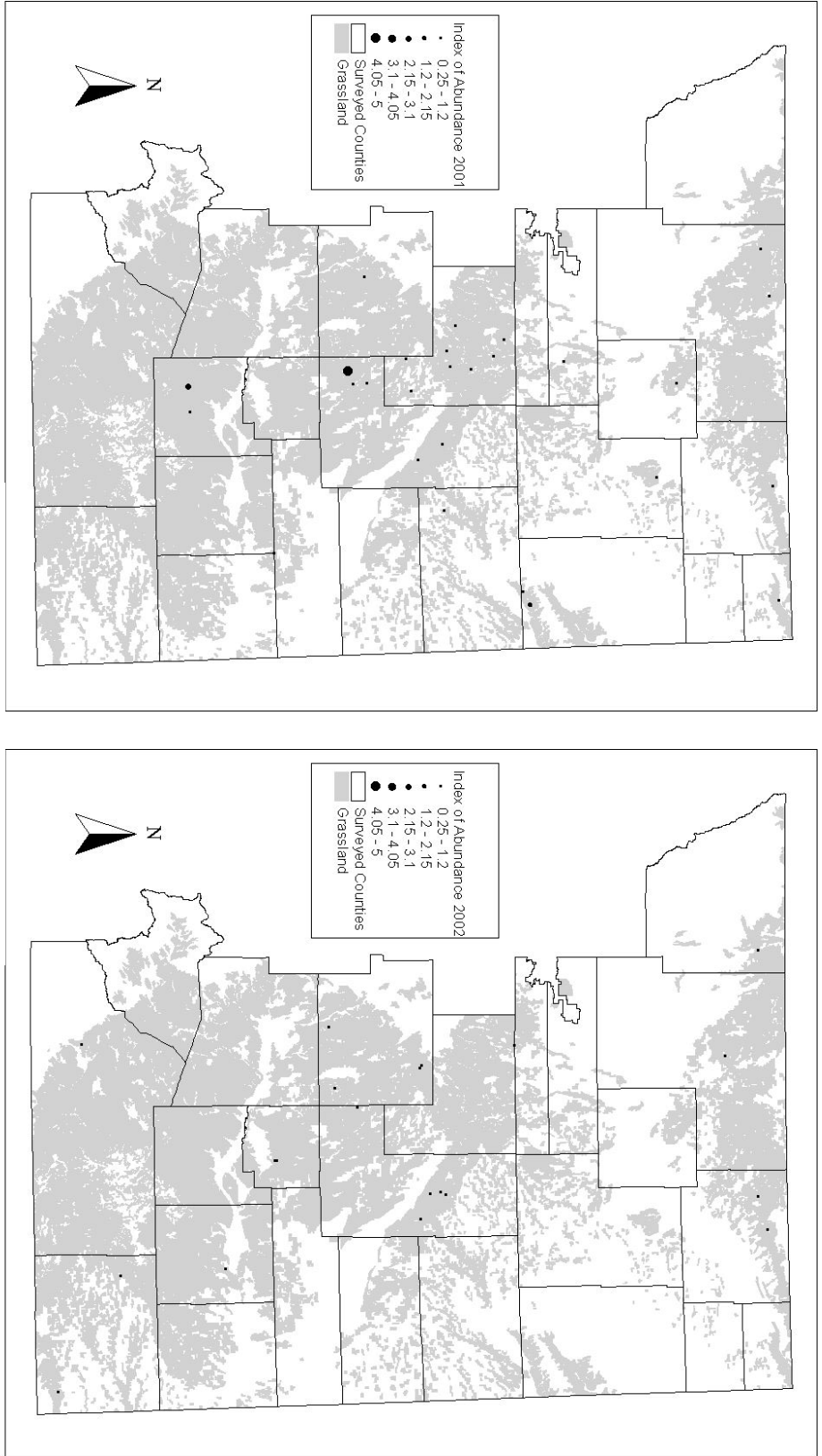
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.70 birds/km² (CV=22%)
- 2002 density estimate
D = 0.58 birds/km² (CV=23%)

Twenty eight individuals were detected on 22 of the sections surveyed (2%). We should be able to monitor this species using the road-based point count technique.



Eastern Kingbird
(*Tyrannus tyrannus*)



Maps show the distribution and relative abundance of the Eastern Kingbird throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

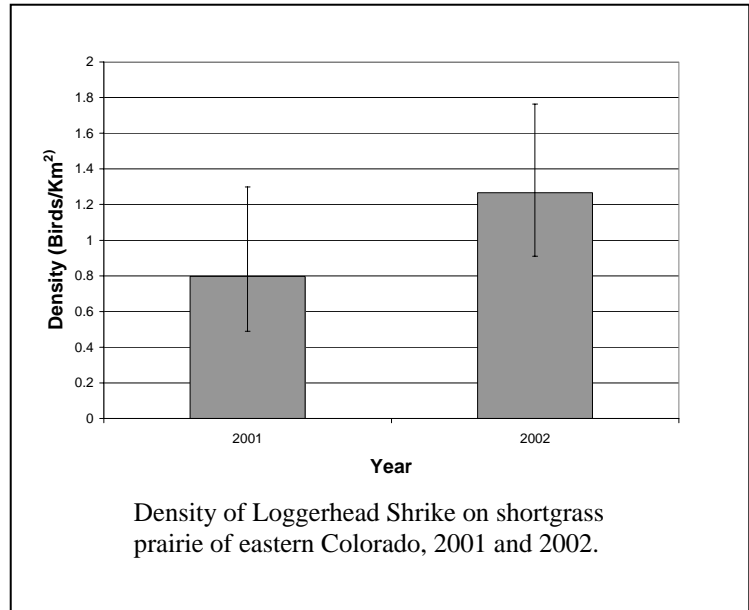
Loggerhead Shrike
(*Lanius ludovicianus*)

The Loggerhead Shrike is distributed throughout eastern Colorado. In the shortgrass prairie, this species nests in trees and shrubs. I calculated density estimates for this species in years 2001 and 2002.

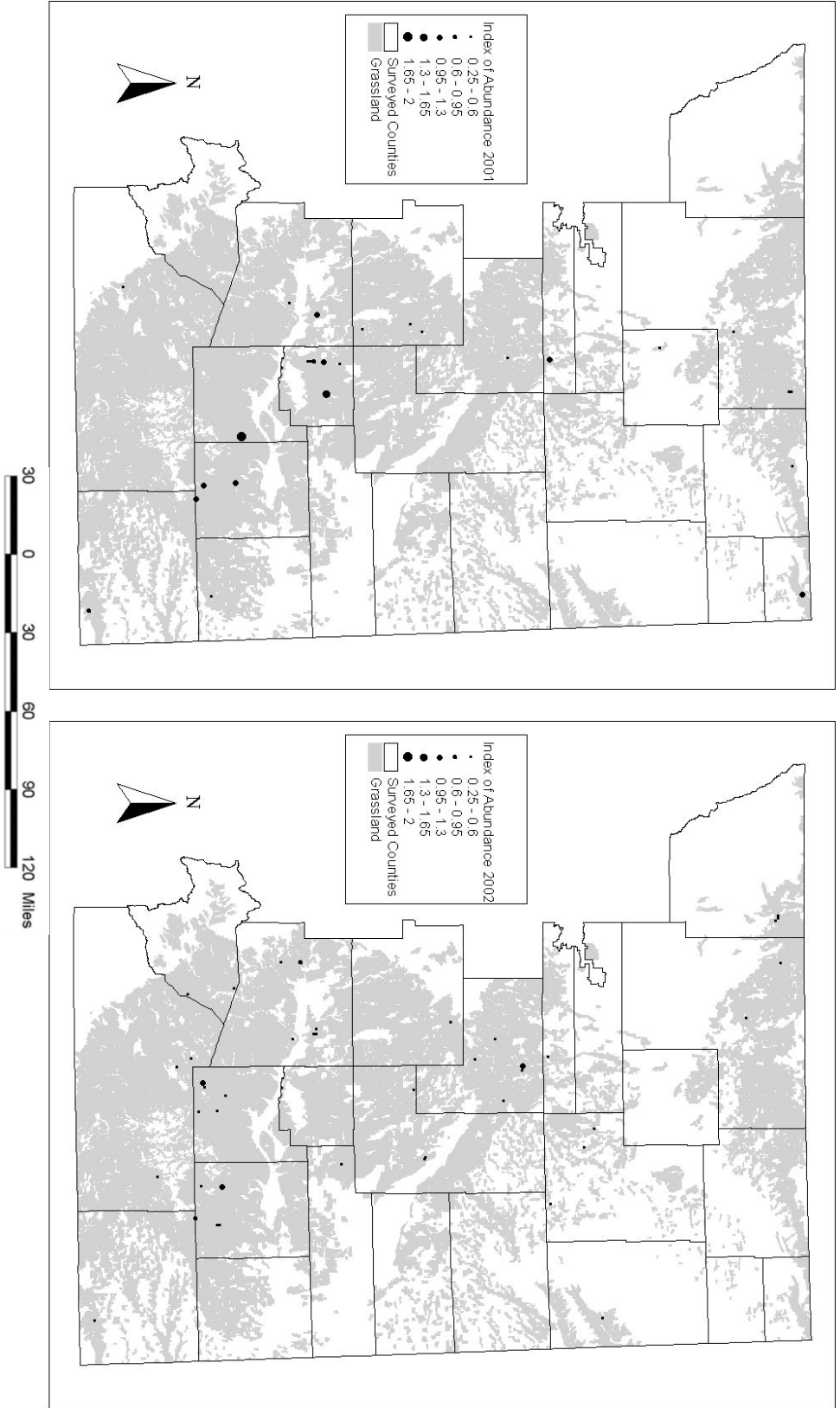
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.80 birds/km² (CV=12%)
- 2002 density estimate
D = 1.27 birds/km² (CV=22%)

Sixty six individuals were detected on 56 of the sections surveyed (4%). We should be able to monitor this species using the road-based point count technique.



Loggerhead Shrike
(*Lanius ludovicianus*)



Maps show the distribution and relative abundance of the Loggerhead Shrike throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Chihuahuan Raven
(*Corvus cryptoleucus*)

The Chihuahuan Raven is located in the southeastern part of eastern Colorado. This species can be found nesting on windmills and power poles. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure.

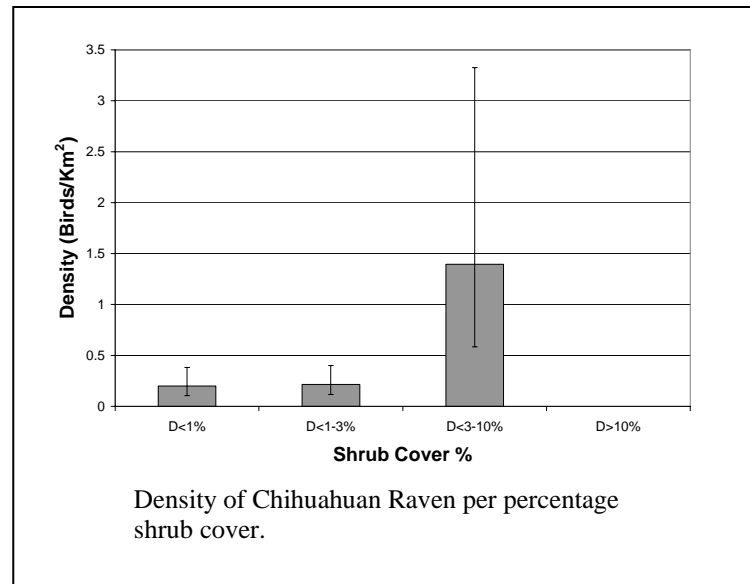
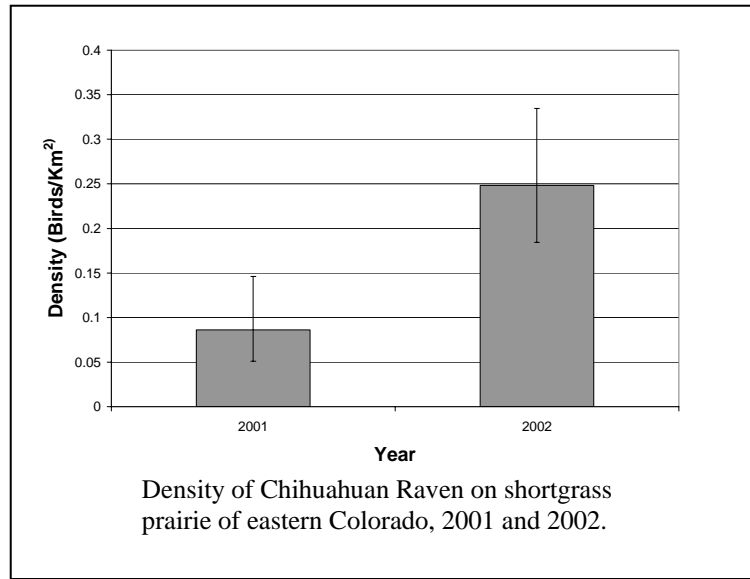
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.10 birds/km² (CV=27%)
- 2002 density estimate
D = 0.25 birds/km² (CV=15%)

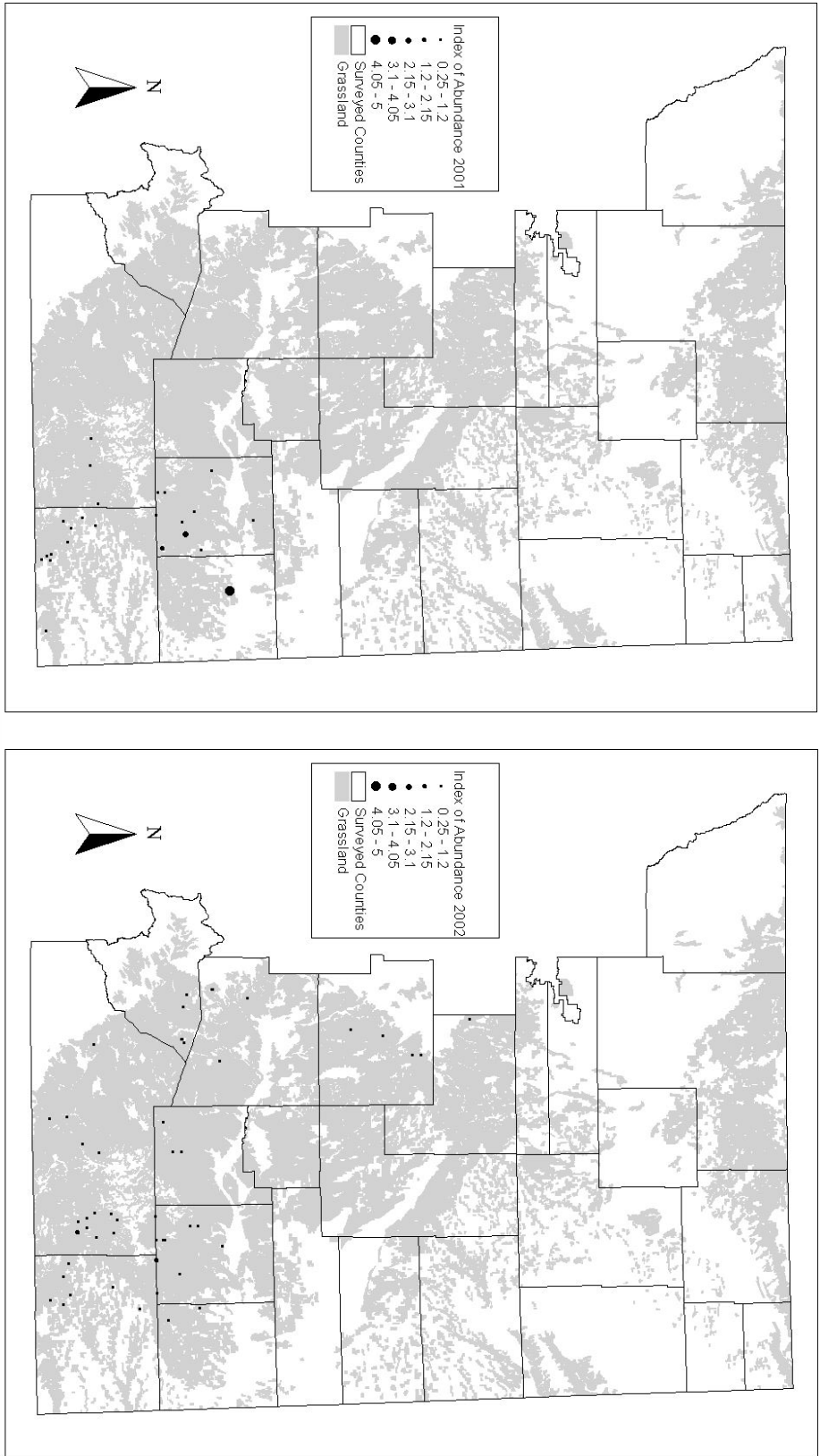
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 0.20 birds/km² (CV=33%)
- Between 1 and 3 % shrub cover
D = 0.22 birds/km² (CV=31%)
- Between 3 and 10 % shrub cover
D = 1.39 birds/km² (CV=45%)
- Greater than 10% shrub cover
Insufficient data for analysis

Eighty two individuals were detected on 59 of the sections surveyed (5%). We should be able to monitor this species using the road-based point count technique.



Chihuahuan Raven
(*Corvus cryptoleucus*)



Maps show the distribution and relative abundance of the Chihuahuan Raven throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Horned Lark
(*Eremophila alpestris*)

The Horned Lark is distributed throughout the eastern plains in Colorado. This species was one of the most abundant with 6,901 individuals detected on 77% of the sections. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure and habitat.

Density estimates (D) for this species by year:

- 2001 density estimate
D = 85.60 birds/km² (CV=3%)
- 2002 density estimate
D = 138.01 birds/km² (CV=2%)

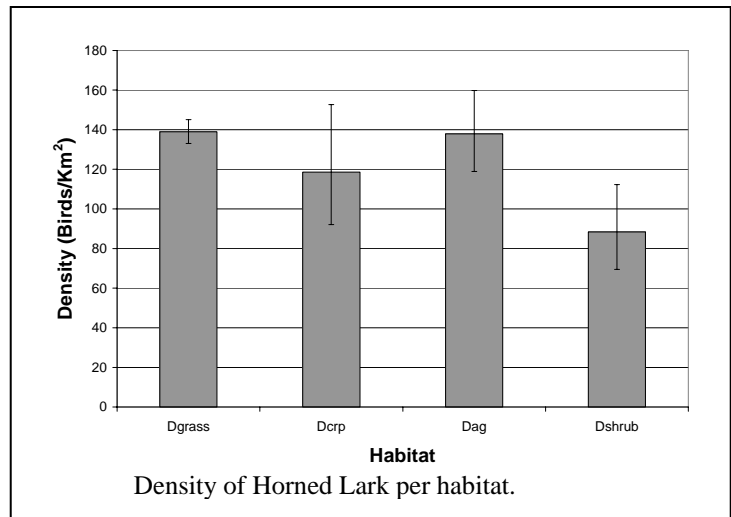
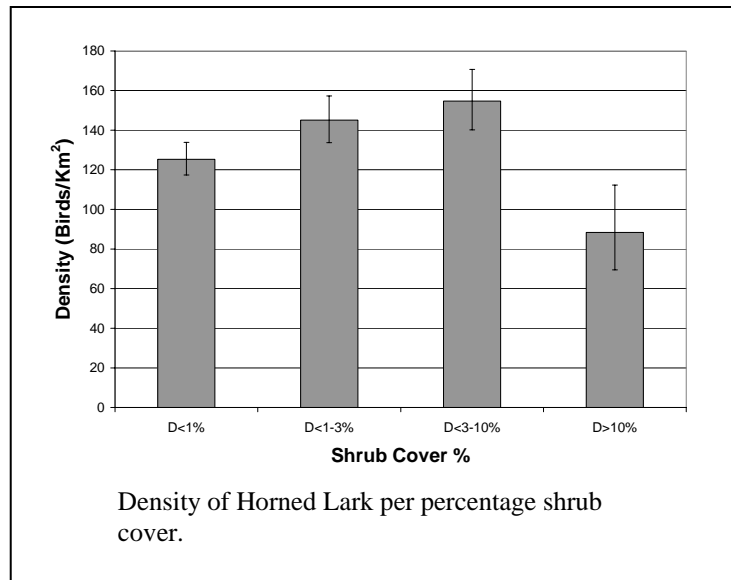
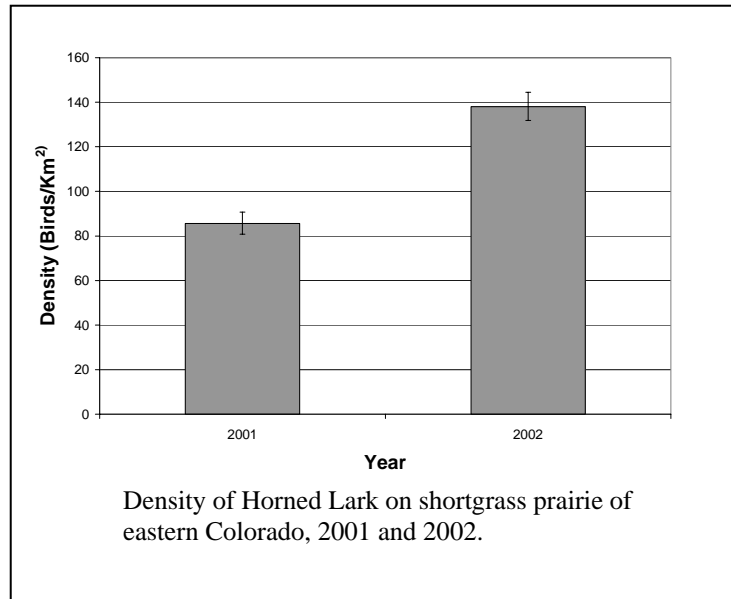
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 125.34 birds/km² (CV=3%)
- Between 1 and 3 % shrub cover
D = 145.03 birds/km² (CV=4%)
- Between 3 and 10 % shrub cover
D = 154.67 birds/km² (CV=5%)
- Greater than 10% shrub cover
D = 88.37 birds/km² (CV=12%)

