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IN COLORADO

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ABSTRACT.—The historical distribution of Gunnison Sage-Grouse (*Centrocercus minimus*) in Colorado is described based on published literature, observations, museum specimens, and the known distribution of sagebrush (*Artemisia* spp.). Historically, Gunnison Sage-Grouse were widely but patchily distributed in up to 22 counties in south-central and southwestern Colorado. The historical distribution of this species was south of the Colorado-Eagle river drainages primarily west of the Continental Divide. Potential contact areas with Greater Sage-Grouse (*C. urophasianus*) were along the Colorado-Eagle river system in Mesa, Garfield, and Eagle counties, west of the Continental Divide. Gunnison Sage-Grouse historically occupied habitats that were naturally highly fragmented by forested mountains and plateaus/mesas, intermountain basins without robust species of sagebrush, and river systems. This species adapted to use areas with more deciduous shrubs (i.e., *Quercus* spp., *Amelanchier* spp., *Prunus* spp.) in conjunction with sagebrush. Most areas historically occupied were small, linear, and patchily distributed within the overall landscape matrix. The exception was the large intermountain basin in Gunnison, Hinsdale, and Saguache counties. The documented distribution east of the Continental Divide within the large expanse of the San Luis Valley (Alamosa, Conejos, Costilla, and Rio Grande counties) was minimal and mostly on the eastern, northern, and southern fringes. Many formerly occupied habitat patches were vacant by the mid 1940s with extirpations continuing to the late 1990s. Counties from which populations were recently extirpated include Archuleta and Pitkin (1960s), and Eagle, Garfield, Montezuma, and Ouray (1990s). Received 1 November 2013. Accepted 29 January 2014.

Key words: *Centrocercus minimus*, *C. urophasianus*, Colorado, Greater Sage-Grouse, Gunnison Sage-Grouse.

The Gunnison Sage-Grouse (*Centrocercus minimus*) was not described as a species separate from Greater Sage-Grouse (*C. urophasianus*) until 2000 (Young et al. 2000). They were known to differ from Greater Sage-Grouse by 1977 and were subsequently investigated in a series of studies starting in the mid 1980s (Hupp 1987) and 1990s (Young 1994, Commons 1997, Oyler-McCance 1999). These studies characterized many different aspects including morphology (Hupp and Braun 1991), behavior (Young et al. 1994), habitat (Commons et al. 1999, Oyler-McCance et al. 2001), and genetics (Oyler-McCance et al. 1999).

The distribution of sage-grouse in North America, including Gunnison Sage-Grouse, was most recently reported by Schroeder et al. (2004)

while Rogers (1964) and Braun (1995) described the early distribution of sage-grouse in Colorado. Young et al. (2000) described the general historical and current distribution of Gunnison Sage-Grouse when they formally described the species. This information is particularly important as Gunnison Sage-Grouse populations have declined dramatically (Gunnison Sage-Grouse Rangeland Steering Committee 2005) and the species has been proposed for listing as endangered under the U.S. Endangered Species Act (USDI 2013).

The oldest fossil evidence of sage-grouse (Emslie 2004) suggests they existed in Colorado in the early Pleistocene (~1.6 million years ago). Anecdotal accounts of sage-grouse in Colorado are available (Morrison 1888, Cooke 1897, Rockwell 1908, Warren 1909, Sclater 1912, Bergtold 1928) and provide some evidence of where sage-grouse occurred in the late 1800s and early 1900s. Additionally, Rogers (1964) summarized the distribution of sage-grouse and sagebrush (*Artemisia* spp.) in Colorado in the late 1950s and early 1960s. These accounts provide important information on the historical distribution of Gunnison Sage-Grouse. Additional information exists in the form of museum specimens, personal communications with ranchers and wildlife managers, and field work specifically searching for evidence of sage-grouse that can be used to refine the

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historical distribution of Gunnison Sage-Grouse in Colorado. The objectives of this study were to (1) review all pertinent information regarding Gunnison Sage-Grouse to define the historical distribution in Colorado, and (2) provide the timing of recent population extirpations.

METHODS

We reviewed the early published literature on avifauna (and sage-grouse) in Colorado, attempted to locate specimens in museums by circulating requests in the ornithological literature, and interviewed people who lived and or worked in areas depicted as historical range by Rogers (1964:fig. 1). We also examined historic journals describing some of the first documented reports of flora and fauna in areas possibly occupied by Gunnison Sage-Grouse in the 1800s. Of particular use was the Beckwith (1855) account of Captain Gunnison's explorations (1853–1854) in New Mexico and Colorado, as well as the Coues (1898) account of Major Fowler's 1821–1822 journey through several western states including Oklahoma, New Mexico, and Colorado.

We conducted field surveys in spring from 1978 as time permitted to spring 1999 in areas reported by Rogers (1964) to have had sage-grouse. We restricted our investigations to areas generally south of the Colorado River from the Colorado-Utah State line east to the junction with the Eagle River and from there east to the Continental Divide. We included all sagebrush habitats south of Interstate 70 east of the Continental Divide (especially in Lake, Park, and Chaffee counties), and all areas within the San Luis Valley to the Colorado-New Mexico State line and west to the Arizona-Utah State boundaries. This included all of southwest Colorado and immediately adjacent counties within Colorado. We also surveyed and viewed sage-grouse in all counties (Mesa, Garfield, and Eagle) immediately north of the Colorado-Eagle rivers. We selected this area as all sage-grouse north of the Colorado-Eagle rivers were known to be Greater Sage-Grouse (Hupp and Braun 1991). These areas were open (except Mesa County) to hunting of sage-grouse and data (observations and wing collections) were available precluding the presence of Gunnison Sage-Grouse.