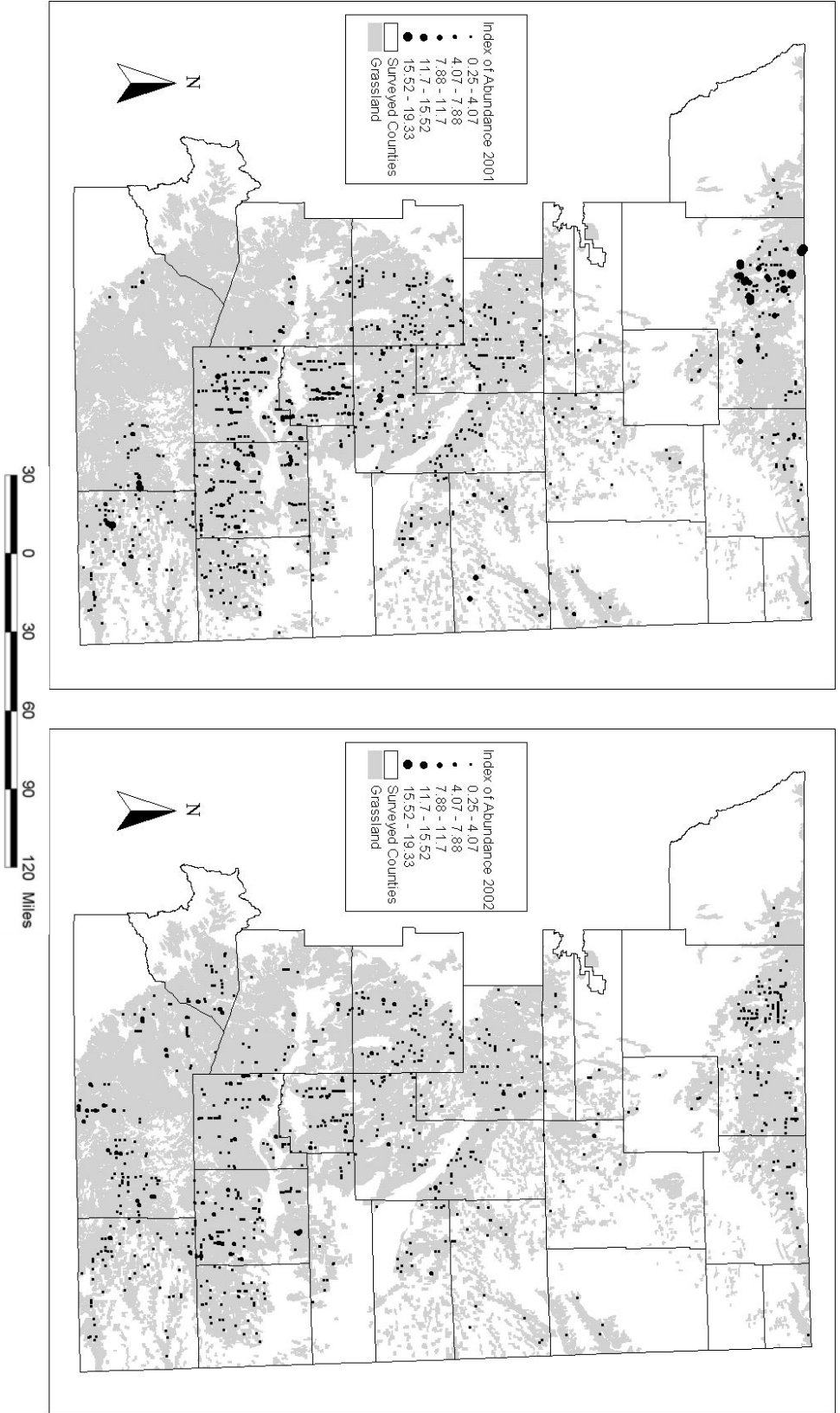
Density estimates (D) for this species categorized by habitat type:

- Grassland
D = 138.91 birds/km² (CV=2%)
- CRP in Weld County
D = 118.58 birds/km² (CV=13%)
- Dry-land agriculture
D = 137.83 birds/km² (CV=8%)
- Shrubland (>10% shrub cover)
D = 88.37 birds/km² (CV=12%)

Six thousand three hundred and five individuals were detected on 1092 of the sections surveyed (87%). We should be able to monitor this species using the road-based point count technique.



Horned Lark
Eremophila alpestris



Maps show the distribution and relative abundance of the Horned Lark throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

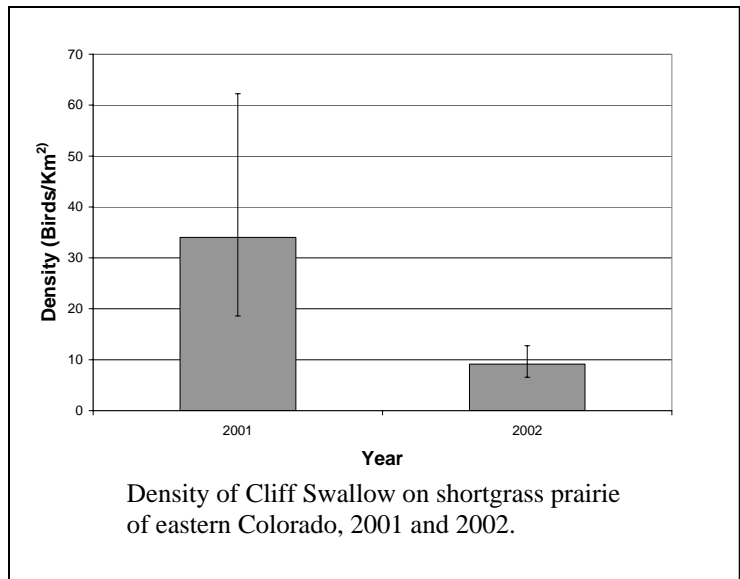
Cliff Swallow
(Petrochelidon pyrrhonota)

The Cliff Swallow is distributed throughout the plains of eastern Colorado. This species can be found nesting on vertical faces of cliffs, canyons and the undersides of bridges and culverts. I calculated density estimates for this species in years 2001 and 2002.

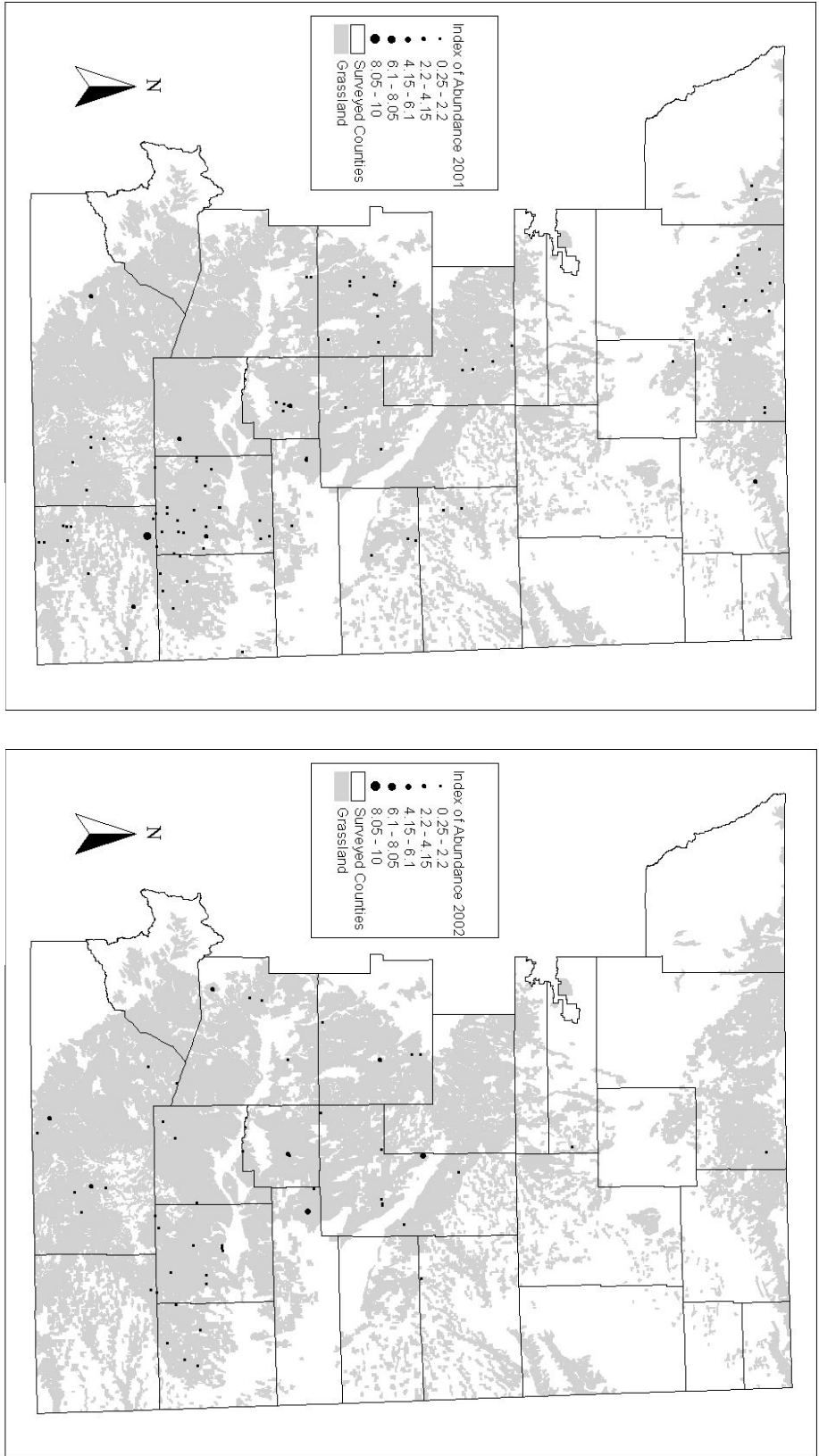
Density estimates (D) for this species by year:

- 2001 density estimate
D = 34.00 birds/km² (CV=31%)
- 2002 density estimate
D = 9.18 birds/km² (CV=17%)

Two hundred and twenty four individuals were detected on 64 of the sections surveyed (5%). We should be able to monitor this species using the road-based point count technique.



Cliff Swallow
Petrochelidon pyrrhonota



Maps show the distribution and relative abundance of the Cliff Swallow throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

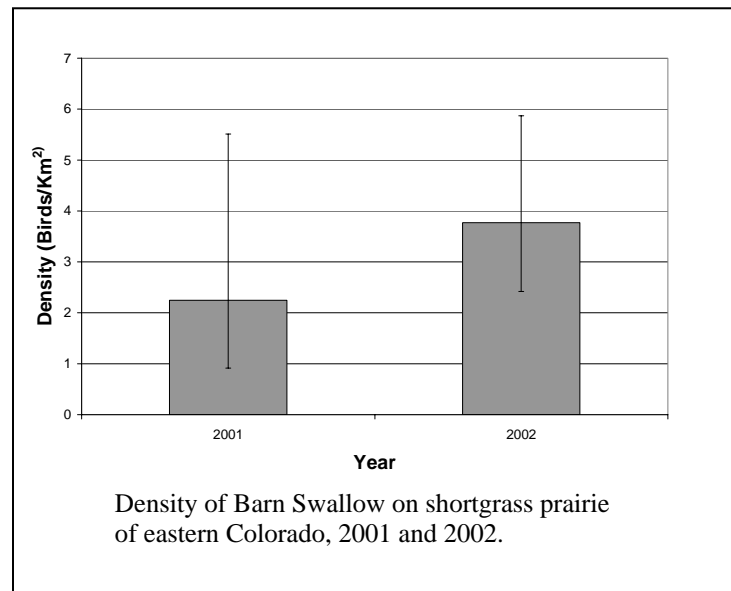
Barn Swallow
(*Hirundo rustica*)

The Barn Swallow is distributed throughout eastern Colorado, using primarily man-made structures, to which it attaches its nest. I calculated density estimates for this species in years 2001 and 2002.

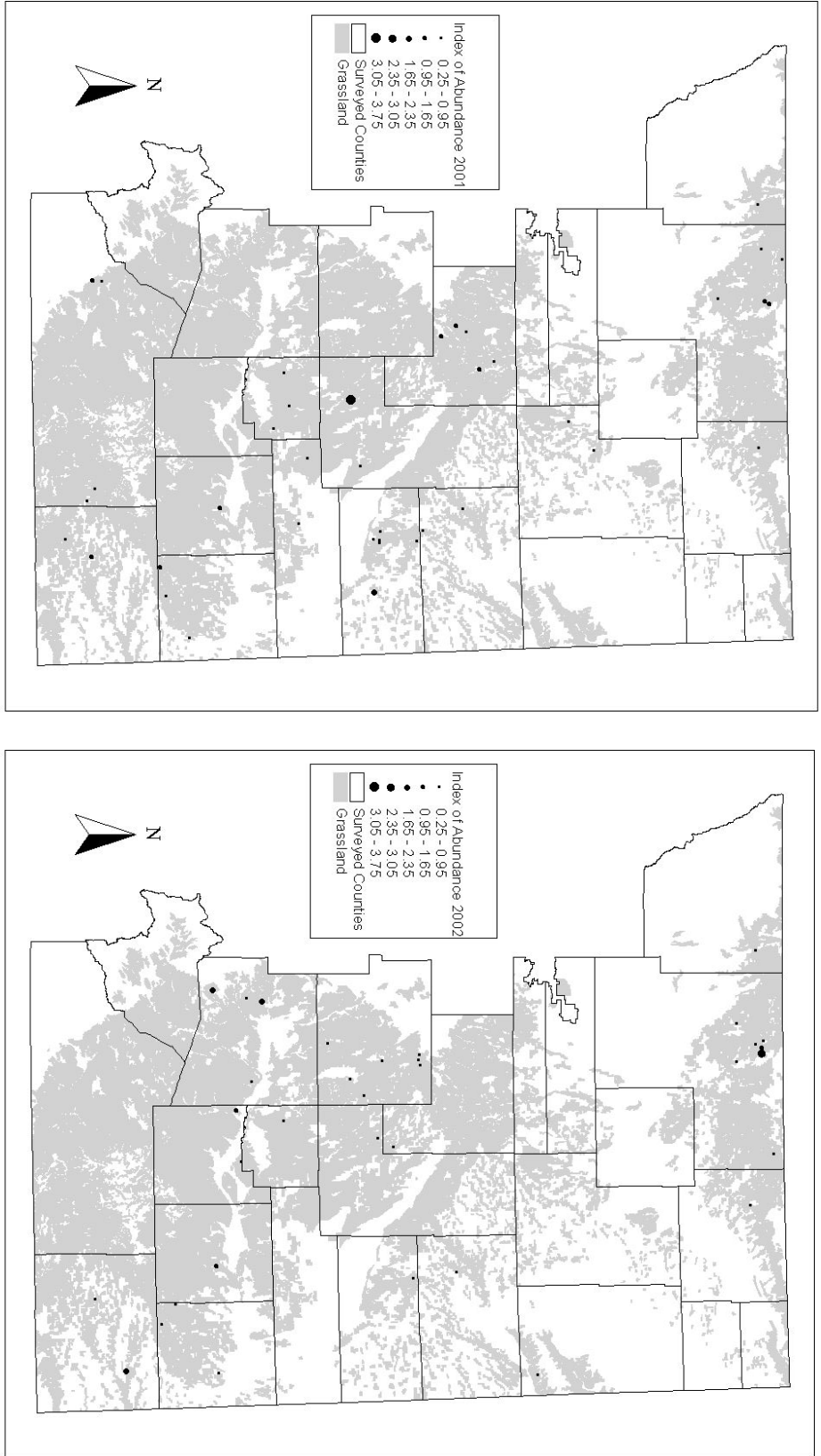
Density estimates (D) for this species by year:

- 2001 density estimate
D = 2.20 birds/km² (CV=47%)
- 2002 density estimate
D = 3.77 birds/km² (CV=23%)

Eighty five individuals were detected on 45 of the sections surveyed (4%). We should be able to monitor this species using the road-based point count technique.



Barn Swallow
(*Hirundo rustica*)



Maps show the distribution and relative abundance of the Barn Swallow throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Northern Mockingbird
(*Mimus polyglottos*)

The Northern Mockingbird is distributed throughout eastern Colorado. The highest relative abundances are in the southern portion. This species nests in trees and shrubs that occur around human habitation located in the shortgrass prairie. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure.