RESULTS

The oldest fossil evidence of sage-grouse is from the early Pleistocene (~1.6 million years

ago) in central Colorado (i.e., Park County, 20 km northeast of present Salida in Chaffee County) (Emslie 2004). This is ~35 km northeast of the present population of Gunnison Sage-Grouse at Poncha Pass in Saguache County. Early reports of sage-grouse distribution in Colorado include Cooke (1897), Sclater (1912), and Bergtold (1928). Cooke (1897:71) reported that sage-grouse were common residents in Colorado with a few ranging to 2,896 m in summer and were much more common in the northern half of the state. Sclater (1912) reported the presence of sage-grouse in Gunnison and Mesa counties, near Cortez in Montezuma County, and in the lower Trinchera Valley in Costilla County. Bergtold (1928:97) reported sage-grouse were frequent residents occurring locally in more northern parts of Colorado up to 2,743 m in elevation. Rogers (1964) reported sage-grouse occurred in the southwestern Colorado counties of Archuleta, Delta, Dolores, Eagle, Garfield, Gunnison, La Plata, Mesa, Montezuma, Montrose, Ouray, Pitkin, Saguache, and San Miguel. He also suggested (1964:9) the eastern slope counties of Alamosa, Chaffee, Lake, Conejos, Costilla, Rio Grande, and possibly Huerfano likely contained sage-grouse.

Rogers (1964:fig. 3) reported on the distribution of sagebrush which was present in southwestern Colorado at Iron Springs Divide, Uncompahgre Plateau, Plateau Creek, Roaring Fork Valley to Aspen, Lone Cone, Lone Mesa, Naturita, Cerro Ridge, Somerset, Marshall Pass, Durango, Crested Butte, Sapinero, Gunnison, Creede, Poncha Pass, Buena Vista, Leadville, Hotchkiss, Saguache, Bayfield, Arboles, and McElmo. Anderson (1969) reported that sagebrush spraying on the Uncompahgre Plateau resulted in loss (emigration) of the sage-grouse from the area. J. D. Hart of the Colorado Game and Fish Department (memo of 1 July 1937 cited in Rogers [1964:20]), reported slight increases in sage-grouse in Archuleta, Dolores, Garfield, Hinsdale, La Plata, Mesa, Montezuma, and Montrose counties during 1936–1937. Hart also reported that populations were static in Delta, Eagle, Gunnison, Mineral, and Saguache counties. While sage-grouse populations in some counties had disappeared by 1944 (Rogers 1964:25), the species was present in Delta, Dolores, Eagle, Garfield, Gunnison, Hinsdale, Mesa, Montezuma, Montrose, Ouray, Saguache, and San Miguel counties in 1961 (Rogers 1964:fig. 9).

TABLE 1. Gunnison Sage-Grouse occurrence in Colorado.

County	Historic occurrence ^a	Where	Current occurrence	When extirpated
Alamosa	Yes	Unknown	No	<1942
Archuleta	Yes	Multiple Areas	No	1960s
Chaffee	Yes	Unknown	No	1940s
Conejos	Yes	Unknown	No	1940s
Costilla	Yes	Trinchera Valley	No	1930s
Delta	Yes	Multiple Areas	Yes	
Dolores	Yes	Multiple Areas	Yes	
Eagle	Yes	Multiple Areas	No	By 1998
Garfield	Yes	Multiple Areas	No	By 1996
Gunnison	Yes	Multiple Areas	Yes	
Hinsdale	Yes	Multiple Areas	Yes	
Huerfano	??	Unknown	No	<1930?
La Plata	Yes	Multiple Areas	No	<1960
Mesa	Yes	Multiple Areas	Yes	
Mineral	Yes	Unknown	No	<1940
Montezuma	Yes	Multiple Areas	No	By 1996
Montrose	Yes	Multiple Areas	Yes	
Ouray	Yes	Multiple Areas	No	By 1996
Pitkin	Yes	Multiple Areas	No	By 1965
Rio Grande	Yes	Unknown	No	<1940
Saguache	Yes	Multiple Areas	Yes	
San Miguel	Yes	Multiple Areas	Yes	

^a Based on Rogers 1964.

Based on a review of the literature, personal communications with ranchers and wildlife managers, museum specimens (27 from Dolores [1], Gunnison [11], Mesa [1], Montrose [1], Saguache [6], and San Miguel [7] counties), and actual searches for birds, the historical distribution of Gunnison Sage-Grouse in Colorado (Table 1, Fig. 1) was as described below.

Alamosa, Conejos, Costilla, and Rio Grande Counties.—Captain J. W. Gunnison reported “grouse” (species not identified) in his 1853 expedition through the Sangre de Cristo Mountains and San Luis Valley of Colorado (Beckwith 1855). He arrived in the San Luis Valley from Huerfano County (to the east), over the Sangre de Cristo Mountains and then proceeded south to Taos, New Mexico, through the south end of the Valley. He returned to Fort Massachusetts (north of present Fort Garland) and proceeded north to Poncha Pass and west into the Gunnison Basin through Saguache County. This travel included at least Alamosa, Costilla, and Saguache counties, the southern portion of Chaffee County, and possibly Conejos and Rio Grande counties. This report commonly mentioned the presence of sagebrush (specifically *Artemisia*) throughout the

area and on two occasions and in two different locations grouse are mentioned in the San Luis Valley.

Major Fowler did not mention grouse of any kind during his travels in the San Luis Valley, although he mentioned killing other birds for food (Coues 1898). Sclater (1912) (per Brunner in litt.) reported the presence of sage-grouse in the lower Trinchera Valley of Costilla County. Rogers (1964:20) suggested that sage-grouse persisted in this county into the late 1930s but may have been eliminated by subsistence hunting.

Intensive field investigations (by JRY) in 1989 on the Forbes Trinchera Ranch (~657,277 ha of which ~98,839–123,548 ha appeared to be potential habitat for sage-grouse) in Costilla County revealed no evidence of the presence of sage-grouse. Rogers (1964) reported there was only limited (~16 km²) sagebrush in Conejos County. We could not document the presence of sage-grouse in Alamosa, Conejos, Costilla, and Rio Grande counties (but see Sclater 1912 for Costilla County), although they are inferred to have been historically present by Rogers (1964:fig. 1). The presence of sage-grouse in these counties was not included on distribution

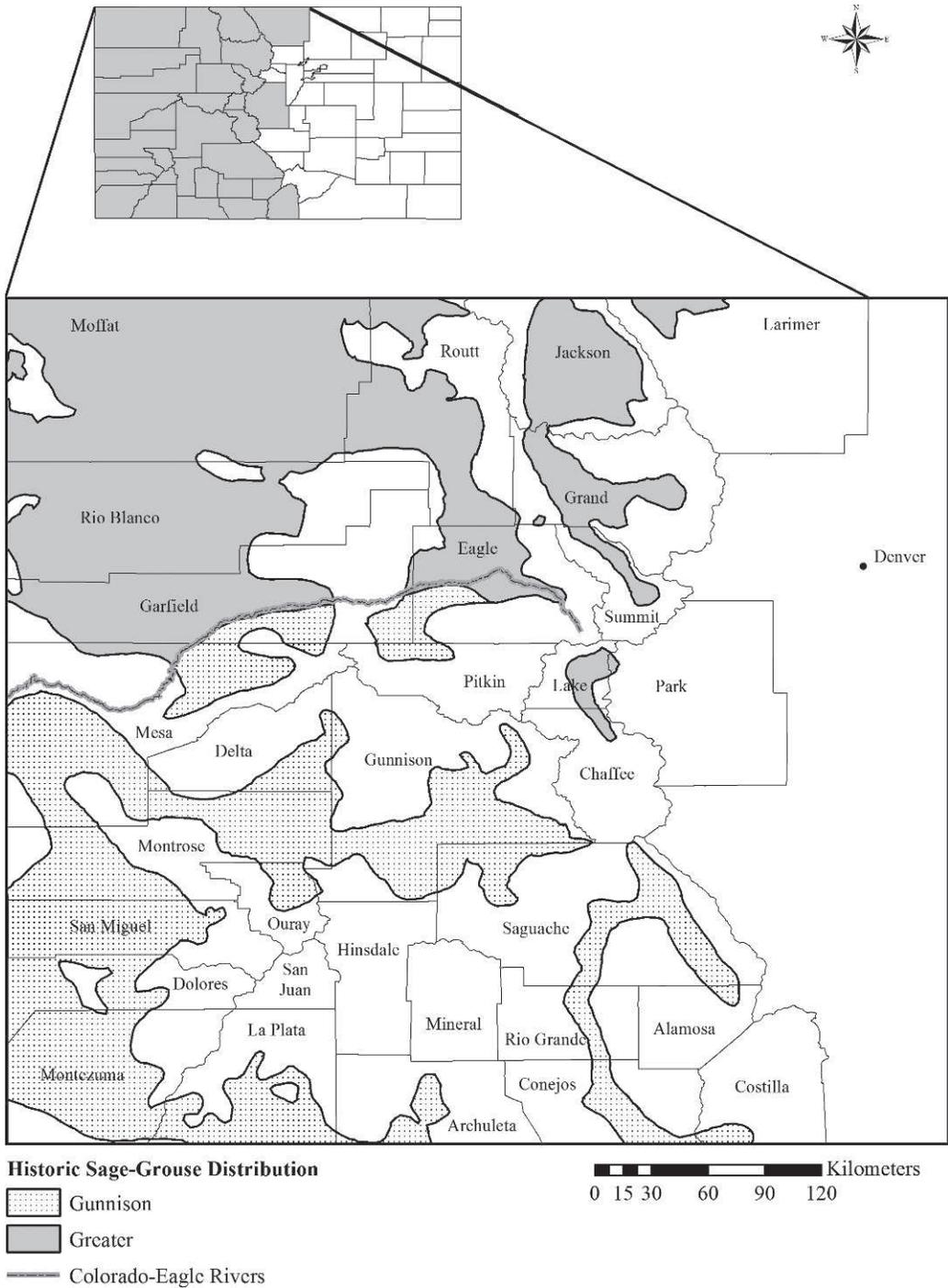


FIG. 1. Assumed historical distribution (1961) of Gunnison Sage-Grouse and Greater Sage-Grouse in Colorado (modified from Rogers 1964).

maps for 1942 or 1945 (Rogers 1964:22–23). These populations were likely extirpated in the late 1930s to early 1940s.

Archuleta County.—Sage-grouse were present in this county in the early 1940s to at least 1945 (Rogers 1964). Pat Waters of the Colorado Game, Fish and Parks Department recalled in the early 1970s that sage-grouse had persisted into the early 1960s near Arboles. This population was probably extirpated as the result of completion and filling of the Navajo Reservoir in 1962.

Chaffee County.—Captain J. W. Gunnison did not report any grouse during his brief travels in 1853 north of Poncha Pass into southern Chaffee County to the Arkansas River (Beckwith 1855). Rogers (1964) suggested that sage-grouse likely occurred in Chaffee County as the sage-grouse hunting season was closed in this county in 1944. The closest historic record is in Park County to the northeast dating to the early Pleistocene (Emslie 2004). The closest current record is about 2 km south of Poncha Pass in Saguache County.

Delta County.—Rogers (1964) indicated sage-grouse were present in the Smith Fork drainage in the southeast part of Delta County and near Dry Fork Creek on the Montrose-Delta County boundary. Gunnison Sage-Grouse were known to persist in the area (Fruitland Mesa) near Crawford during 1978 to the present. Counts of males on leks were made annually during this period and some birds were radiomarked and studied (Commons 1997).

Dolores County.—Bent (1932:309) reported sage-grouse near the town of Dolores. They historically occurred in the western portion of the county with main concentrations northwest of Dolores and a scattered population near Dove Creek and Cahone (Rogers 1964, Bailey and Niedrach 1965). Rogers (1964) reported that sage-grouse hunting was closed in Dolores County in 1960. A flock of 100 sage-grouse was reported in the Groundhog Lake area at the head of Disappointment Creek in 1960. Bill Fischer of the Colorado Game, Fish and Parks Department reported (to the senior author) a flock of 52 sage-grouse on Sage Hen Flats along the Dolores River, on the west edge of Dolores in winter 1976–1977. This area was to be flooded by construction of a new reservoir. He believed these birds summered south of Groundhog Reservoir. Gunnison Sage-Grouse were radiomarked and studied in the mid 1990s northeast and northwest of Dove Creek (Commons 1997).