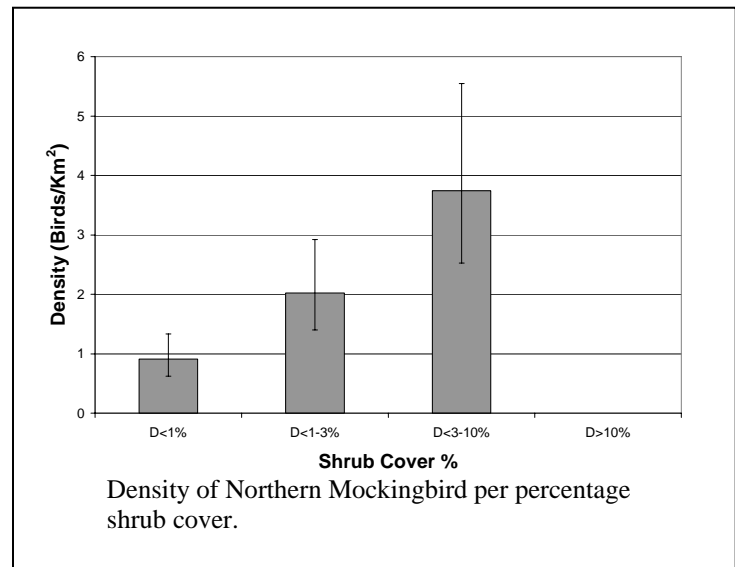
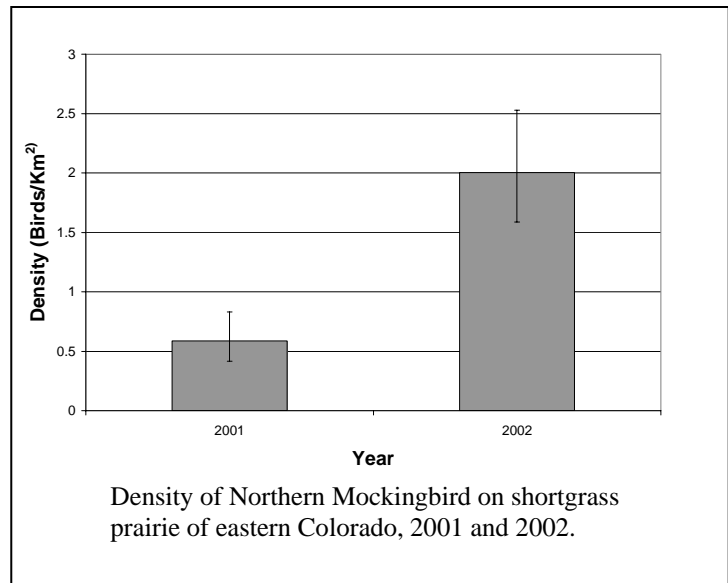
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.60 birds/km² (CV=18%)
- 2002 density estimate
D = 2.00 birds/km² (CV=12%)

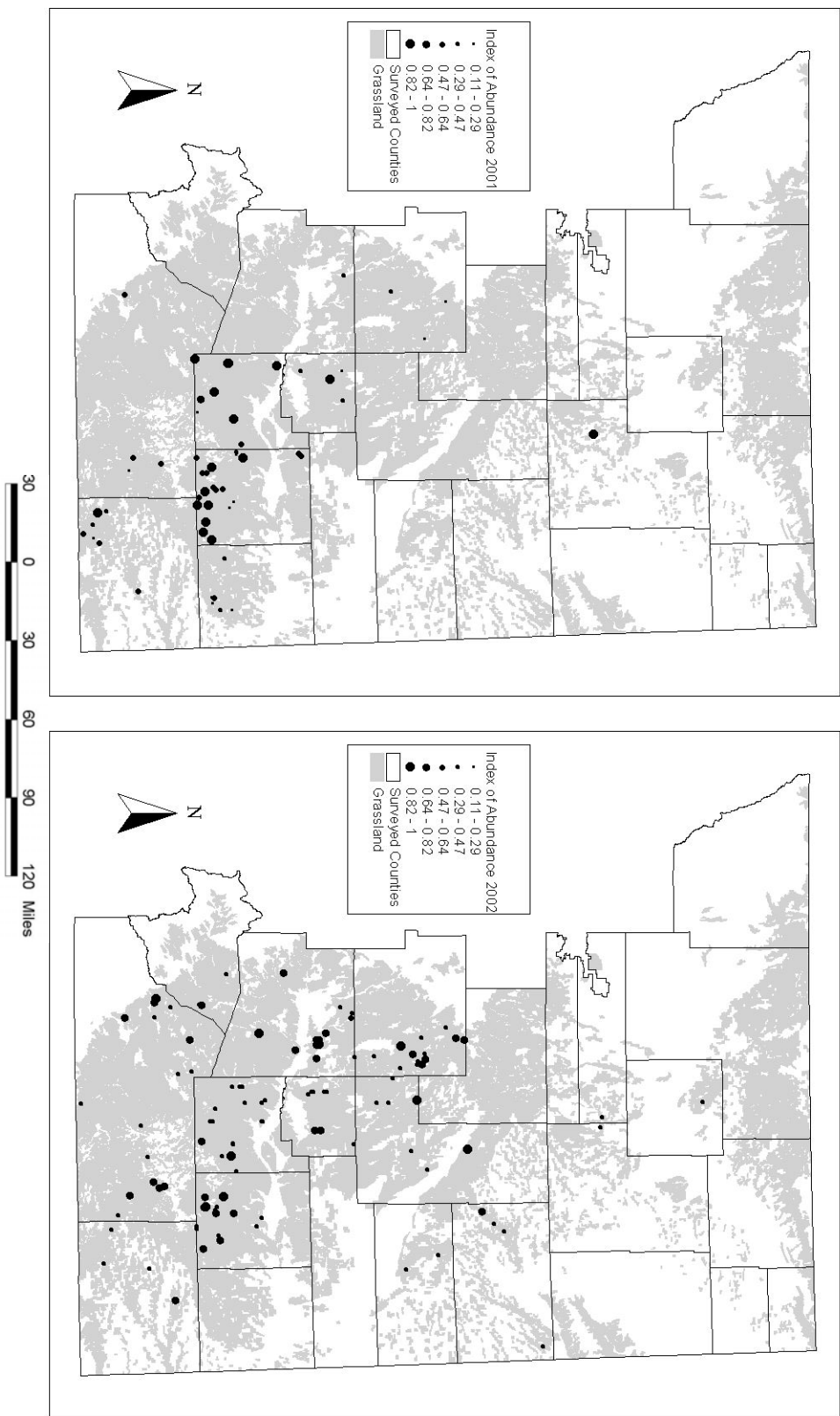
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 0.91 birds/km² (CV=20%)
- Between 1 and 3 % shrub cover
D = 2.02 birds/km² (CV=19%)
- Between 3 and 10 % shrub cover
D = 3.74 birds/km² (CV=20%)
- Greater than 10% shrub cover
Insufficient data for analysis

Two hundred fourteen individuals were detected on 132 of the sections surveyed (11%). We should be able to monitor this species using the road-based point count technique.



Northern Mockingbird
(*Mimus polyglottos*)



Maps show the distribution and relative abundance of the Northern Mockingbird throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

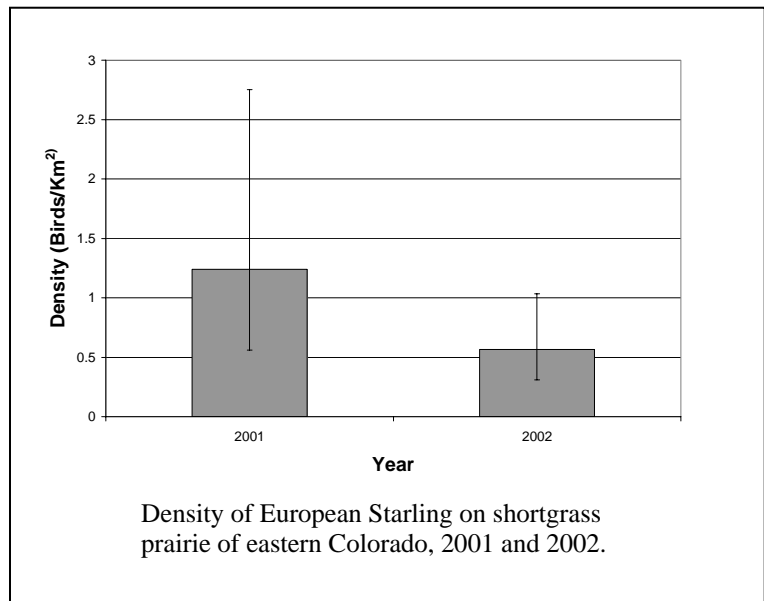
European Starling
(*Sturnus vulgaris*)

The European Starling is distributed throughout eastern Colorado, but is rare in shortgrass prairie areas, except where anthropogenic changes (e.g., homesteads) have provided nesting opportunities. I calculated density estimates for this species in years 2001 and 2002.

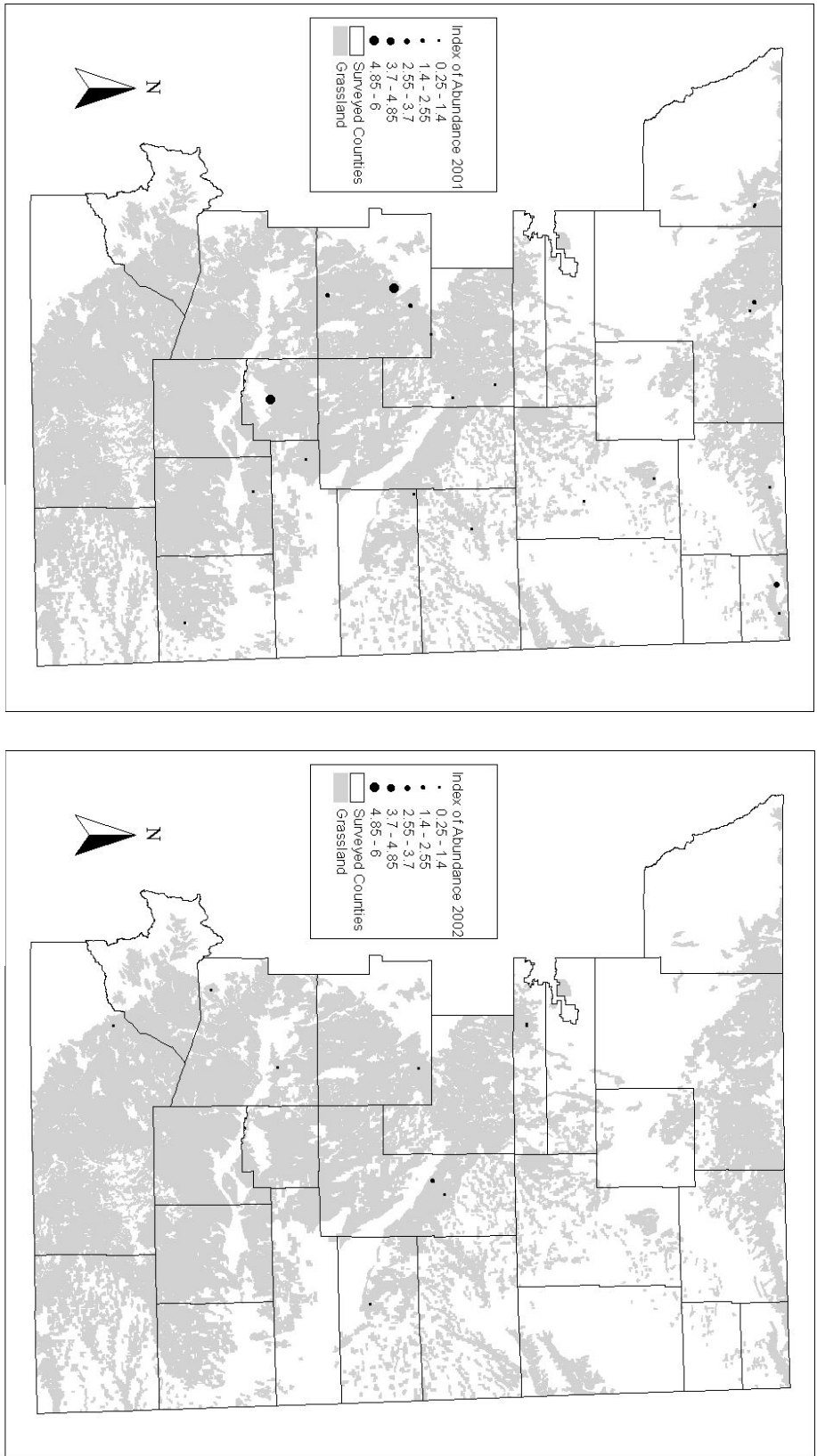
Density estimates (D) for this species by year:

- 2001 density estimate
D = 1.20 birds/km² (CV=42%)
- 2002 density estimate
D = 0.57 birds/km² (CV=31%)

Thirty six individuals were detected on 15 of the sections surveyed (1%). We should be able to monitor this species using the road-based point count technique.



European Starling
(*Sturnus vulgaris*)



Maps show the distribution and relative abundance of the European Starling throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Cassin's Sparrow
(*Aimophila cassinii*)

The Cassin's Sparrow is distributed throughout eastern Colorado, in most years concentrated in the southeastern portion. Though it breeds in numbers in this area every year, this species' occurrence in the rest of Colorado is variable in extent and numbers due to its nomadic nature. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure and habitat.

Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.07 birds/km² (CV=12%)
- 2002 density estimate
D = 17.96 birds/km² (CV=5%)

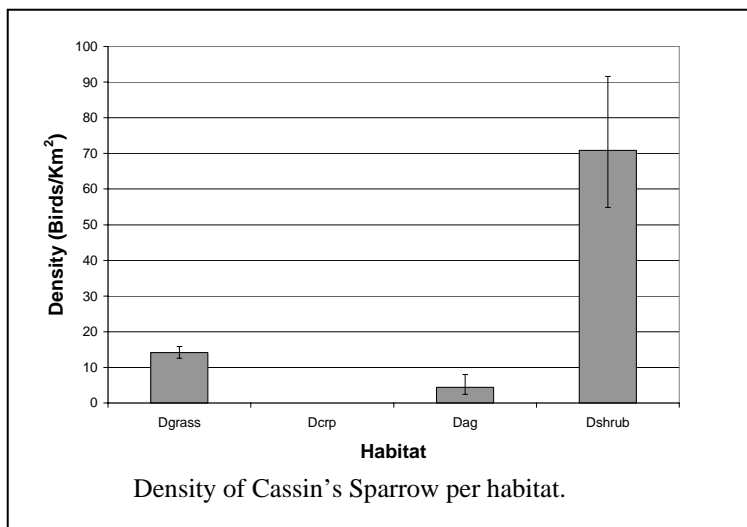
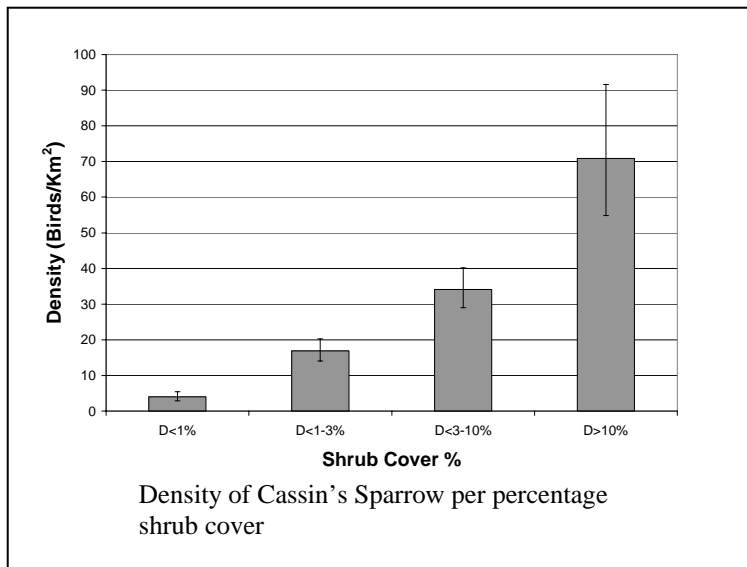
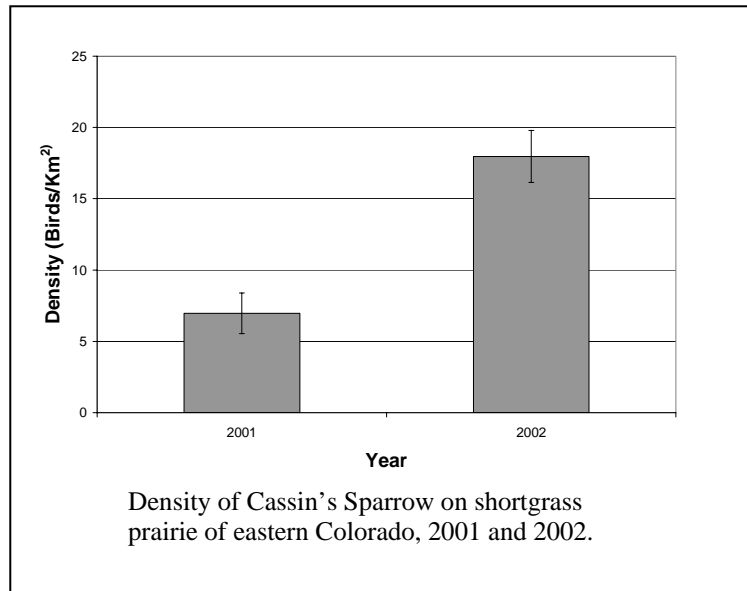
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 3.98 birds/km² (CV=16%)
- Between 1 and 3 % shrub cover
D = 16.90 birds/km² (CV=9%)
- Between 3 and 10 % shrub cover
D = 34.12 birds/km² (CV=8%)
- Greater than 10% shrub cover
D = 70.86 birds/km² (CV=13%)

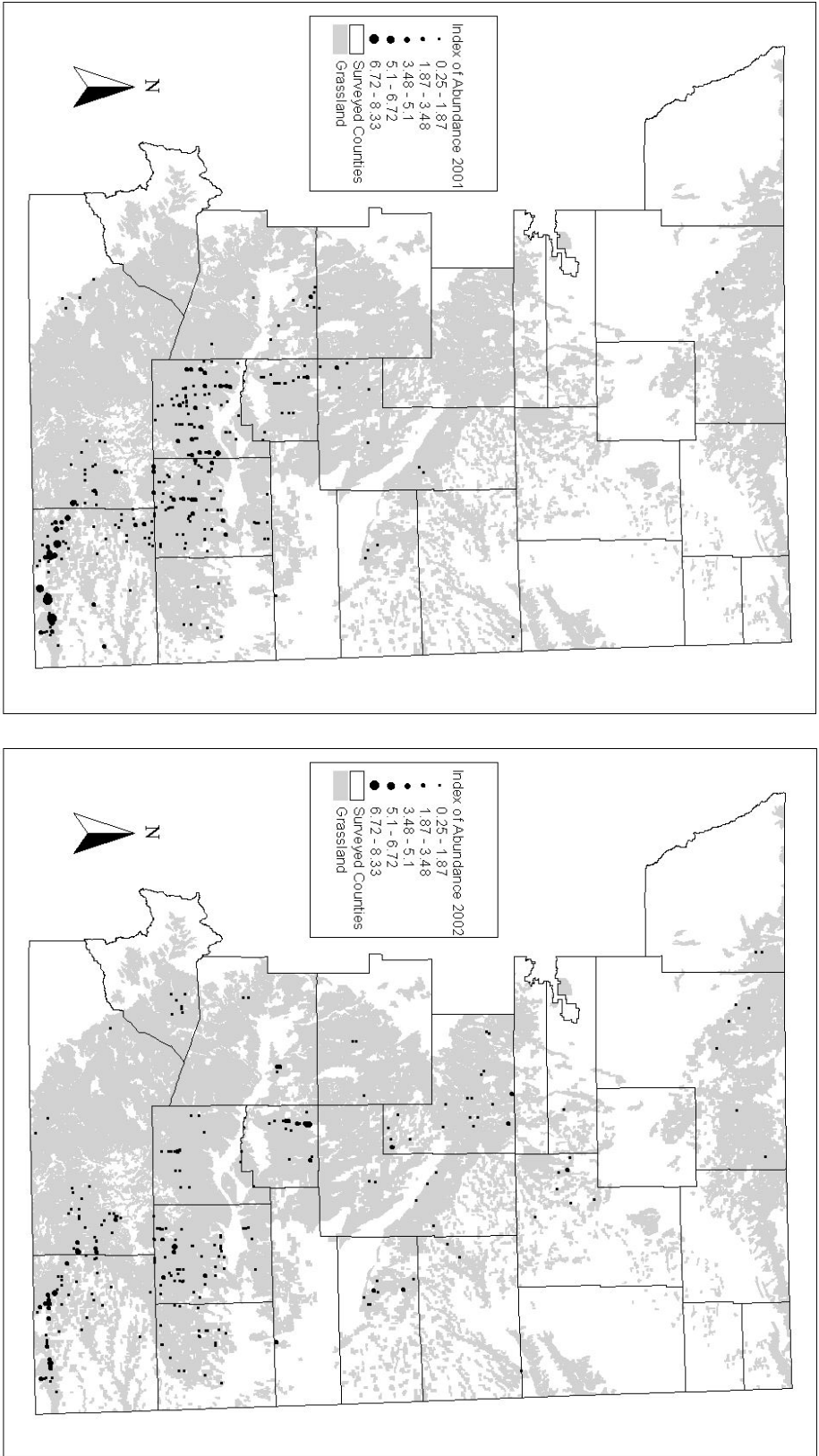
Density estimates (D) for this species categorized by habitat type:

- Grassland
D = 14.10 birds/km² (CV=6%)
- CRP in Weld County
Insufficient data for analysis
- Dry-land agriculture
D = 4.40 birds/km² (CV=31%)
- Shrubland (>10% shrub cover)
D = 70.86 birds/km² (CV=13%)

One thousand twenty eight individuals were detected on 323 of the sections surveyed (26%). We should be able to monitor this species using the road-based point count technique.



Cassin's Sparrow
(*Aimophila cassinii*)



Maps show the distribution and relative abundance of the Cassin's Sparrow throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Brewer's Sparrow
(*Spizella breweri*)

The Brewer's Sparrow has a scattered distribution throughout the eastern plains of Colorado. This species prefers to nest and breed in areas that contain sage brush (*Artemisia* spp.). I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure and habitat.