Eagle County.—Rogers (1964) reported that sage-grouse hunting was closed in Eagle County in 1961. Birds were present south of the Colorado-Eagle rivers in 1961 southwest of Gypsum near the heads of Cattle and Coulter creeks, and near Missouri Heights (Rogers 1964). These birds were known to be small-bodied sage-grouse (P. D. Olson, Colorado Division of Wildlife, pers. obs.). Kevin L. Berner found a hatched sage-grouse nest in early July 1979 along the road (Mayer Gulch) to Hardscrabble Mountain. Tom Verry, working for the Colorado Division of Wildlife, flushed 3 sage-grouse of unknown sex in Mayer Gulch on 20 March 1991 and a hen on 30 April 1991 on Bellyache Ridge. Sage-grouse persisted in this area into the mid to late 1990s, as droppings were found in several locations (southwest of Brush Creek, Bellyache Ridge) in 1995 (CEB, SJO-M, pers. obs.) including near the airport. Displaying sage-grouse were not heard in an intensive search using a parabolic ear in spring 1998 by Wildlife Manager Bill Heicher of the Colorado Division of Wildlife. The population was likely extirpated in the late 1990s.

Garfield County.—Rockwell (1908) reported sage-grouse with young in southern Garfield County near Mamm Creek. Rogers (1964) reported that the hunting of sage-grouse in Garfield County was closed in 1958. Birds were present in 1961 south of the Colorado River (Rogers 1964). Sage-grouse were known to occur in the Cattle and Coulter creek areas near Cottonwood Pass, and also in the Dry Park-Jerome Park area west of the Roaring Fork River and the town of Carbondale (Rogers 1964). T. D. I. Beck of the Colorado Division of Wildlife reported seeing two small active leks each with 5–6 birds south of Glenwood Springs in 1977–1978. Sage-grouse and their droppings were seen near Colorado Mountain College southeast of Glenwood Springs, and Parry A. Larsen reported seeing up to 5 sage-grouse in Spring Valley for 3–5 years prior to 1992. CEB found old droppings at several locations in Spring Valley in 1994. The population was likely extirpated in the mid 1990s.

Gunnison County.—Captain J. W. Gunnison reported sage-grouse in his travels in 1853 near present Elk Creek east of the Lake Fork of the Gunnison River (Beckwith 1855). This report commonly mentioned the presence of sagebrush throughout the area. Sclater (1912) reported the presence of sage-grouse in Gunnison County, as did Warren (1916) who reported sage-grouse were

rare in the Elk Mountain region of Gunnison County and did not occur much farther up the East River than Jack's Cabin. Scattered birds were found elsewhere in this county in sagebrush habitat (Rogers 1964, Bailey and Niedrach 1965). Rogers (1964:20) suggested that Gunnison County historically had some of the highest populations of sage-grouse. This continues, especially in the Ohio Creek and Willow Creek drainages, and Elk Creek (CEB, pers. obs.). This population was intensively studied from the mid 1980s to 1999 (Hupp and Braun 1989; Young et al. 1994, 2000; Oyler McCance et al. 1999, 2001).

Hinsdale County.—Sage-grouse were present in this county in the early 1940s (Rogers 1964) and continue to seasonally occupy habitat in the northern part of the county along upper Powderhorn Creek and the upper Lake Fork of the Gunnison River.

Huerfano County.—Captain J. W. Gunnison passed through Huerfano County in his travels through southern Colorado in 1853 and reported grouse (possibly Dusky Grouse [*Dendragapus obscurus*]) and 'pheasants' (possibly Sharp-tailed Grouse [*Tympanuchus phasianellus*] based on written descriptions in Beckwith 1855) before he crossed the Sangre de Cristo Mountains into the San Luis Valley. Rogers (1964:9) suggested it was possible that sage-grouse once occurred in this county.

La Plata County.—Sage-grouse were present in the early 1940s (Rogers 1964) in this county and occurred along the Pine and Florida rivers, south of Bayfield. Other areas where sage-grouse occurred were south of Hesperus near Breen and Red Mesa. Several older ranchers in these areas mentioned to CEB the past presence of sage-grouse in the pre-1969 interval. This population appears to have been extirpated prior to 1960.

Mesa County.—Rockwell (1908) reported the presence of sage-grouse in Mesa County in March ~12 km south of DeBeque, in summer in Plateau Valley, and in July at the base of Mamm's Peak. Sclater (1912) also reported the presence of sage-grouse in this county. Rogers (1964) observed males displaying in Glade Park and on Pinon Mesa in early April 1959. Scattered groups of birds occurred in Unaweep Canyon (Rogers 1964, Bailey and Niedrach 1965). Sage-grouse also occurred along the Little Dolores River into Grand County, Utah (Rogers 1964, CEB, pers. obs.). The hunting season in Mesa County was closed in 1958 (Rogers 1964), but hunting was

known to occur (11 sage-grouse wings received from hunters in 1985) into the mid 1990s in Glade Park and on Pinon Mesa. Sage-grouse also occurred in the Dominguez Canyon area of the Uncompahgre Plateau as Anderson (1969) reported the population disappeared after the entire area had been sprayed with the herbicide 2, 4-D. No sage-grouse or signs of them were observed in this area during habitat surveys in 1999 (KMP, pers. obs.). Birds were present in eastern Mesa County south of the Colorado River in 1961 (Rogers 1964). Evidence (fresh droppings) of sage-grouse were reported (J. P. Beason, Rocky Mountain Bird Observatory, pers. comm.) near the community of Mesa during systematic surveys in suitable habitat during February, March, and April 2009 suggesting winter use of this area. Gunnison Sage-Grouse were radiomarked and studied in the Glade Park-Pinon Mesa area in 1995–1997 (Commons 1997).

Mineral County.—The only report of any sage-grouse in this county is that of J. D. Hart dated 1 July 1937 (in Rogers 1964:20). There is an area southeast of Creede towards South Fork that is dominated by sagebrush, which may be where sage-grouse were present in this county. It is peripherally linked to sagebrush habitats near Del Norte in Rio Grande County.

Montezuma County.—Sage-grouse were reported to be common in Montezuma County (Morrison 1888) and Sclater (1912) reported the presence of sage-grouse north and south of Cortez. Considerable numbers of birds occurred north of Narraquinep Reservoir, with a few southwest of Dolores near Ruins Canyon and the Utah line (Rogers 1964, Bailey and Niedrach 1965). Rogers (1964) reported that hunting of sage-grouse was closed in Montezuma County in 1960. A few birds were observed in 1961 east of Pleasant View, west of the Dolores River around Ruins Canyon, south of Cortez and west of U.S. Rte. 666 (present-day U.S. Rte. 491), and in the Sandstone, Hovenweep, Wood, and Yellowjacket Canyon areas (Rogers 1964). Sage-grouse persisted in this area into the mid 1990s and a hen was observed northwest of Cortez towards Hovenweep Canyon by Robin Olterman (Colorado Division of Wildlife, pers. comm.) in about 1996. This population was likely extirpated in the late 1990s.

Montrose County.—Sage-grouse were 'very common' winter residents of southwestern Montrose County (Warren 1909). Rogers (1964) reported sage-grouse occurred northwest of Norwood to near Nucla (airport). There were five

small leks with a few birds in the Cimarron drainage in the eastern part of the county (Rogers 1964, Bailey and Niedrach 1965). Sage-grouse also occurred in Bostwick Park (5 males counted on a lek in 1959), the area around Gould's Reservoir, and near the town of Maher (Rogers 1964). A few remained on Sims Mesa in April 1995 (CEB, pers. obs.) and near Colona into the mid to late 1990s. Dale Coven of the Colorado Division of Wildlife observed one male on Sims Mesa in spring 2000. This observation was followed by release of six birds at Sims Mesa in April 2000 that were captured in the Gunnison Basin. A few birds persisted on Cerro Summit with little change in numbers counted (2–5 males each year with counts) between 1959–1999.

Ouray County.—Sage-grouse were present in this county in 1961 (Rogers 1964). Sage-grouse were reported to be present in December 1989 (Ken Miller, Colorado Division of Wildlife, pers. comm.) 3 km north of Ridgway and towards Duckett Draw to Sims Mesa in Montrose County (1995–1997) into the mid to late 1990s. This population was extirpated in the late 1990s.

Pitkin County.—Rogers (1964) reported there were only 4 km² of sagebrush habitat in Pitkin County. Sage-grouse were counted on leks at Capitol Creek in 1960–1961 near Snowmass and were also known to occur west of the town of Carbondale in the Thompson Creek Drainage near the Garfield County line (Rogers 1964). This population was extirpated by the mid 1960s.

Saguache County.—Captain J. W. Gunnison reported grouse (species not identified) at two different locations during his travel in 1853 in the San Luis Valley north of Fort Massachusetts (Beckwith 1855). Sage-grouse were collected on Cochetopa Pass in 1858 by Captain Beckwith and Mr. Kreutzfeldt (Baird 1858). The 1855 Beckwith report describing Gunnison's travels commonly mentioned the presence of sagebrush throughout the area. This county has the second largest amount of sagebrush habitat in southwestern Colorado. Especially good habitat occurred along the Razor, Cochetopa, Gold Basin, Pole, Sugar, and Beaver Creek drainages (Rogers 1964, Bailey and Niedrach 1965).

A small population of Gunnison Sage-Grouse currently persists on the south side of Poncha Pass. Rogers (1964:116) stated the Poncha Pass area was not checked, but birds had not been reported in some time. Rogers further states the Poncha Pass area was the top choice of four

possible locations in Colorado for potential transplants of sage-grouse (1964:27). These comments likely precipitated the transplant of a group of 32 birds captured on Sapinaro Mesa in the Gunnison Basin in 1971 (17) and 1972 (15), and released (by the Colorado Department of Game, Fish and Parks and the Bureau of Land Management) near Round Hill (along San Luis Creek) on the south side of Poncha Pass. At least 20 sage-grouse were harvested in this area in September 1992 when the area was accidentally opened for hunting. Gunnison Sage-Grouse were observed, radiomarked, and studied in this area during part of 1990 through 2012 (CEB, JAN, pers. obs.). Gunnison Sage-Grouse were transplanted to Poncha Pass during spring 2000 (24), spring 2001 (20), and fall 2002 (7) from the Gunnison Basin.

San Miguel County.—Bent (1932:309) reported sage-grouse from Lone Cone southeast of Norwood in San Miguel County. Rogers (1964) reported that a few occurred in the southwestern corner of the county north of Dove Creek and west of Egnar. They also occurred south of Norwood near Basin Creek, Beaver Mesa, and south of Gurley Reservoir (Rogers 1964, Bailey and Niedrach 1965). Rogers (1964:24) noted that sage-grouse in the Gregor Flats area only had between 13–26 km² of habitat. Gunnison Sage-Grouse were studied in this area, as well as on Hamilton Mesa, and in Dry Creek Basin in the mid to late 1990s (Commons 1997).

DISCUSSION

Gunnison Sage-Grouse were patchily distributed, frequently in linear strips along riparian areas as well as in intermountain basins in Colorado in the early 1900s. These areas, based on observations by CEB in the post 1969 period, were dominated by species of *Artemisia* (*cana*, *nova*, *tridentata tridentata*, *t. vaseyana*), Gambel's oak (*Quercus gambelii*), serviceberry (*Amelanchier* spp.), and snowberry (*Symphoricarpos* spp.), as well as a large variety of native forbs and taller grasses. Gunnison Sage-Grouse used smaller (<4 km²) sagebrush-dominated openings in southwest Colorado that contained sagebrush as well as deciduous shrubs. Use of <5–6 km² patches of suitable habitat by radio-marked birds (Commons 1997) suggests more adaptability to heterogeneous sagebrush habitats than Greater Sage-Grouse (Connelly et al. 2011).