Density estimates (D) for this species by year:

- 2001 density estimate
D = 4.50 birds/km² (CV=14%)
- 2002 density estimate
D = 3.08 birds/km² (CV=19%)

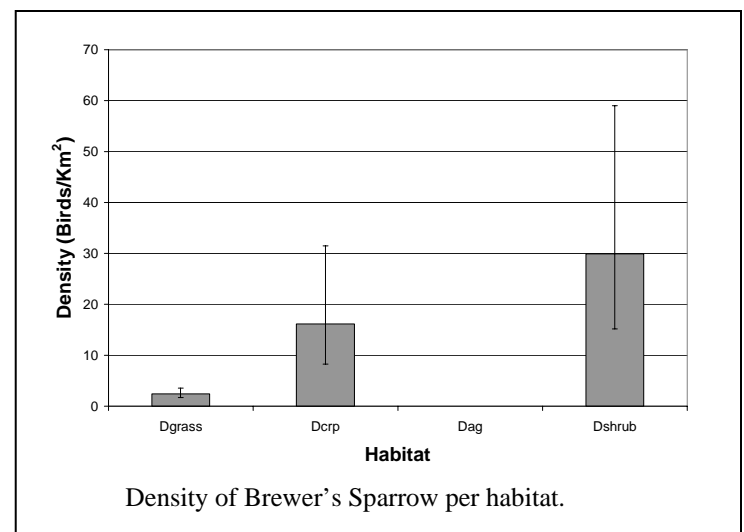
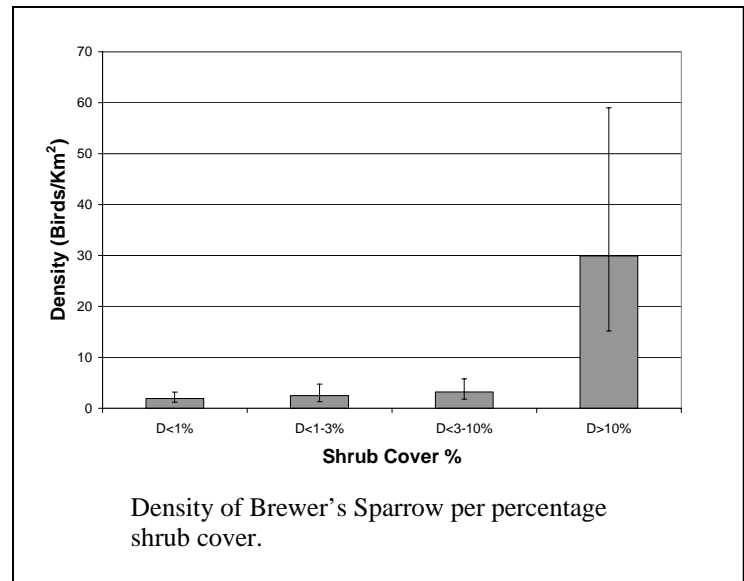
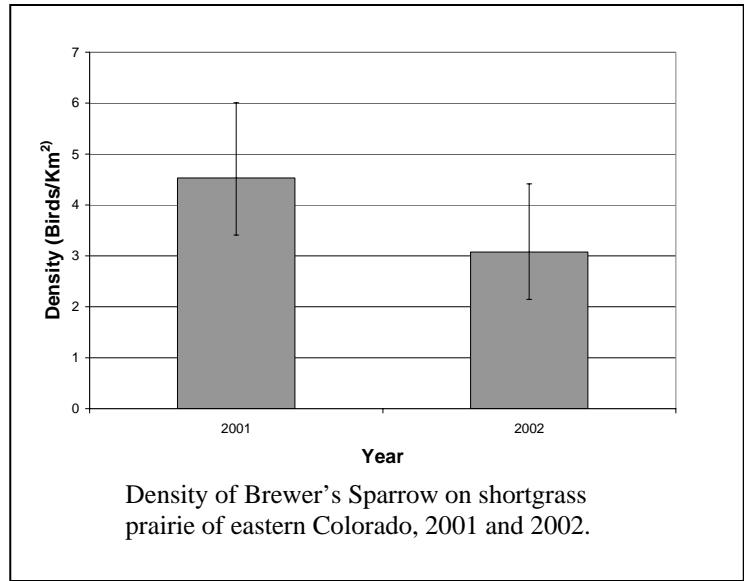
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 1.93 birds/km² (CV=25%)
- Between 1 and 3 % shrub cover
D = 2.49 birds/km² (CV=33%)
- Between 3 and 10 % shrub cover
D = 3.22 birds/km² (CV=31%)
- Greater than 10% shrub cover
D = 29.92 birds/km² (CV=35%)

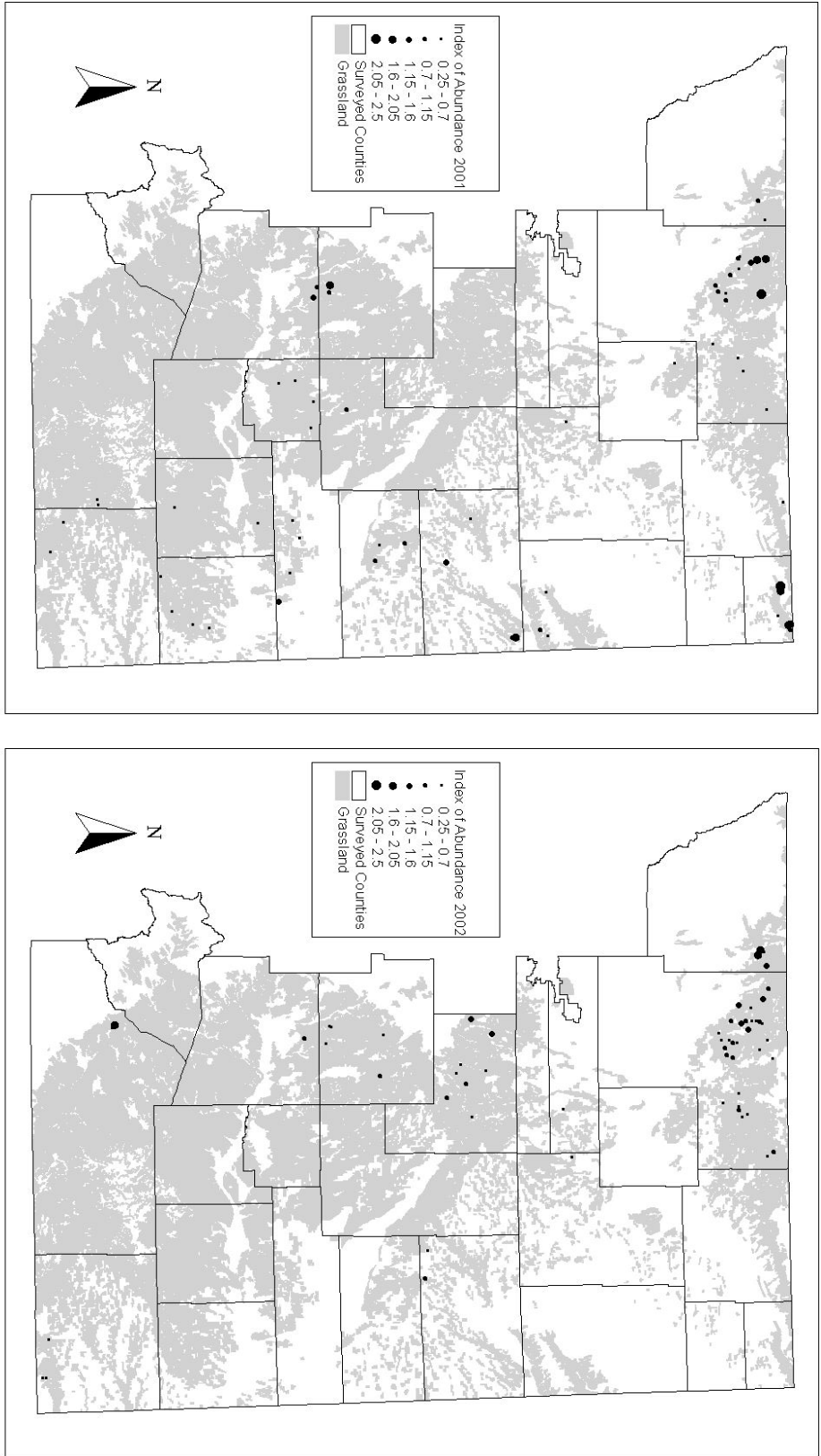
Density estimates (D) for this species categorized by habitat type:

- Grassland
D = 2.45 birds/km² (CV=19%)
- CRP in Weld County
D = 16.16 birds/km² (CV=35%)
- Dry-land agriculture
Insufficient data for analysis
- Shrubland (>10% shrub cover)
D = 29.92 birds/km² (CV=36%)

One hundred seventy five individuals were detected on 79 of the sections surveyed (6%). We should be able to monitor this species using the road-based point count technique.



Brewer's Sparrow
(*Spizella breweri*)



Maps show the distribution and relative abundance of the Brewer's Sparrow throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

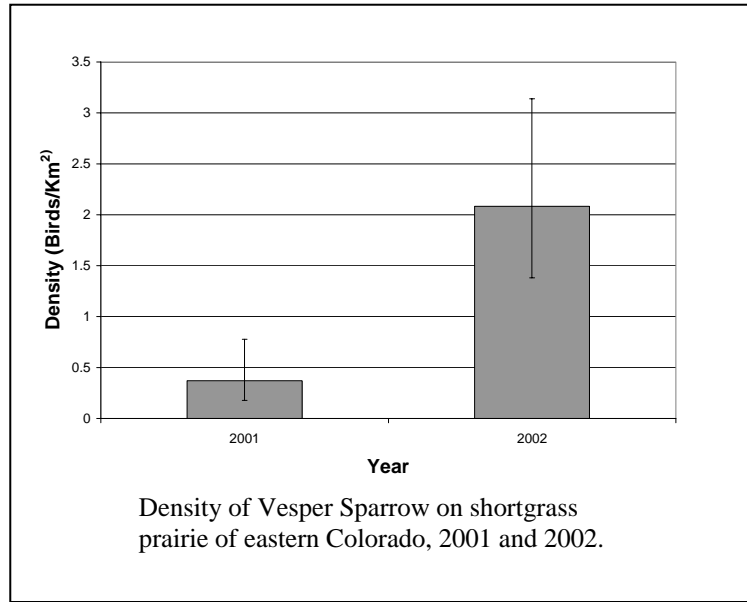
Vesper Sparrow
(*Pooecetes gramineus*)

The Vesper Sparrow is found in distinct vegetation communities that are locally distributed and biased toward the front range. I calculated density estimates for this species in years 2001 and 2002.

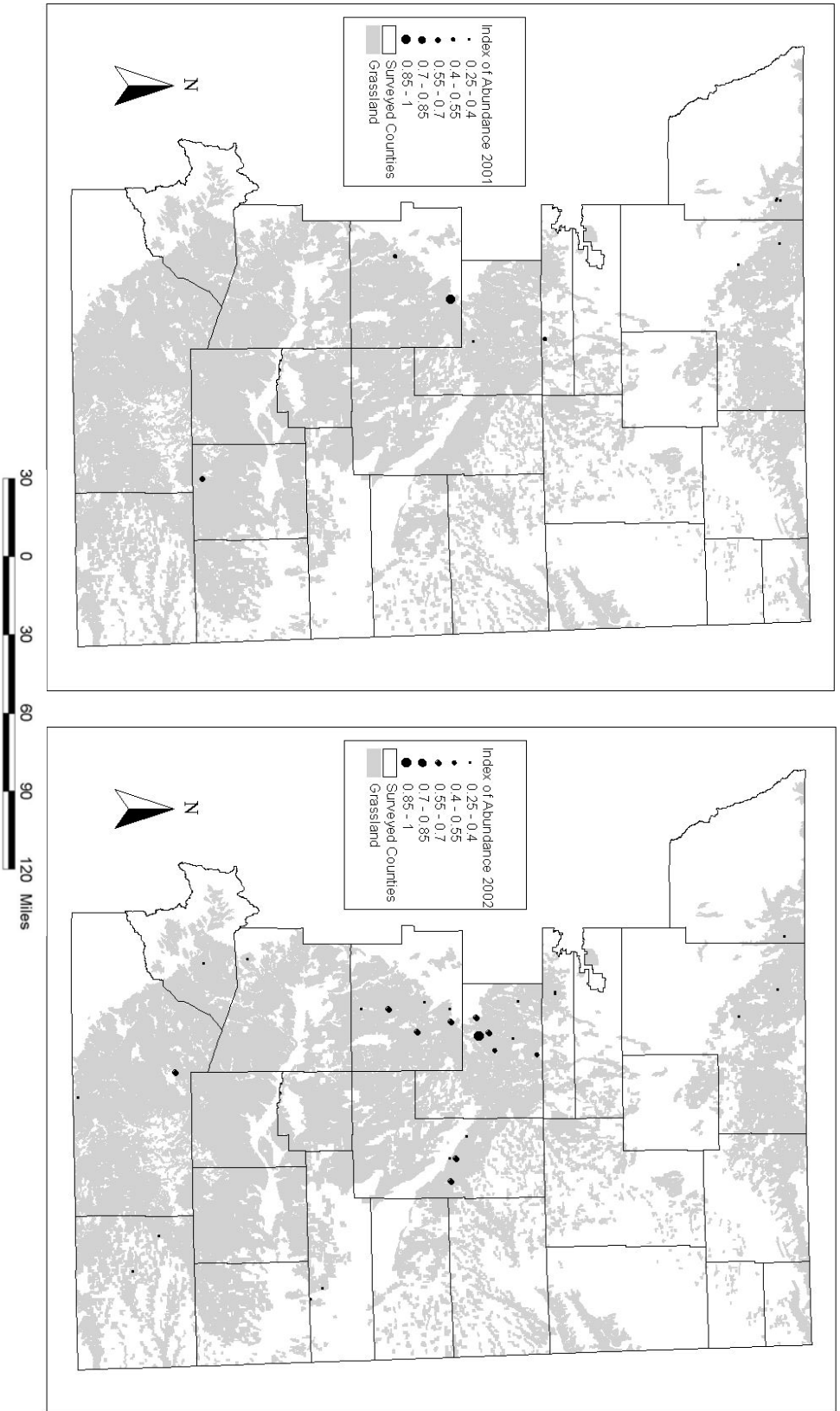
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.40 birds/km² (CV=39%)
- 2002 density estimate
D = 2.08 birds/km² (CV=21%)

Sixty eight individuals were detected on 46 of the sections surveyed (4%). We should be able to monitor this species using the road-based point count technique.



Vesper Sparrow
(*Poocetes gramineus*)



Maps show the distribution and relative abundance of the Vesper Sparrow throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Lark Sparrow
(*Chondestes grammacus*)

The Lark Sparrow is distributed throughout the shortgrass prairie of eastern Colorado. This species prefers to nest in areas with a variety of structure. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure and habitat.

Density estimates (D) for this species by year:

- 2001 density estimate
D = 11.70 birds/km² (CV=11%)
- 2002 density estimate
D = 16.56 birds/km² (CV=7%)

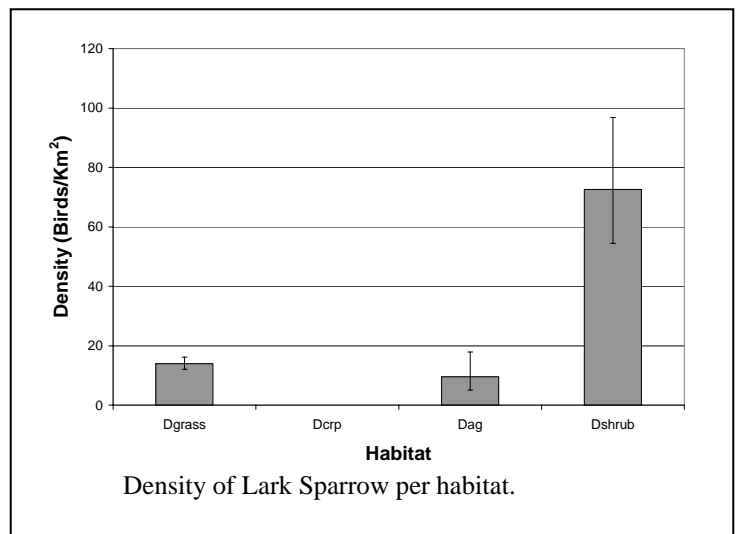
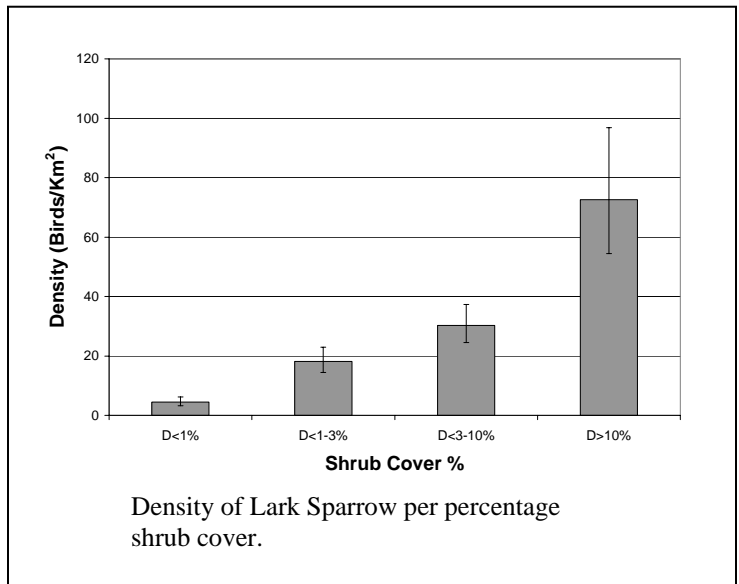
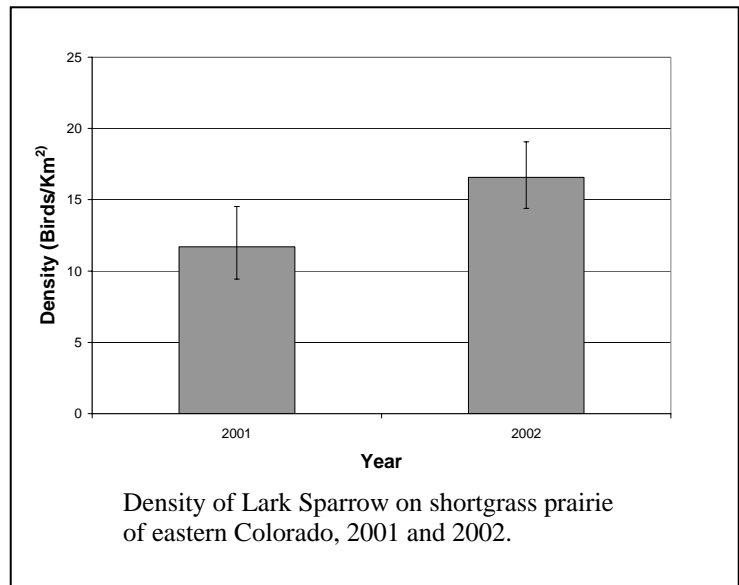
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 4.49 birds/km² (CV=17%)
- Between 1 and 3 % shrub cover
D = 18.17 birds/km² (CV=12%)
- Between 3 and 10 % shrub cover
D = 30.27 birds/km² (CV=11%)
- Greater than 10% shrub cover
D = 72.58 birds/km² (CV=15%)

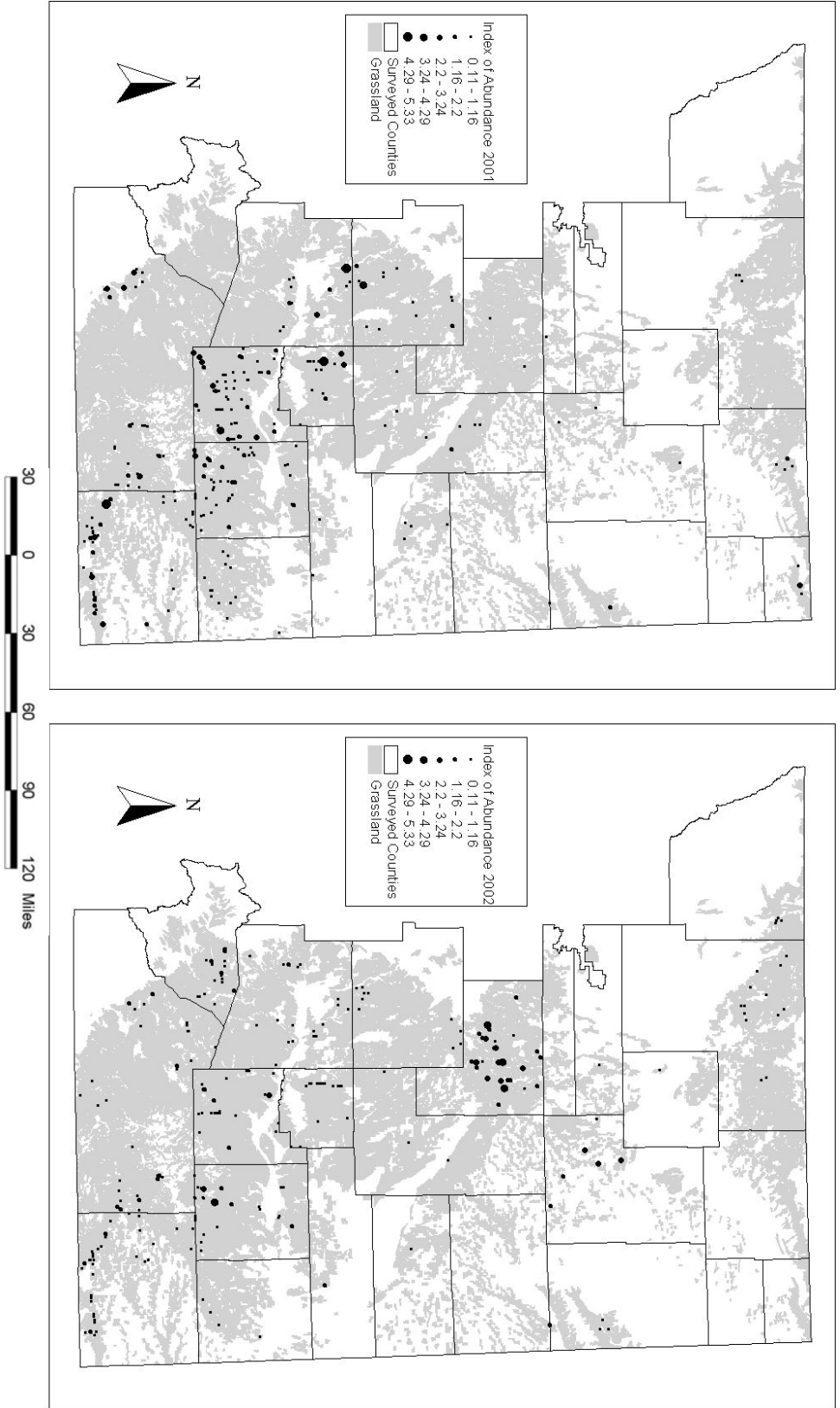
Density estimates (D) for this species categorized by habitat type:

- Grassland
D = 13.99 birds/km² (CV=8%)
- CRP in Weld County
Insufficient data for analysis
- Dry-land agriculture
D = 9.56 birds/km² (CV=33%)
- Shrubland (>10% shrub cover)
D = 72.58 birds/km² (CV=15%)

Eight hundred and five individuals were detected on 303 of the sections surveyed (24%). We should be able to monitor this species using the road-based point count technique.