We view the former distribution of Gunnison Sage-Grouse in Colorado as a series of five metapopulations (a set of local populations that interact through individual movements among populations [Hanski and Gilpin 1991]) based on likely linkages among habitat patches. For example, the Colorado River metapopulation was linked to the west with the Uncompahgre Plateau metapopulation, which was linked with the Gunnison Basin metapopulation to the east and the Colorado Plateau metapopulation to the south. The San Luis Valley metapopulation was more isolated but was linked with the Gunnison Basin to the northwest (Table 2). Sagebrush-dominated corridors among these metapopulations continue to exist although they are now fragmented.

Linkages among populations of Gunnison Sage-Grouse in the mid-1990s were examined using genetic methods (Oyler-McCance et al. 2005). Of the eight subpopulations recognized by Colorado Parks and Wildlife (Oyler-McCance et al. 2005:fig. 1), seven were included in the genetic analysis. The Poncha Pass subpopulation was not included because at that time, it was the only subpopulation that had been augmented by translocations from other areas. Oyler-McCance et al. (2005) found a high degree of genetic structure and low amounts of gene flow across most subpopulations of Gunnison Sage-Grouse (the only exception being between the geographically adjacent Gunnison and Curecanti subpopulations in the Gunnison Basin). The Dove Creek/Monticello (San Juan County, Utah) and Pinon Mesa subpopulations were the most different and had the lowest levels of genetic diversity. Oyler-McCance et al. (2005) also found that the San Miguel subpopulation may act as a conduit of gene flow surrounding the larger subpopulation in the Gunnison Basin. Gunnison Sage-Grouse from Cerro/Cimarron/Sims were more closely aligned with the San Miguel subpopulation than the Gunnison or Curecanti subpopulations. The Crawford (Fruitland Mesa) subpopulation was also significantly different from surrounding populations suggesting low levels of gene flow (Oyler-McCance et al. 2005). Such patterns of genetic structure within Gunnison Sage-Grouse will change as augmentation efforts now involve moving birds from the Gunnison Basin subpopulation to maintain the other subpopulations.

The Colorado River and its tributary, the Eagle River appear to be the northern boundary of the

TABLE 2. Possible metapopulations of Gunnison Sage-Grouse in Colorado.

Metapopulation	Counties
Colorado River Gunnison Basin	S Eagle, Pitkin, S Garfield, E Mesa Gunnison, NW Saguache, Hinsdale, Delta, Montrose
Uncompahgre Plateau	Ouray, Montrose, SW Mesa, San Miguel
Colorado Plateau	Dolores, Montezuma, LaPlata, Archuleta
San Luis Valley	NE Saguache, Alamosa, Conejos, Costilla, Rio Grande

Gunnison sage-grouse historical distribution in Colorado. Greater Sage-Grouse are known to occur immediately north of the Colorado-Eagle River system in Mesa, Garfield, and Eagle counties. Sage-grouse in these counties, as with all counties in northwestern and northcentral Colorado, were studied during the 1973–1999 interval. All were Greater Sage-Grouse (CEB, pers. obs., Hupp and Braun 1991, Oyler-McCance et al. 1999). We found no museum specimens of Greater Sage-Grouse from the area south of the Colorado-Eagle River boundary and no specimens of Gunnison Sage-Grouse from north of this boundary.

Armstrong (1972) studied ecogeographic distributions of fauna in Colorado and (page 337) reported the Colorado River and its canyons form important physical barriers and that the Grand River Valley was an important barrier. He concluded it was not only the presence of a large river system but also the diversity of the vegetation on the floor and sides of the valley that affected faunal populations north and south of the river system. It is difficult to perceive the present upper Grand Valley along the Colorado River drainage in Mesa, Garfield, and Eagle counties as a barrier to north-south movement by sage-grouse. However, we have limited knowledge of historic habitat conditions when and where the two sage-grouse species evolved.

Specimen records were found from Dolores, Gunnison, Mesa, Saguache, and San Miguel counties in Colorado. Only one of multiple sage-grouse specimens collected in the 1870s in Lake County near Twin Lakes (Henshaw 1875) was located (U.S. National Museum). A piece of toepad was obtained from this specimen and tested for species identification (by SJO-M) by comparing its mitochondrial haplotypes with those