Lark Sparrow
(*Chondestes grammacus*)



Maps show the distribution and relative abundance of the Lark Sparrow throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Lark Bunting
(*Calamospiza melanocorys*)

The Lark Bunting is distributed throughout the shortgrass prairie in eastern Colorado. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure and habitat.

Density estimates (D) for this species by year:

- 2001 density estimate
D = 80.20 birds/km² (CV=3%)
- 2002 density estimate
D = 10.58 birds/km² (CV=11%)

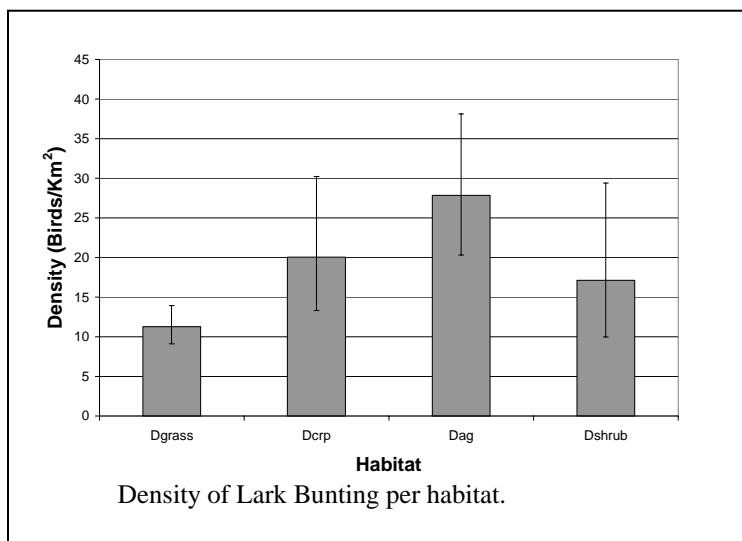
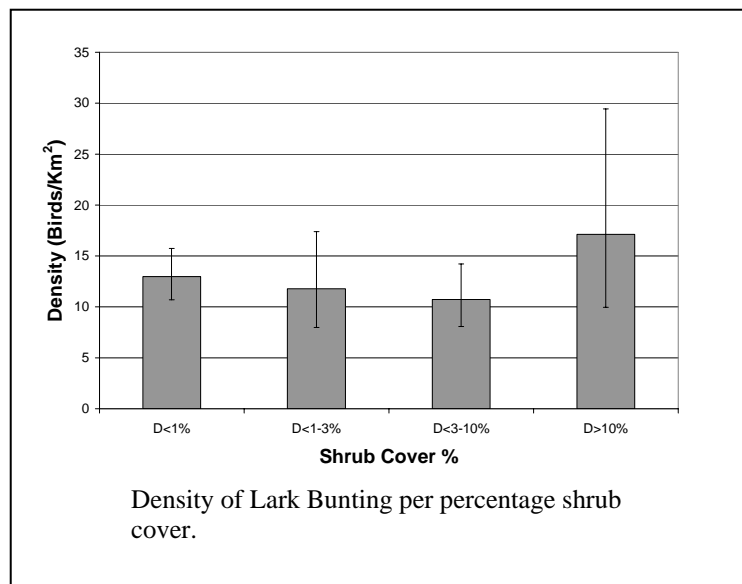
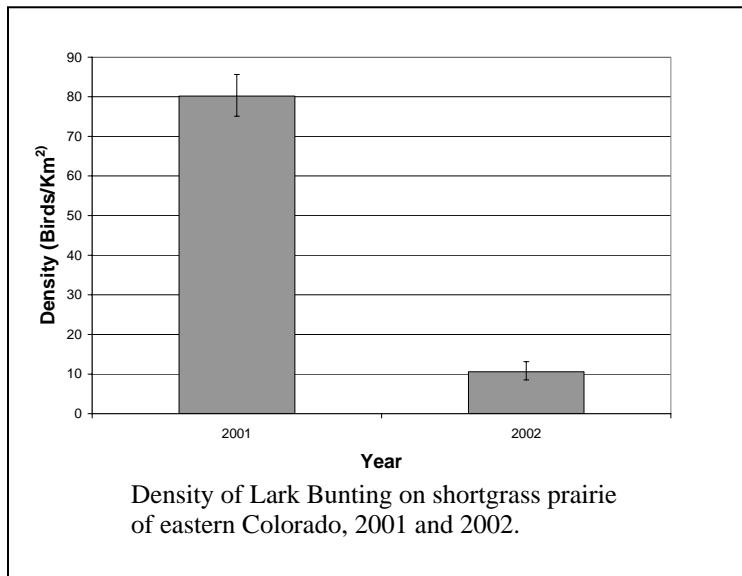
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 12.99 birds/km² (CV=10%)
- Between 1 and 3 % shrub cover
D = 11.79 birds/km² (CV=20%)
- Between 3 and 10 % shrub cover
D = 10.72 birds/km² (CV=15%)
- Greater than 10% shrub cover
D = 17.13 birds/km² (CV=28%)

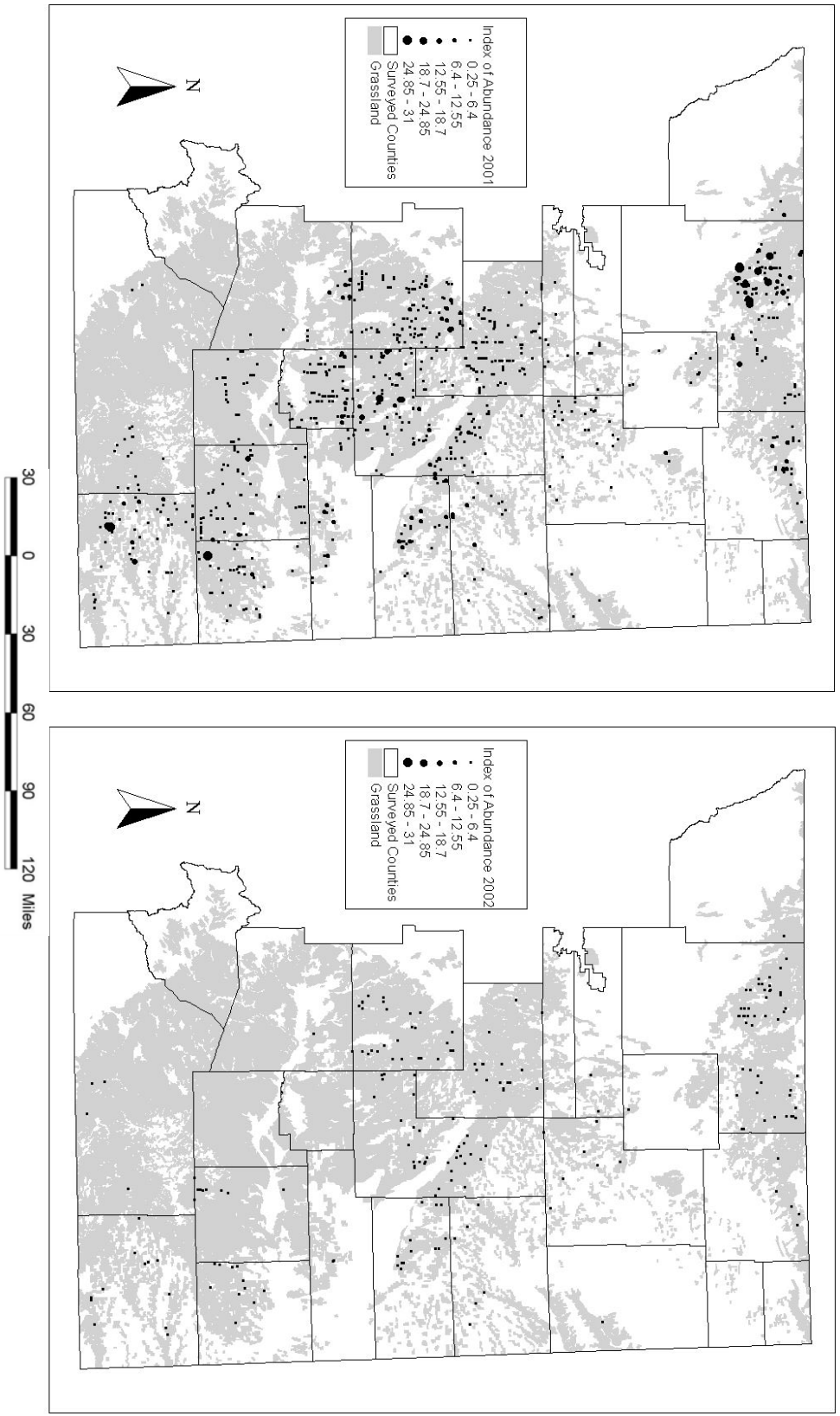
Density estimates (D) for this species categorized by habitat type:

- Grassland
D = 11.27 birds/km² (CV=11%)
- CRP in Weld County
D = 20.06 birds/km² (CV=21%)
- Dry-land agriculture
D = 27.84 birds/km² (CV=16%)
- Shrubland (>10% shrub cover)
D = 17.13 birds/km² (CV=28%)

Nine hundred and forty five individuals were detected on 298 of the sections surveyed (24%). We should be able to monitor this species using the road-based point count technique.



Lark Bunting
(*Calamospiza melanocorys*)



Maps show the distribution and relative abundance of the Lark Bunting throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Grasshopper Sparrow
(*Ammodrammus savannarum*)

The Grasshopper Sparrow breeds in areas within in eastern Colorado where the grass is taller than average. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing habitat.

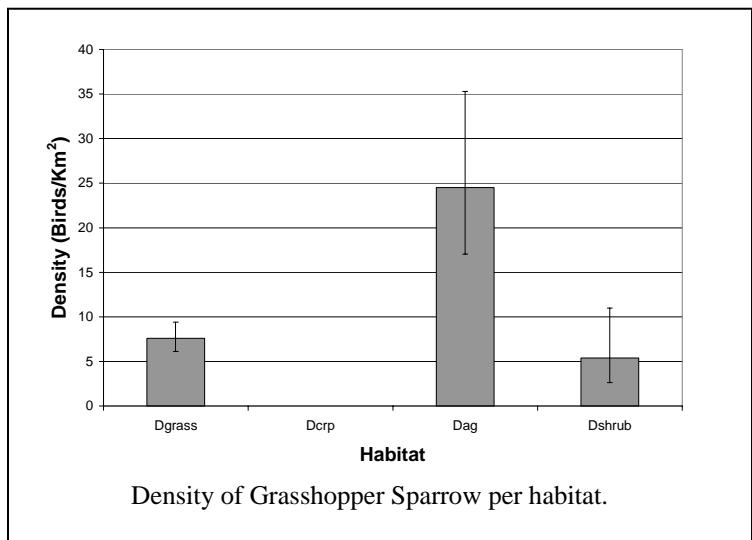
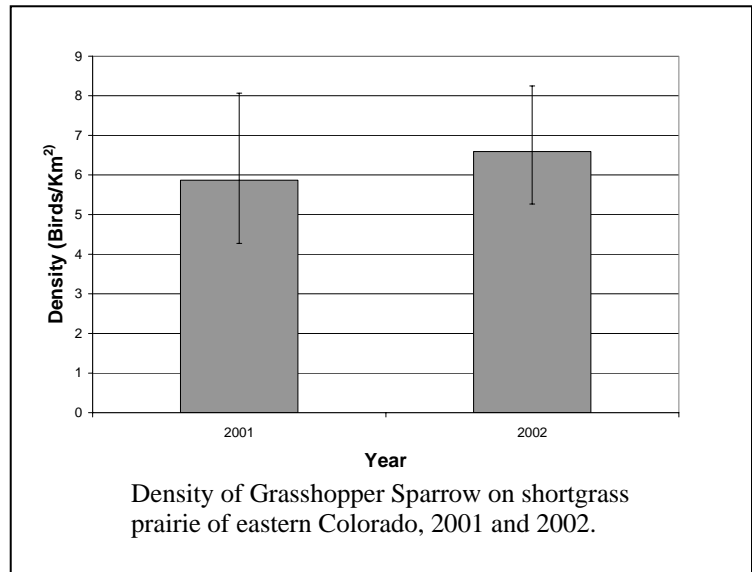
Density estimates (D) for this species by year:

- 2001 density estimate
D = 5.90 birds/km² (CV=16%)
- 2002 density estimate
D = 6.59 birds/km² (CV=11%)

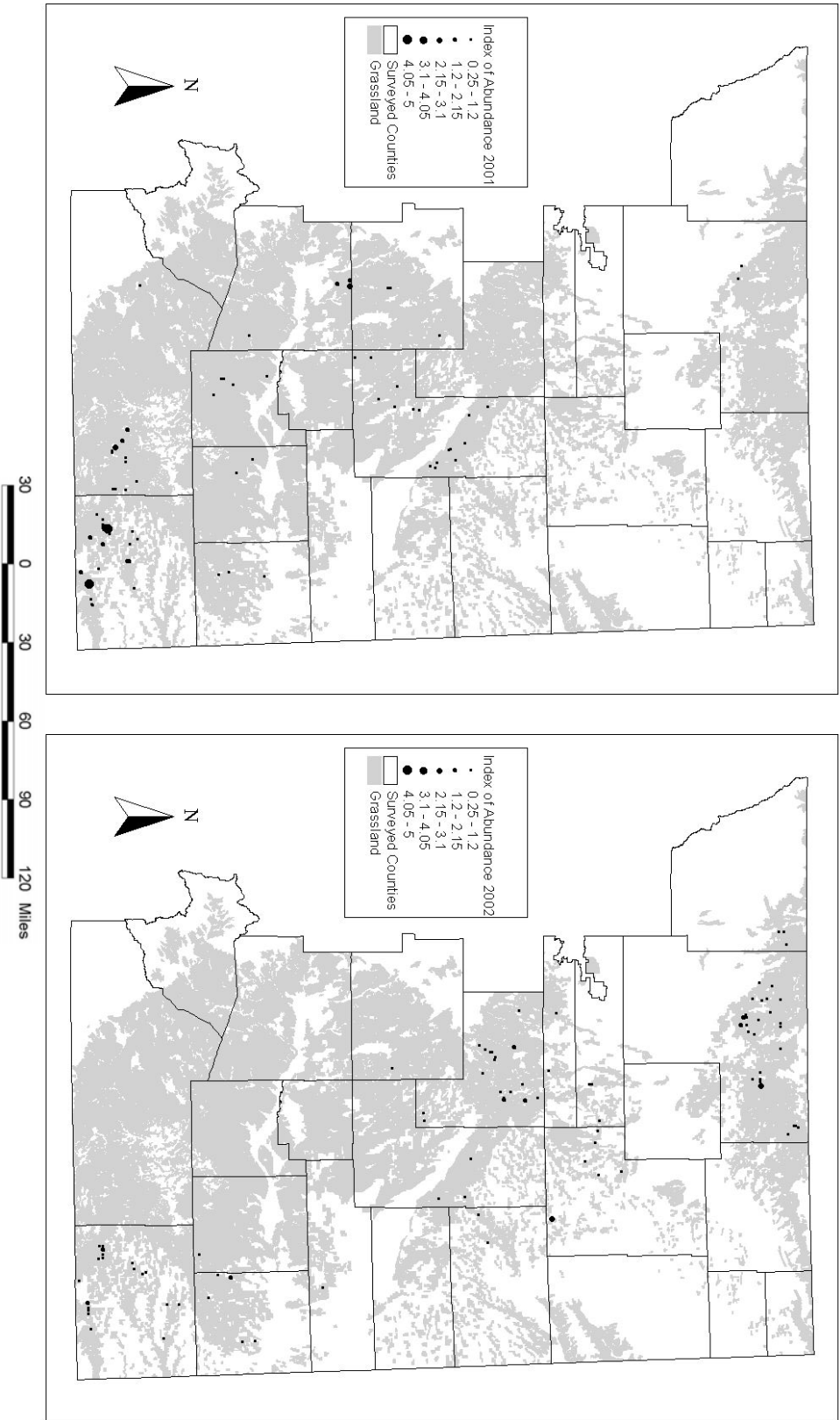
Density estimates (D) for this species categorized by habitat type:

- Grassland
D = 7.60 birds/km² (CV=19%)
- CRP in Weld County
Insufficient data for analysis
- Dry-land agriculture
D = 24.52 birds/km² (CV=19%)
- Shrubland (>10% shrub cover)
D = 5.3 birds/km² (CV=37%)

Two hundred and ninety individuals were detected on 156 of the sections surveyed (12%). We should be able to monitor this species using the road-based point count technique.



Grasshopper Sparrow
(Ammodramus savaannarium)



Maps show the distribution and relative abundance of the Grasshopper Sparrow throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

McCown's Longspur
(*Calcarius mccownii*)

The McCown's Longspur is concentrated in the northwest portion of the shortgrass prairie in eastern Colorado. This species prefers short, grazed grass. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure.

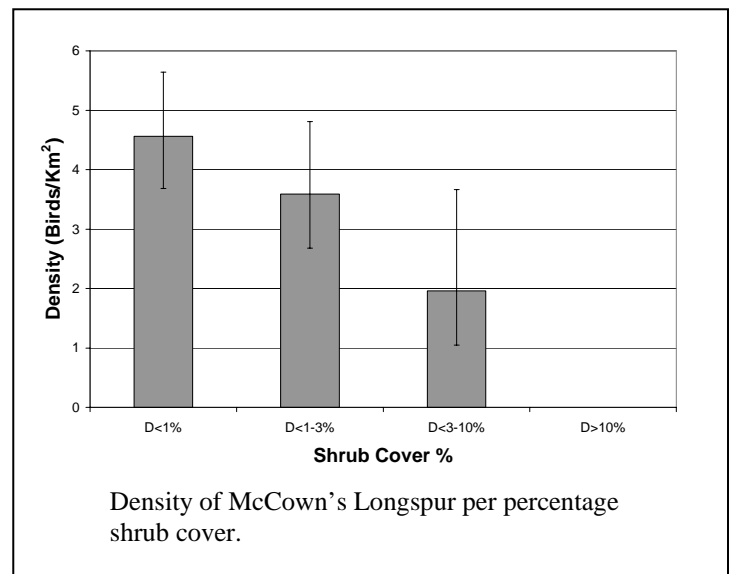
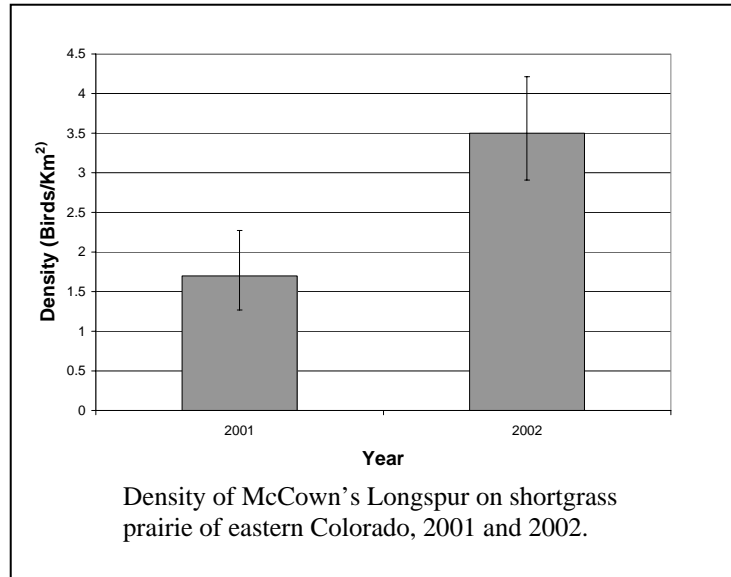
Density estimates (D) for this species by year:

- 2001 density estimate
D = 1.70 birds/km² (CV=15%)
- 2002 density estimate
D = 3.50 birds/km² (CV=9%)

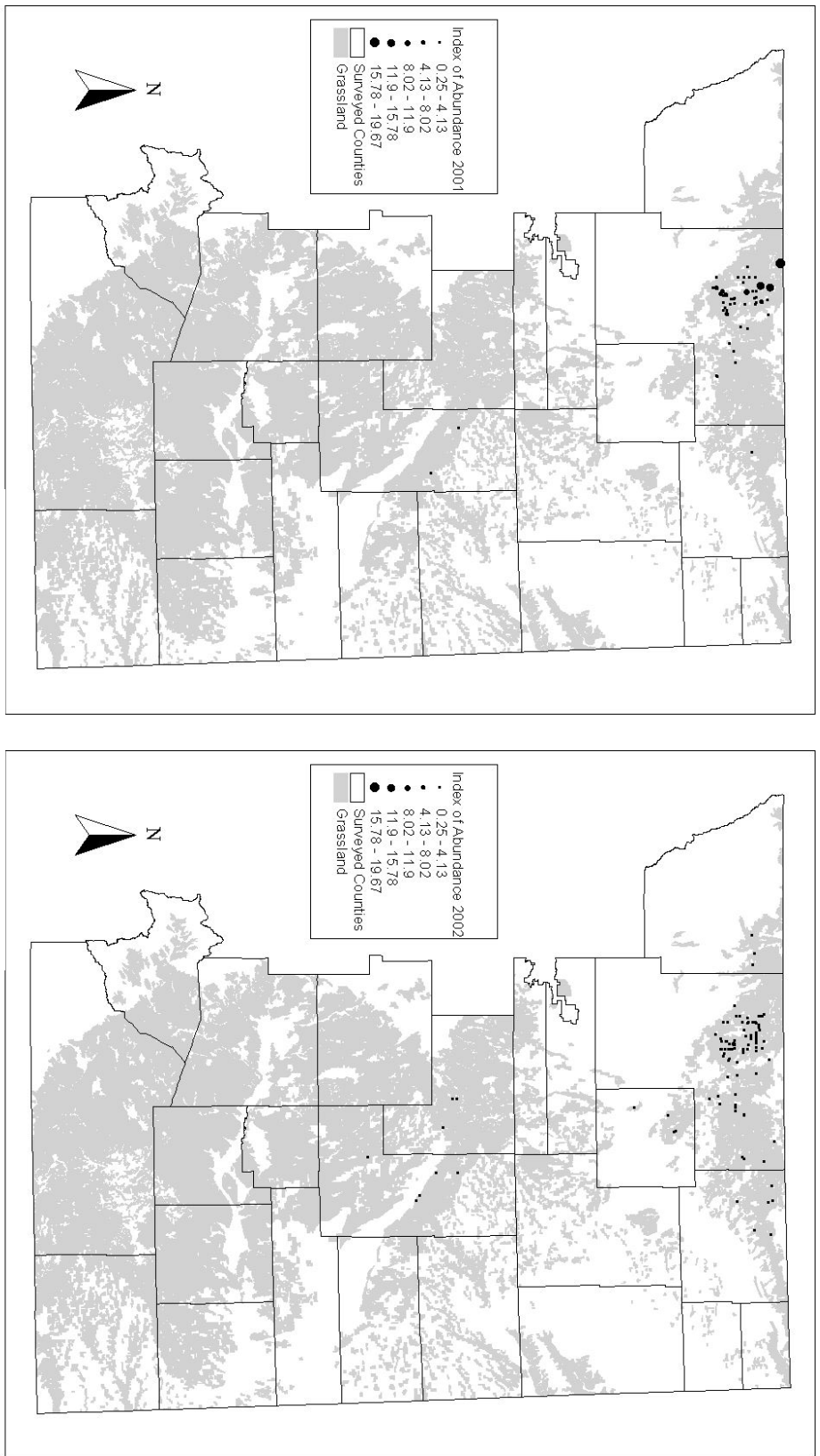
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 4.56 birds/km² (CV=11%)
- Between 1 and 3 % shrub cover
D = 3.59 birds/km² (CV=15%)
- Between 3 and 10 % shrub cover
D = 1.96 birds/km² (CV=33%)
- Greater than 10% shrub cover
Insufficient data for analysis

Four hundred fifty seven individuals were detected on 123 of the sections surveyed (10%). We should be able to monitor this species using the road-based point count technique.



McCown's Longspur
(*Calcarius mccownii*)



Maps show the distribution and relative abundance of the McCown's Longspur throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

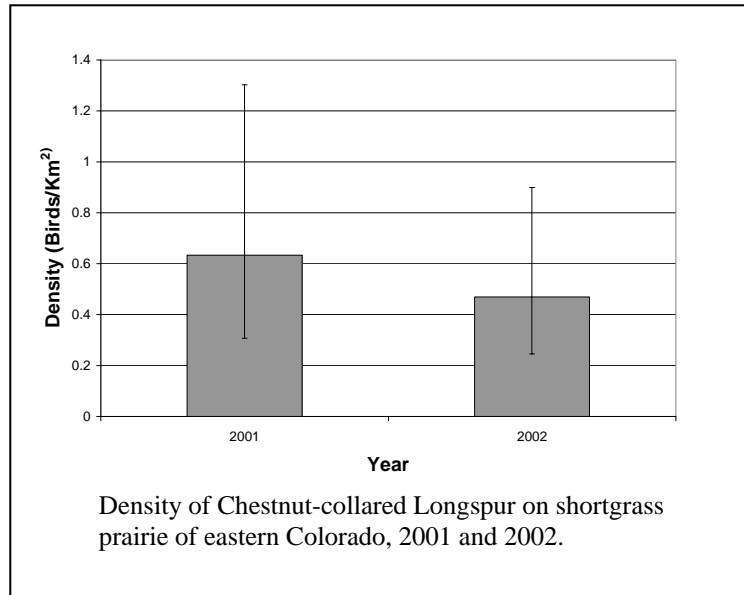
Chestnut-collared Longspur
(*Calcarius ornatus*)

The Chestnut-collared Longspur is distributed locally in the northwest part of the shortgrass prairie in Colorado. This species prefers areas of shortgrass with patches of taller bunch grass. I calculated density estimates for this species in years 2001 and 2002.

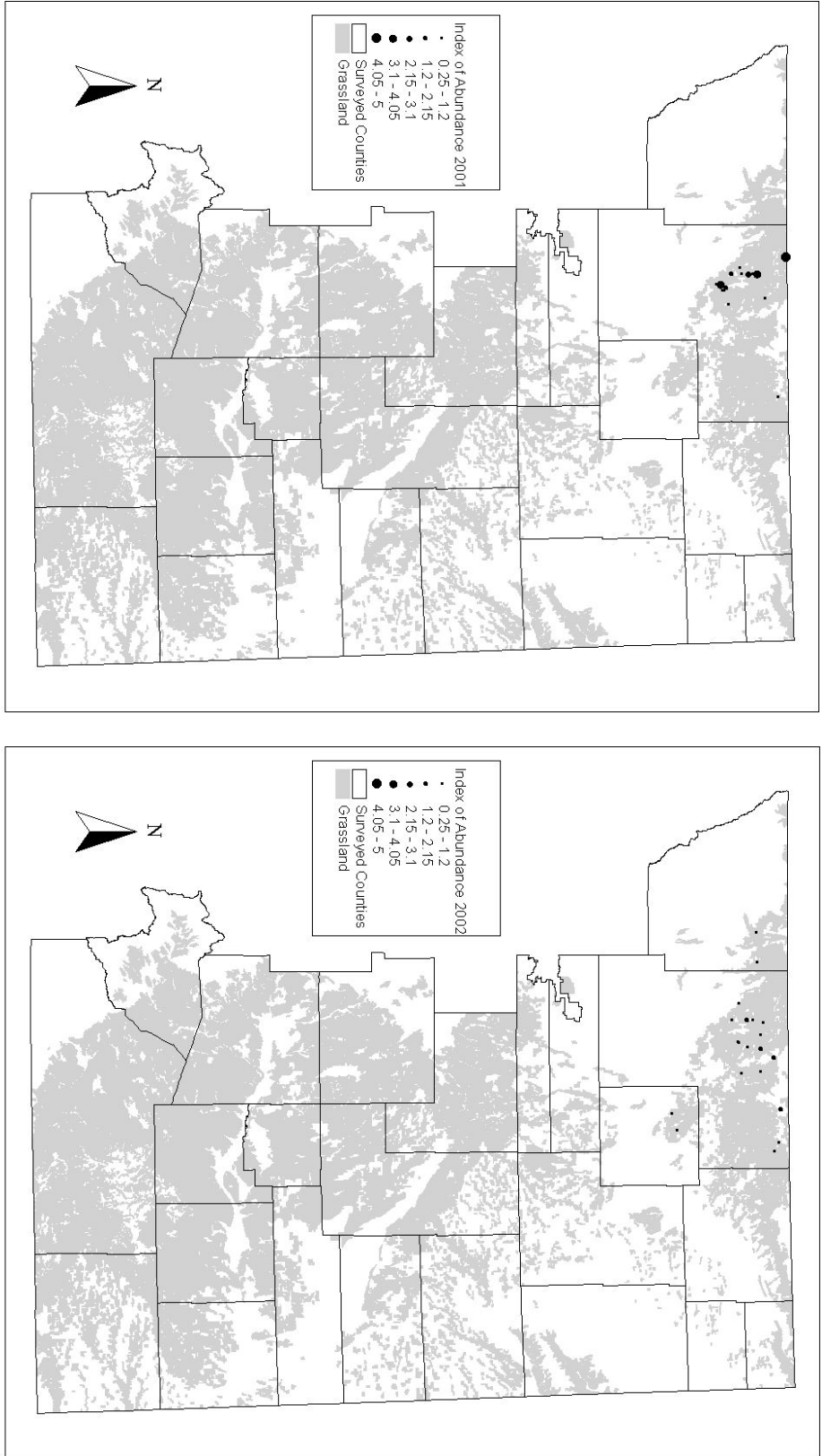
Density estimates (D) for this species by year:

- 2001 density estimate
D = 1.70 birds/km² (CV=15%)
- 2002 density estimate
D = 0.47 birds/km² (CV=34%)

Fifty four individuals were detected on 24 of the sections surveyed (2%). We should be able to monitor this species using the road-based point count technique.



Chestnut-collared Longspur
(*Calcarius ornatus*)



Maps show the distribution and relative abundance of the Chestnut-collared Longspur throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Red-winged Blackbird
(*Agelaius phoeniceus*)

Though typically an inhabitant of marshes, the Red-winged Blackbird is distributed throughout the shortgrass prairie of eastern Colorado. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing habitat.

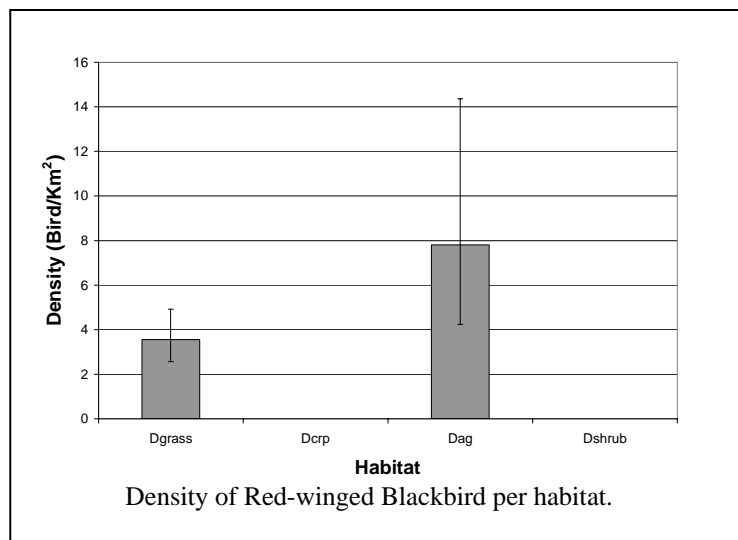
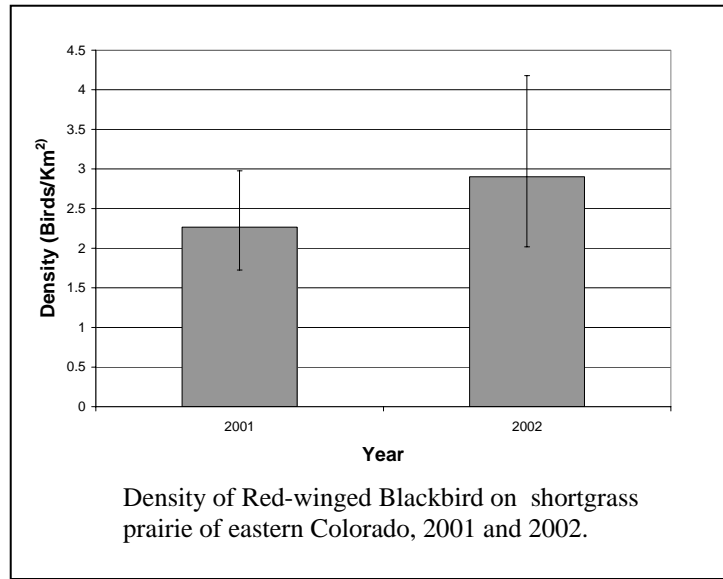
Density estimates (D) for this species by year:

- 2001 density estimate
D = 2.30 birds/km² (CV=14%)
- 2002 density estimate
D = 2.90 birds/km² (CV=19%)

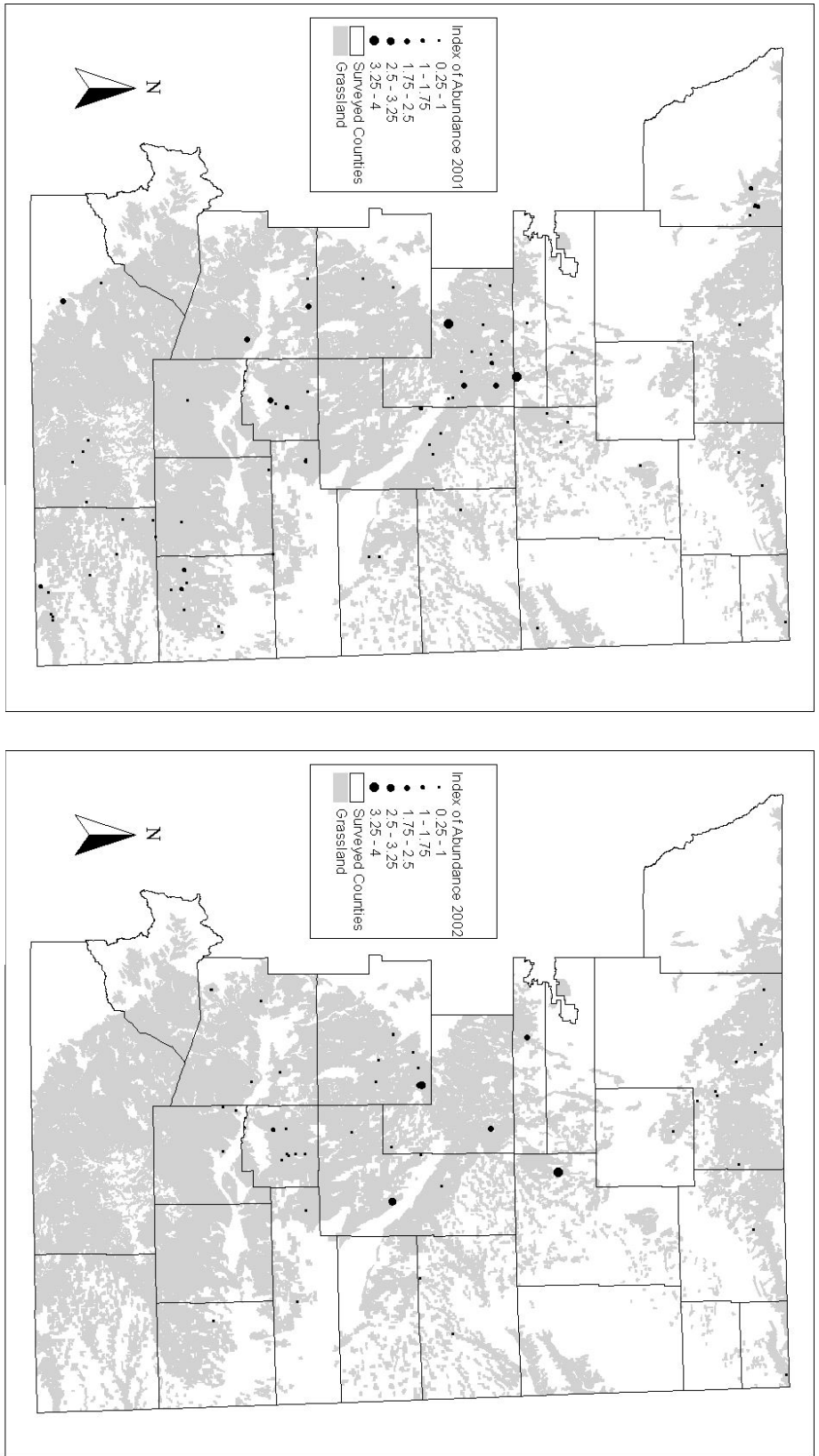
Density estimates (D) for this species categorized by habitat type:

- Grassland
D = 3.55 birds/km² (CV=17%)
- CRP in Weld County
Insufficient data for analysis
- Dry-land agriculture
D = 7.80 birds/km² (CV=32%)
- Shrubland (>10% shrub cover)
Insufficient data for analysis

Two hundred and four individuals were detected on 85 of the sections surveyed (7%). We should be able to monitor this species using the road-based point count technique.



Red-winged Blackbird
(*Agelaius phoeniceus*)



Maps show the distribution and relative abundance of the Red-winged Blackbird throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Western Meadowlark
(*Sturnella neglecta*)

The Western Meadowlark is found commonly throughout the shortgrass prairie of eastern Colorado. This species prefers open grasslands with taller vegetation. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure and habitat.

Density estimates (D) for this species by year:

- 2001 density estimate
D = 40.50 birds/km² (CV=2%)
- 2002 density estimate
D = 43.15 birds/km² (CV=3%)

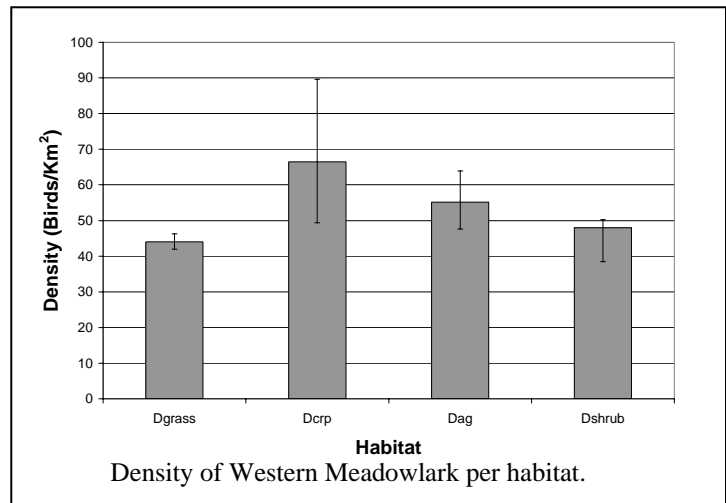
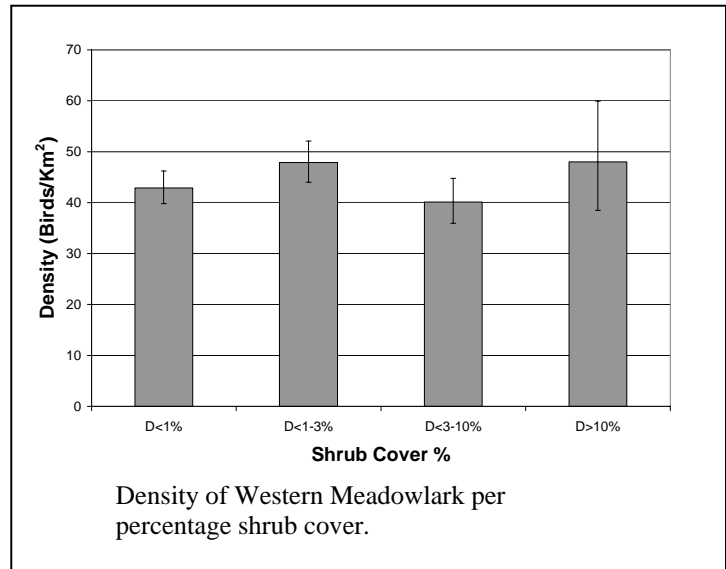
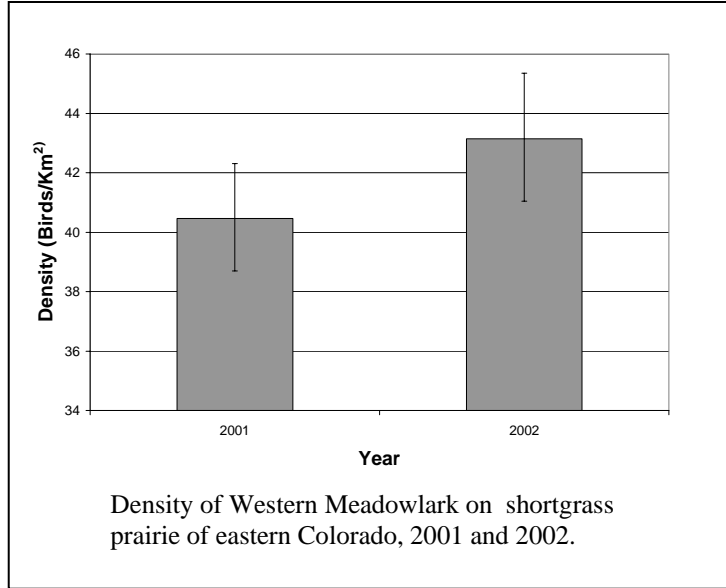
Density estimates (D) for this species separated by categories of percent shrub cover.