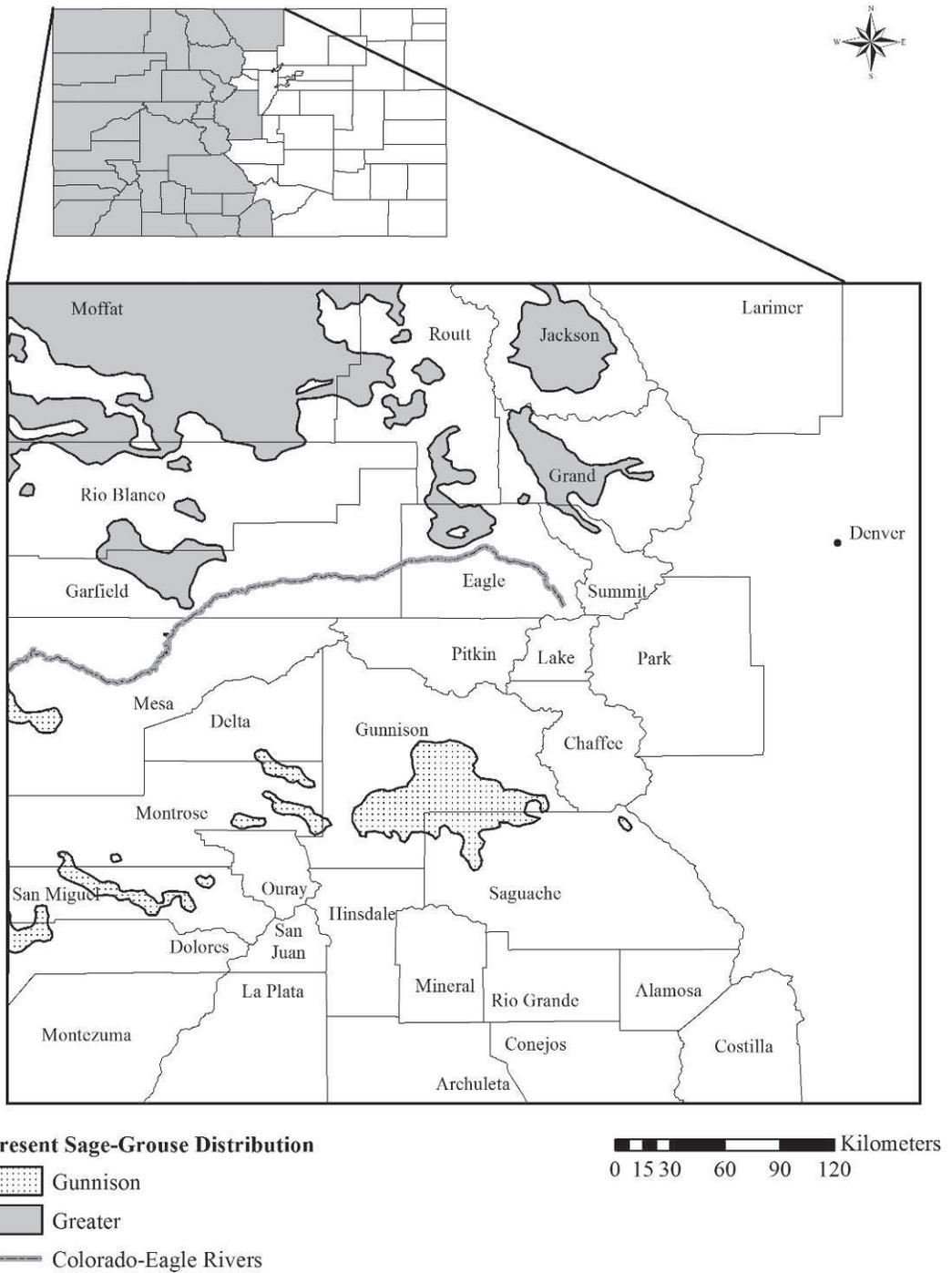


FIG. 2. Present distribution of Gunnison Sage-Grouse and Greater Sage-Grouse in Colorado (modified from Braun 1995).

published previously for both species (Oyler-McCance et al. 1999). The mitochondrial DNA haplotype from this specimen was consistent with Greater Sage-Grouse rather than Gunnison Sage-Grouse. Lake County is adjacent (north) of Chaffee County and immediately south of Summit County where Greater Sage-Grouse are known to exist. Field surveys in Park County, immediately east of Lake and Chaffee counties, where the earliest fossil sage-grouse was reported (Emslie 2004), failed to locate contemporary sagebrush communities capable of supporting sage-grouse.

The historical distribution of Gunnison Sage-Grouse included at least 20 counties (based on Braun 1995). At present, this species persists in only eight counties (Table 1, Fig. 2) in Colorado, five of which, Montrose (Cimarron), Dolores (Dove Creek), Mesa (Pinon Mesa/Glade Park), Saguache (Poncha Pass), and San Miguel (Miramonte/Dry Creek Basin) are being sustained by augmentations from the subpopulation in the Gunnison Basin. Half of the county extirpations occurred prior to or around 1945 (Alamosa, Chaffee, Conejos, Costilla, Mineral, and Rio Grande). Others occurred in the 1960s (Archuleta, Pitkin) and 1996–1998 (Eagle, Garfield, Montezuma, and Ouray) (Table 1).

The possibilities for restoration of extirpated populations or the augmentation of those presently with small populations are problematic as most historically occupied areas are no longer suitable because of habitat degradation, fragmentation, and permanent loss from agricultural activities, gas and oil development, and expansion of homes and ranchettes. The Gunnison Basin could have the greatest restoration potential given the large amount of habitat still available. The Cimarron area also has potential for increasing population size through habitat management. Areas outside of the Gunnison Basin that may be options for restoration of Gunnison Sage-Grouse, based on public land ownership and current areas with larger patches of sagebrush, are those in Dolores, Montezuma, San Miguel, Montrose, and Delta counties. Other suitable reintroduction sites might include the area east and south of Fort Garland as sagebrush habitats extend into New Mexico. CEB reviewed adjacent sagebrush-dominated areas in New Mexico in the 1970s and again in the mid 2000s and noted the lack of suitable brood habitat as well as degraded nesting habitats. Similar conditions occur in Costilla County, Colorado and any restoration attempts would need to focus on

improving native understory species in nesting areas with live sagebrush, brood habitat, as well as potential winter-use areas (Connelly et al. 2011).

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LITERATURE CITED

- ANDERSON, A. E. 1969. 2, 4-D, sagebrush, and mule deer-cattle use of upper winter range. Colorado Division of Game, Fish and Parks Special Report. Number 21.
- ARMSTRONG, D. M. 1972. Distribution of mammals in Colorado. Museum of Natural History Monograph. Number 3. University of Kansas, Lawrence, USA.
- BAILEY, A. M. AND R. J. NIEDRACH. 1965. Birds of Colorado. Volume 1. Denver Museum of Natural History, Denver, Colorado, USA.
- BAIRD, S. F. 1858. Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean. Volume IX, Beverly Tucker, Printer. Washington, D.C., USA.
- BECKWITH, E. G. 1855. Report upon the route near the Thirty-Eight and Thirty-Ninth Parallels explored by Captain J. W. Gunnison. Chapters III and IV. Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean, made under the direction of the Secretary of War, in 1853–1854. Volume II. U.S. Government Printing Office, Washington, D.C., USA.
- BENT, A. C. 1932. Life histories of North American gallinaceous birds. Orders Galliformes and Columbigallinae. U.S. National Museum Bulletin 162.
- BERGTOLD, W. H. 1928. A guide to Colorado birds. Smith-Brooks Printing Co., Denver, Colorado, USA.
- BRAUN, C. E. 1995. Distribution and status of sage grouse in Colorado. *Prairie Naturalist* 27:1–9.
- COMMONS, M. L. 1997. Movement and habitat use by Gunnison Sage Grouse in southwestern Colorado. Thesis. University of Manitoba, Winnipeg, Canada.
- COMMONS, M. L., R. K. BAYDACK, AND C. E. BRAUN. 1999. Sage grouse response to pinyon-juniper management. Pages 238–239 in *Proceedings: ecology and management of pinyon-juniper communities within the Interior West* (S. B. Monsen and R. Stevens,