- Less than 1 % shrub cover
D = 42.90 birds/km² (CV=4%)
- Between 1 and 3 % shrub cover
D = 47.86 birds/km² (CV=4%)
- Between 3 and 10 % shrub cover
D = 40.13 birds/km² (CV=6%)
- Greater than 10% shrub cover
D = 48.01 birds/km² (CV=11%)

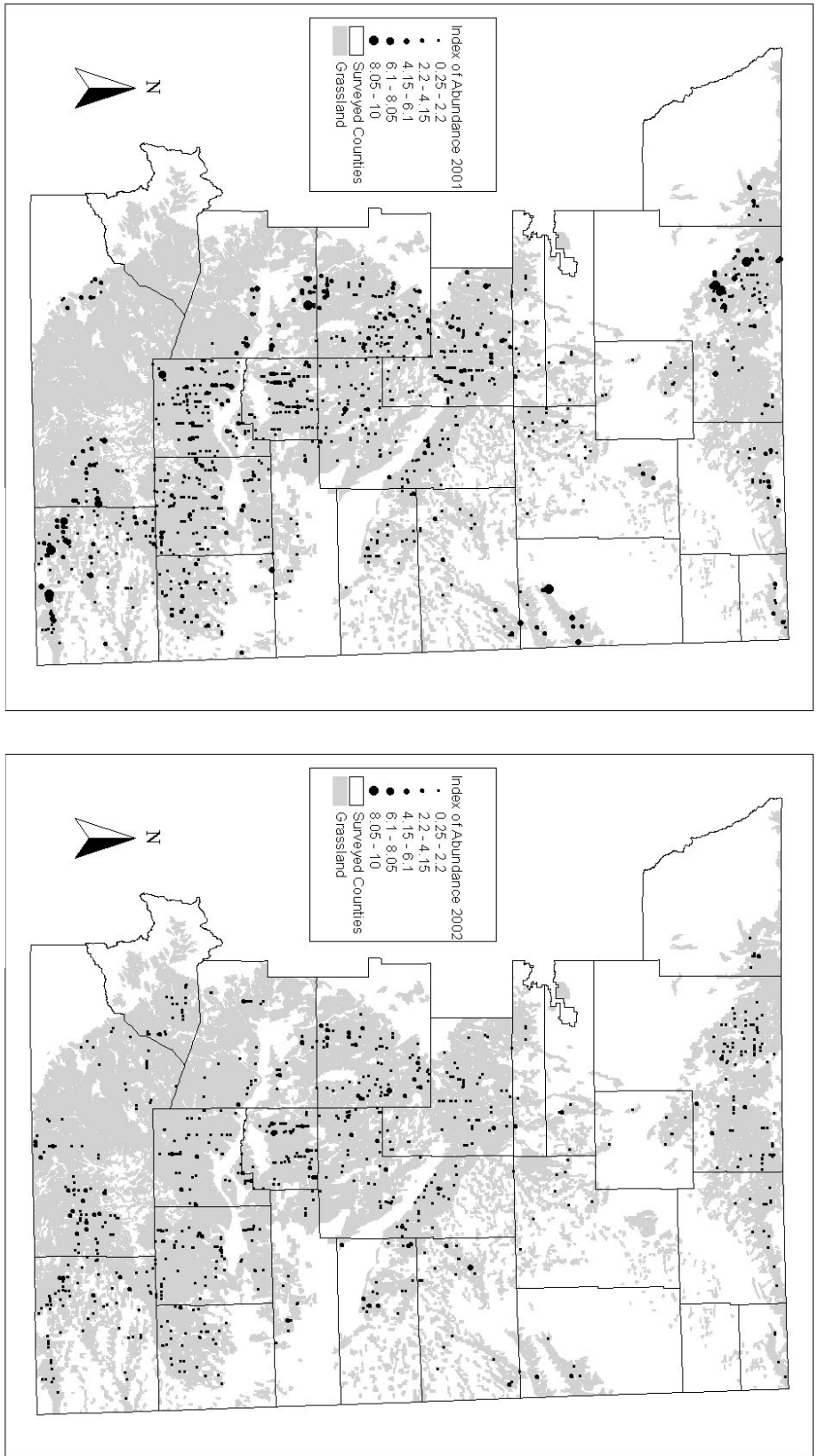
Density estimates (D) for this species categorized by habitat type.

- Grassland
D = 44.07 birds/km² (CV=3%)
- CRP in Weld County
D = 66.50 birds/km² (CV=15%)
- Dry-land agriculture
D = 55.18 birds/km² (CV=8%)
- Shrubland (>10% shrub cover)
D = 48.01 birds/km² (CV=11%)

Three thousand nine hundred and fifteen individuals were detected on 1045 of the sections surveyed (84%). We should be able to monitor this species using the road-based point count technique.



Western Meadowlark
(*Sturnella neglecta*)



Maps show the distribution and relative abundance of the Western Meadowlark throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

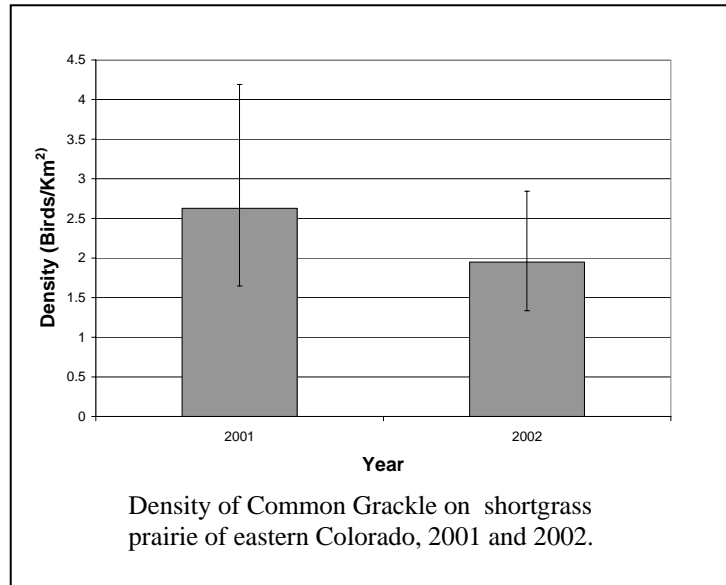
Common Grackle
(*Quiscalus quiscula*)

The Common Grackle is distributed throughout eastern Colorado, but is not an inhabitant of native grassland, preferring anthropogenic habitats. I calculated density estimates for this species in years 2001 and 2002.

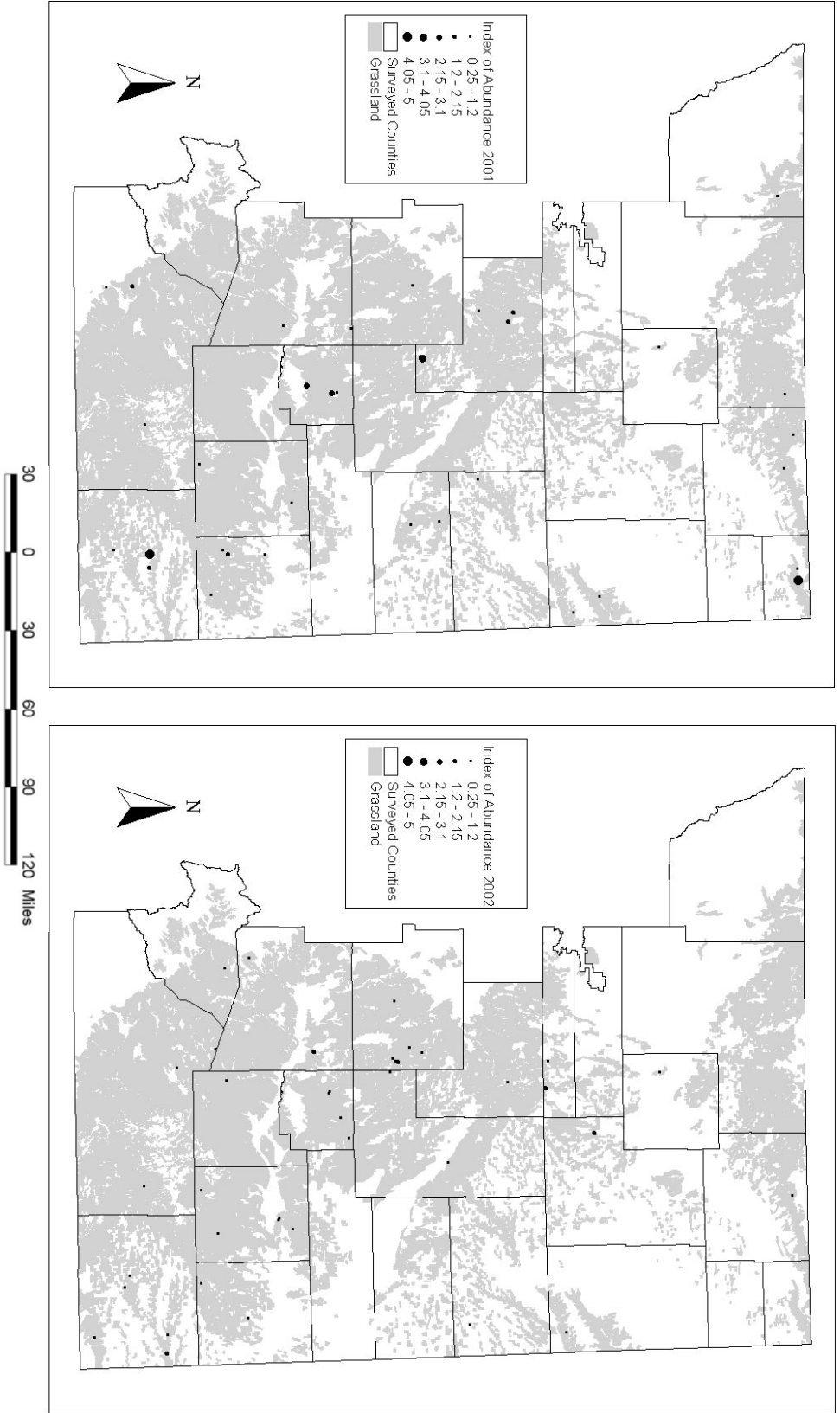
Density estimates (D) for this species by year:

- 2001 density estimate
D = 2.60 birds/km² (CV=24%)
- 2002 density estimate
D = 1.95 birds/km² (CV=19%)

One hundred and six individuals were detected on 64 of the sections surveyed (5%). We should be able to monitor this species using the road-based point count technique.



Common Grackle
(*Quiscalus quiscula*)



Maps show the distribution and relative abundance of the Common Grackle throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

Brown-headed Cowbird
(*Molothrus ater*)

The Brown-headed Cowbird is distributed across the shortgrass prairie of eastern Colorado. This species is an edge species and prefers areas of human habitation and feedlots in the eastern portion of Colorado. I calculated density estimates for this species in years 2001 and 2002. I was also able to determine density estimates for this species in categories of differing structure.

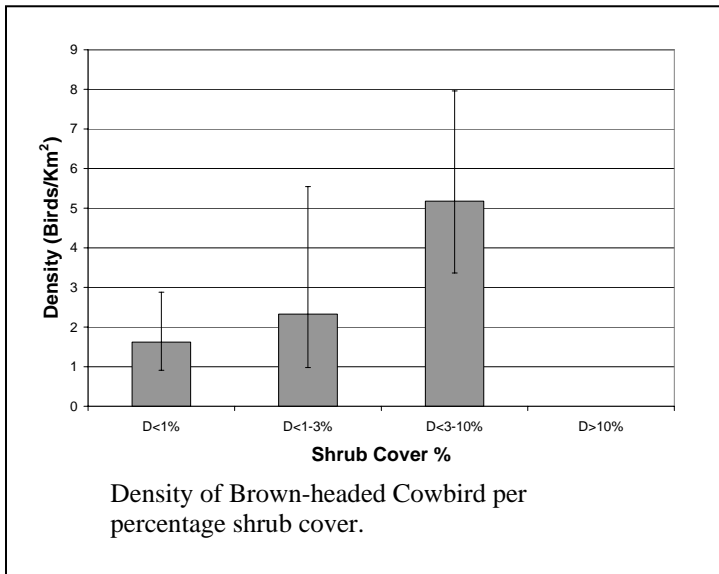
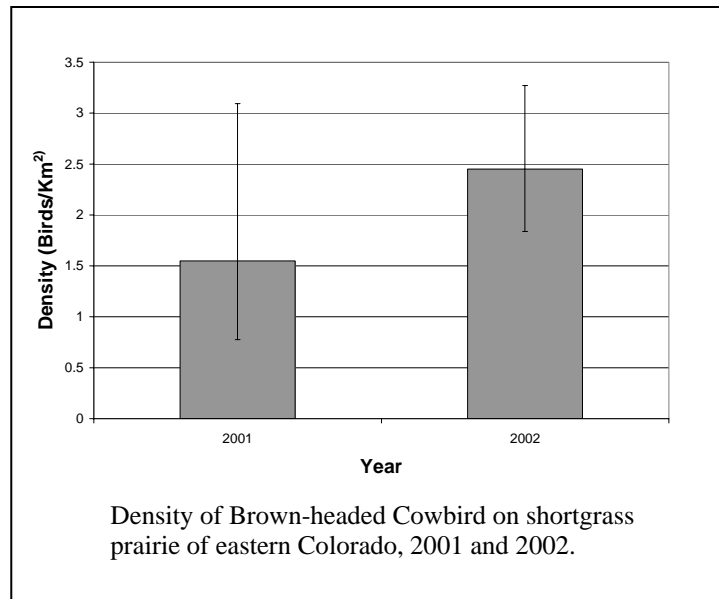
Density estimates (D) for this species by year:

- 2001 density estimate
D = 1.50 birds/km² (CV=36%)
- 2002 density estimate
D = 2.45 birds/km² (CV=15%)

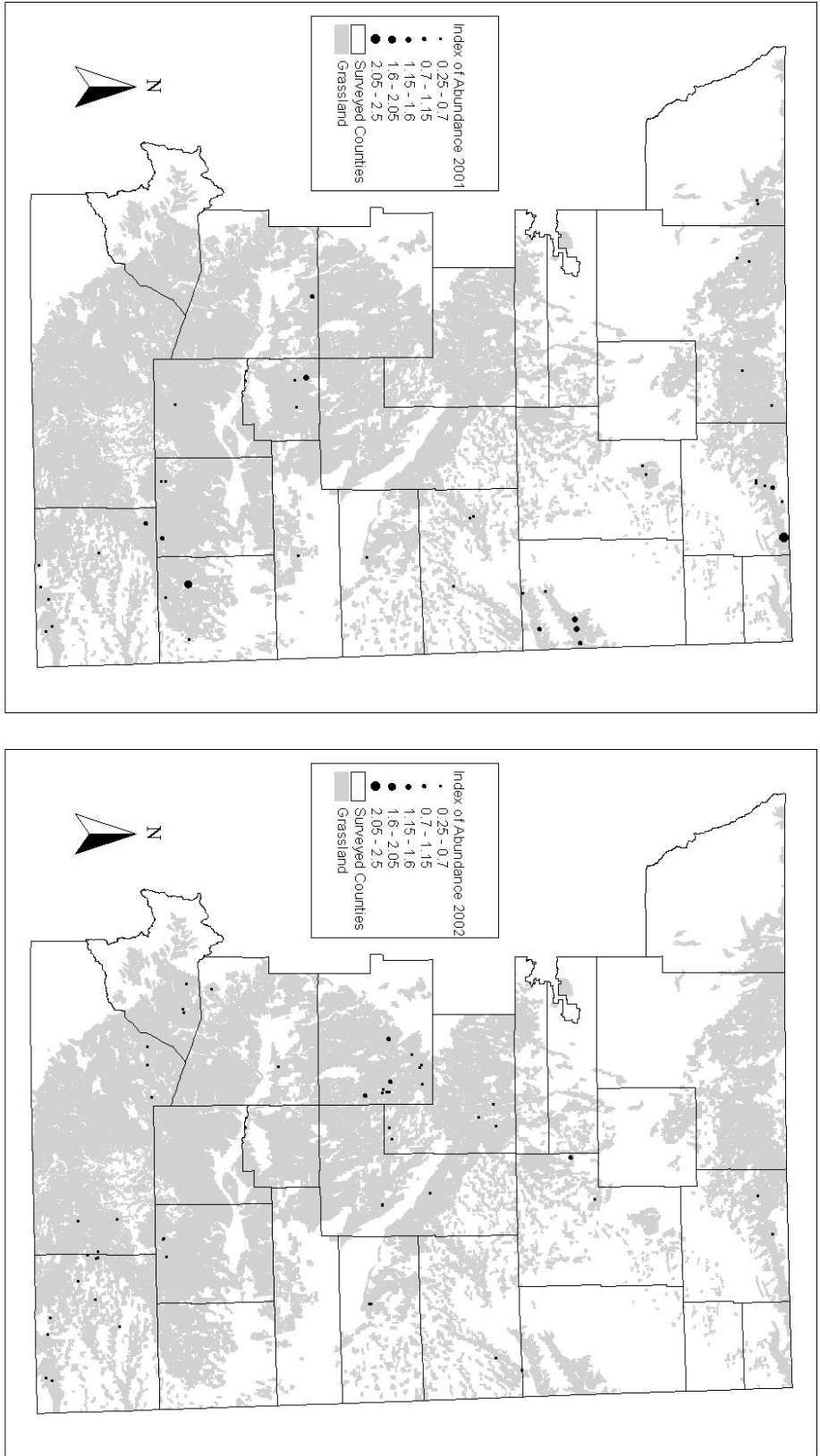
Density estimates (D) for this species separated by categories of percent shrub cover:

- Less than 1 % shrub cover
D = 1.62 birds/km² (CV=30%)
- Between 1 and 3 % shrub cover
D = 2.32 birds/km² (CV=45%)
- Between 3 and 10 % shrub cover
D = 5.18 birds/km² (CV=22%)
- Greater than 10% shrub cover
Insufficient data for analysis

One hundred and nine individuals were detected on 78 of the sections surveyed (6%). We should be able to monitor this species using the road-based point count technique.



Brown-headed Cowbird
Molothrus ater



Maps show the distribution and relative abundance of the Brown-headed Cowbird throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

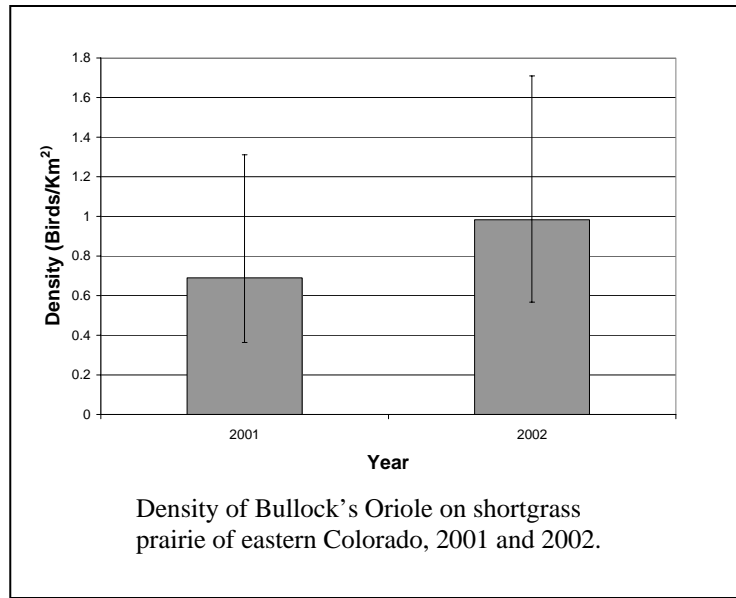
Bullock's Oriole
(*Icterus bullockii*)

Bullock's Oriole occupies habitats with at least some deciduous trees, thus it is rare in the shortgrass prairie. I calculated density estimates for this species in years 2001 and 2002.

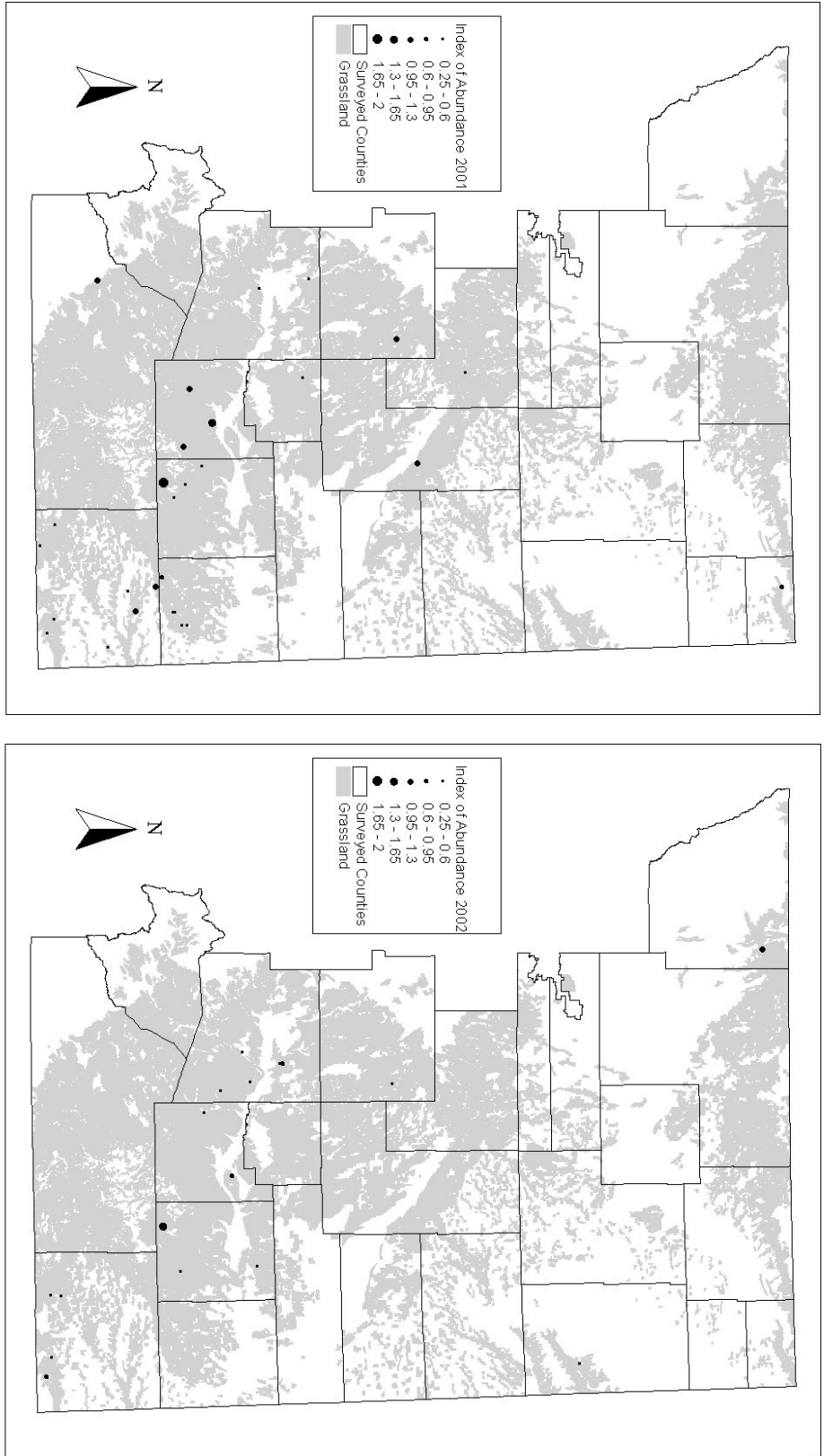
Density estimates (D) for this species by year:

- 2001 density estimate
D = 0.70 birds/km² (CV=33%)
- 2002 density estimate
D = 0.98 birds/km² (CV=29%)

Forty individuals were detected on 22 of the sections surveyed (2%). We should be able to monitor this species using the road-based point count technique.



Bullock's Oriole
Icterus bullockii



Maps show the distribution and relative abundance of the Bullock's Oriole throughout the native grasslands located in eastern Colorado for years 2001 and 2002.

DISCUSSION

There are several advantages of using the section-based technique to monitor birds in the shortgrass prairie of eastern Colorado: 1) it can be used to monitor not only population trends, but changes in distribution and abundance of individual species; 2) it can be implemented at a variety of scales; 3) it can provide information on vegetation characteristics and management practices that could be compared to the bird community; and 4) it can aid us in determining areas in eastern Colorado in which to focus conservation efforts.

This section-based monitoring technique can potentially monitor 65% of the upland breeding species in BCR 18. Included in this list are 13 of 16 species that are declining significantly in this region (Partners in Flight Species Assessment and Prioritization Database 2003). This same technique is currently being implemented in several states that include portions of Shortgrass Prairie BCR 18 (NE, CO, KS, and OK) which will document population and distribution changes across an entire ecoregion. One interesting example of this is the state bird, the Lark Bunting, for which density estimates in 2002 were one-eighth those of 2001. This information does not necessarily mean that the species' population is declining. The decrease in Colorado could be due to a shift in distribution. During 2002, RMBO and the U.S.D.A. Forest Service were conducting the same technique on five National Grasslands in the Great Plains. Results from this study showed that Fort Pierre had the greatest density of Lark Buntings and the southern most grassland (Kiowa National Grassland) had the lowest density (Hanni 2003). Since this was the first year of the study there are no values for density estimates in the National Grasslands that would allow us to compare over years. However, anecdotal reports from Montana suggest that the state hosted much greater numbers of Lark Buntings than normal (fide T. Leukering).

Data gathered using this technique can also be used to delineate areas that are important to breeding prairie birds. Relative abundance and distribution layers for threatened species in Colorado, shown in the species accounts section, can be overlaid to form maps on which we can draw polygons around areas that have high relative abundances and species richness. These polygons indicate where conservation dollars would be used most effectively to conserve Colorado threatened species in the eastern portion of the state (Fig. 5). These maps can be created for any species, or group of species, that are detected using this technique.

By expanding the program to include different habitats and collecting more accurate vegetation information, we can compare these variables and determine how they affect common prairie bird species. For example, last year, during a severe drought, I compare density estimates for this species among structure and habitat. The largest estimate for this species, when comparing structure, is found in >10% shrub cover ($D=27.84$ birds/km², CV=16%). When comparing habitat, the Lark Bunting occurred in the highest density on dry-land agriculture ($D=17.13$ birds/km², CV=28%). This example gives us information on how the species is responding in year 2002. Monitoring these responses, through time, across habitats and vegetation characteristics will allow us to determine

some of the variables for which we should be managing to effectively conserve prairie species.

Colorado Threatened Species 2001 and 2002

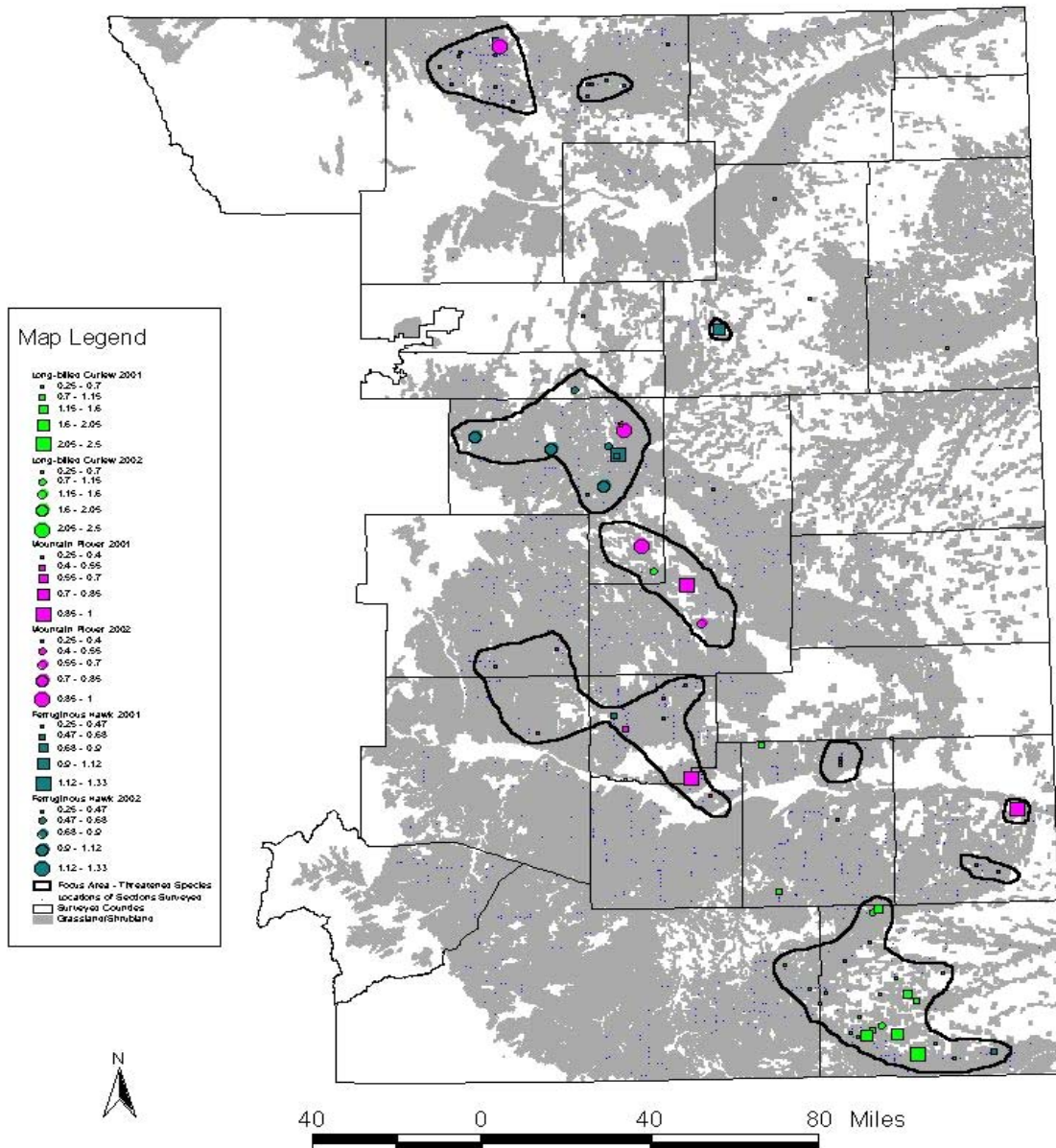


Figure 5. Areas that have relatively high abundance and are in close proximity of other threatened species in Colorado.

RECOMMENDATIONS

Currently, RMBO is working toward determining a correction factor to adjust for the selection that some species show for or against roads. This year, we conducted paired point transects that showed that highest densities for Horned Lark ($D=146.28$ birds/km², $CV=16\%$) and Western Meadowlark (18.18 birds/km², $CV=9\%$) occurred along the road compared to the interior of sections. This methodology only yielded comparable information for two species and also has several biases (fence, regional, road-type, etc.) that reduced our confidence in the capability of this technique to determine accurate correction factors. We decided that comparing the road-based point counts to the unbiased *MCB* point transects should determine a variable for each species for which we were able to obtain density estimates from both techniques. The correction factor should compensate for the density estimate generated from road-based point counts, and should offer an unbiased population estimate for individual species.

Initiation of new projects should focus on obtaining data for species that occur in low densities across this region (e.g., raptors and the Mountain Plover). The implementation of nest monitoring for the raptors would give us information on location of nest sites, productivity, and population estimates for raptor species. The expansion of the RMBO volunteer program *Colony Watch* to prairie dog colonies and playas located on the plains in eastern Colorado will increase the number of detections of species that are associated with these landscape features (e.g., Mountain Plover and Burrowing Owl).

Future efforts to collect objective data for vegetation and information on the management practices at each count point will allow us to evaluate the effects of vegetation characteristics and management practices on birds in eastern Colorado. This will enable managing ecosystems for communities of birds, which is one of the goals shared by RMBO and CDOW.

ACKNOWLEDGEMENTS

I would like to thank the Colorado Division of Wildlife for seeing the importance of this project, through funds provided by Great Outdoors Colorado Trust Fund. We value the partnerships that were created in the pursuit of similar conservation goals. I would especially like to thank Gary Skiba with the CDOW for all of the administrative support provided during the contracts. Many heads were put together to determine techniques to monitor shortgrass prairie birds successfully. People involved include: Mike Carter, Doug Faulkner, Scott Gillihan, Tony Leukering, Ted Toombs and Tammy VerCauteren.,

The final report was reviewed by many within RMBO, particularly Scott Gillihan, Richard Lancaster, Tony Leukering, and Arvind Panjabi. I would like to thank the RMBO staff for their time and effort put in during this process. The pictures were provided by Tony Leukering and Scott Gillihan.

This project could not have been completed with out the help of the 2002 field crew (Nick Lowe, Patti Orth, Ben Pacheco, Ted Toombs, Tammy VerCauteren, Kim Vincent, and Ben Wollenzein). I would also like to recognize and thank Richard Lancaster and Tammy VerCauteren for all of the GIS and technical support.

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Appendix A: Species detected during field work conducted in eastern Colorado.

COMMON NAME	SCIENTIFIC NAME	2001	2002
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	X	
Great Blue Heron	<i>Ardea herodias</i>	X	
Turkey Vulture	<i>Cathartes aura</i>	X	X
Gadwall	<i>Anas strepera</i>	X	X
Mallard	<i>Anas platyrhynchos</i>	X	X
Blue-winged Teal	<i>Anas discors</i>	X	
Northern Pintail	<i>Anas acuta</i>	X	
Mississippi Kite	<i>Ictinia mississippiensis</i>	X	
Northern Harrier	<i>Circus cyaneus</i>	X	X
Cooper's Hawk	<i>Accipiter cooperii</i>	X	
Swainson's Hawk	<i>Buteo swainsoni</i>	X	X
Red-tailed Hawk	<i>Buteo jamaicensis</i>	X	X
Ferruginous Hawk	<i>Buteo regalis</i>	X	X
Golden Eagle	<i>Aquila chrysaetos</i>	X	X
American Kestrel	<i>Falco sparverius</i>	X	X
Prairie Falcon	<i>Falco mexicanus</i>	X	X
Ring-necked Pheasant	<i>Phasianus colchicus</i>	X	X
Northern Bobwhite	<i>Colinus virginianus</i>	X	X
Scaled Quail	<i>Callipepla squamata</i>	X	X
American Coot	<i>Fulica americana</i>		X
Sandhill Crane	<i>Grus canadensis</i>		X
Killdeer	<i>Charadrius vociferus</i>	X	X
Mountain Plover	<i>Charadrius montanus</i>	X	X
Black-necked Stilt	<i>Himantopus mexicanus</i>	X	
American Avocet	<i>Recurvirostra americana</i>	X	
Spotted Sandpiper	<i>Actitis macularia</i>		X
Long-billed Curlew	<i>Numenius americanus</i>	X	X
Least Sandpiper	<i>Calidris minutilla</i>	X	
Upland Sandpiper	<i>Bartramia longicauda</i>		X
Common Snipe	<i>Gallinago gallinago</i>		X
Rock Dove	<i>Columba livia</i>	X	X
Mourning Dove	<i>Zenaida macroura</i>	X	X
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>		X
Greater Roadrunner	<i>Geococcyx californianus</i>		X
Great Horned Owl	<i>Bubo virginianus</i>		X
Burrowing Owl	<i>Athene cunicularia</i>	X	X
Common Nighthawk	<i>Chordeiles minor</i>	X	X
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	X	
Lewis's Woodpecker	<i>Melanerpes lewis</i>	X	X
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	X	X
Northern Flicker	<i>Melanerpes carolinus</i>		X
Western Wood-Pewee	<i>Contopus sordidulus</i>		X
Willow Flycatcher	<i>Empidonax traillii</i>	X	

Say's Phoebe	<i>Sayornis saya</i>	X	X
Cassin's Kingbird	<i>Tyrannus vociferans</i>	X	
Western Kingbird	<i>Tyrannus verticalis</i>	X	X
Eastern Kingbird	<i>Tyrannus tyrannus</i>	X	X
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>	X	
Loggerhead Shrike	<i>Lanius ludovicianus</i>	X	X
Blue Jay	<i>Cyanocitta cristata</i>	X	
Black-billed Magpie	<i>Pica hudsonia</i>	X	X
American Crow	<i>Corvus brachyrhynchos</i>	X	X
Chihuahuan Raven	<i>Corvus cryptoleucus</i>	X	X
Common Raven	<i>Corvus corax</i>	X	
Horned Lark	<i>Eremophila alpestris</i>	X	X
Tree Swallow	<i>Tachycineta bicolor</i>	X	
Violet-green Swallow	<i>Tachycineta thalassina</i>	X	
Bank Swallow	<i>Riparia riparia</i>		X
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	X	X
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	X	X
Barn Swallow	<i>Hirundo rustica</i>	X	X
Rock Wren	<i>Salpinctes obsoletus</i>		X
House Wren	<i>Troglodytes aedon</i>	X	
Eastern Bluebird	<i>Sialia sialis</i>	X	
Western Bluebird	<i>Sialia mexicana</i>		X
Mountain Bluebird	<i>Sialia currucoides</i>	X	X
Swainson's Thrush	<i>Catharus ustulatus</i>	X	
American Robin	<i>Turdus migratorius</i>	X	X
Northern Mockingbird	<i>Mimus polyglottos</i>	X	X
Sage Thrasher	<i>Oreoscoptes montanus</i>	X	X
Brown Thrasher	<i>Toxostoma rufum</i>	X	X
European Starling	<i>Sturnus vulgaris</i>	X	X
Yellow Warbler	<i>Dendroica petechia</i>		X
Common Yellowthroat	<i>Geothlypis trichas</i>	X	
Yellow-breasted Chat	<i>Icteria virens</i>		X
Spotted Towhee	<i>Pipilo maculatus</i>		X
Cassin's Sparrow	<i>Aimophila cassinii</i>	X	X
Chipping Sparrow	<i>Spizella passerina</i>	X	X
Brewer's Sparrow	<i>Spizella breweri</i>	X	X
Vesper Sparrow	<i>Poocetes gramineus</i>	X	X
Lark Sparrow	<i>Chondestes grammacus</i>	X	X
Lark Bunting	<i>Calamospiza melanocorys</i>	X	X
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	X	X
Song Sparrow	<i>Melospiza melodia</i>	X	X
McCown's Longspur	<i>Calcarius mccownii</i>	X	X
Chestnut-collared Longspur	<i>Calcarius ornatus</i>	X	X
Blue Grosbeak	<i>Passerina caerulea</i>	X	X
Lazuli Bunting	<i>Passerina amoena</i>	X	
Dickcissel	<i>Spiza americana</i>	X	

Red-winged Blackbird	<i>Agelaius phoeniceus</i>	X	X
Western Meadowlark	<i>Sturnella neglecta</i>	X	X
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	X	X
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	X	X
Common Grackle	<i>Quiscalus quiscula</i>	X	X
Great-tailed Grackle	<i>Quiscalus mexicanus</i>	X	X
Brown-headed Cowbird	<i>Molothrus ater</i>	X	X
Bullock's Oriole	<i>Icterus bullockii</i>	X	X
House Finch	<i>Carpodacus mexicanus</i>		X
American Goldfinch	<i>Carduelis tristis</i>		X
House Sparrow	<i>Passer domesticus</i>	X	X