- Compilers). USDA, Forest Service, RMRS-P-9. Rocky Mountain Research Station, Ogden, Utah, USA.
- CONNELLY, J. W., E. T. RINKES, AND C. E. BRAUN. 2011. Characteristics of Greater Sage-Grouse habitats: a landscape species at micro- and macroscales. Pages 69–83 in *Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats* (S. T. Knick and J. W. Connelly, Editors). *Studies in Avian Biology*. Volume 38.
- COOKE, W. W. 1897. *The birds of Colorado*. State Agricultural College, Agricultural Experiment Station Bulletin 37, Technical Series 2. Smith-Brooks Printing Co., Denver, Colorado, USA.
- COUES, E. 1898. *The journal of Jacob Fowler*. Francis P. Harper, New York, USA.
- EMSLIE, S. D. 2004. The early and middle Pleistocene avifauna from Porcupine Cave, Colorado. Early and middle Pleistocene biodiversity and environmental change: the Porcupine Cave fauna from Colorado (A. D. Barnowsky, Editor). University of California Press, Berkeley, USA.
- GUNNISON SAGE-GROUSE RANGEWIDE STEERING COMMITTEE. 2005. Gunnison Sage-Grouse rangewide conservation plan. Colorado Division of Wildlife, Denver, USA.
- HANSKI, I. AND M. GILPIN. 1991. Metapopulation dynamics: brief history and conceptual domain. *Biological Journal of the Linnean Society* 42:3–16.
- HENSHAW, H. W. 1875. Report on ornithological collections made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the years 1871, 1872, 1873, and 1874. In *Report upon geographical and geological explorations and surveys west of the one hundredth meridian* (First Lieut. George M. Wheeler, Corps of Engineers, in charge). 6 Volumes. Government Printing Office, Washington, D.C., USA.
- HUPP, J. W. 1987. Sage grouse resource exploitation and endogenous reserves in Colorado. Dissertation. Colorado State University, Fort Collins, USA.
- HUPP, J. W. AND C. E. BRAUN. 1989. Topographic distribution of sage grouse foraging in winter. *Journal of Wildlife Management* 53:823–829.
- HUPP, J. W. AND C. E. BRAUN. 1991. Geographic variation among sage grouse in Colorado. *Wilson Bulletin* 103:255–261.
- MORRISON, C. F. 1888. A list of the birds of La Plata County, Colorado. *Ornithologist and Oologist* 13:70–75, 107–108, 115–116, 139–140, 145–148, 165–168, 181–183.
- OYLER-MCCANCE, S. J. 1999. Genetic and habitat factors underlying conservation strategies for Gunnison Sage Grouse. Dissertation. Colorado State University, Fort Collins, USA.
- OYLER-MCCANCE, S. J., N. W. KAHN, K. P. BURNHAM, C. E. BRAUN, AND T. W. QUINN. 1999. A population genetic comparison of large- and small-bodied Sage Grouse in Colorado using microsatellite and mitochondrial DNA markers. *Molecular Ecology* 8:1457–1465.
- OYLER-MCCANCE, S. J., K. P. BURNHAM, AND C. E. BRAUN. 2001. Influence of changes in sagebrush on Gunnison Sage Grouse in southwestern Colorado. *Southwestern Naturalist* 46:323–331.
- OYLER-MCCANCE, S. J., J. ST. JOHN, S. E. TAYLOR, A. D. APA, AND T. W. QUINN. 2005. Population genetics of Gunnison Sage-Grouse: implications for management. *Journal of Wildlife Management* 69:630–637.
- ROCKWELL, R. R. 1908. An annotated list of the birds of Mesa County, Colorado. *Condor* 10:152–180.
- ROGERS, G. E. 1964. Sage Grouse investigations in Colorado. Colorado Game, Fish and Parks Department Technical Publication. Number 16.
- SCHROEDER, M. A., C. L. ALDRIDGE, A. D. APA, J. R. BOHNE, C. E. BRAUN, S. D. BUNNELL, J. W. CONNELLY, P. A. DEIBERT, S. C. GARDNER, M. A. HILLIARD, G. D. KOBRIGER, S. M. MCADAM, C. W. MCCARTHY, J. J. MCCARTHY, D. L. MITCHELL, E. V. RICKERSON, AND S. J. STIVER. 2004. Distribution of sage-grouse in North America. *Condor* 106:363–376.
- SCLATER, W. L. 1912. *A history of the birds of Colorado*. Witherby and Co., London, UK.
- U.S. DEPARTMENT OF INTERIOR (USDI). 2013. Endangered and threatened wildlife and plants; endangered status for Gunnison Sage-Grouse. U.S. Department of the Interior, Fish and Wildlife Service. *Federal Register* 78:2485–2538.
- WARREN, E. R. 1909. Notes on the birds of southwestern Montrose County, Colorado. *Condor* 11:11–17.
- WARREN, E. R. 1916. Notes on the birds of the Elk Mountain region, Gunnison County, Colorado. *Auk* 33:292–317.
- YOUNG, J. R. 1994. The influence of sexual selection on phenotypic and genetic divergence of Sage Grouse. Dissertation. Purdue University, West Lafayette, Indiana, USA.
- YOUNG, J. R., J. W. HUPP, J. W. BRADBURY, AND C. E. BRAUN. 1994. Phenotypic divergence of secondary sexual traits among Sage Grouse, *Centrocercus urophasianus*, populations. *Animal Behavior* 47:1353–1362.
- YOUNG, J. R., C. E. BRAUN, S. J. OYLER-MCCANCE, J. W. HUPP, AND T. W. QUINN. 2000. A new species of Sage Grouse (Phasianidae: *Centrocercus*) from southwestern Colorado. *Wilson Bulletin* 112:445–453.