Jackson Hole Pronghorn Study

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By

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OVERVIEW

Pronghorn antelope (*Antilocapra americana*) are an important large mammal in the Jackson Hole Valley (JHV), Grand Teton National Park (GNTP) and the Gros Ventre River Drainage (GVRD). Pronghorn complete the bio-diversity of ungulates in GTNP and allow millions of people to encounter, enjoy and study the species. Unfortunately, this small population (~300 animals) is one of the more vulnerable components of northwestern Wyoming's native fauna and must leave the relatively secured habitats of GTNP and complete the longest pronghorn migration in North America to winter in southwestern Wyoming. The 100-170 mile (160-274 km) migration route and the winter ranges they depend upon were largely undocumented prior to this study.

Extensive natural gas development in southwestern Wyoming, proposed gas exploration in the Bridger Teton National Forest (BTNF), and subdivision development on private lands may threaten pronghorn winter ranges and migration routes in the Green River Basin. The objective of this study was to provide the information necessary to develop a conservation strategy for pronghorn that summer in GTNP and the GVRD.

BACKGROUND

Harper (1985) reviewed historical records and conducted interviews in the first attempt to consolidate existing information on the Jackson Hole pronghorn population. A decade later, Segerstrom (1997) compiled a review on the history and status of the Jackson Hole pronghorn. According to Harper (1985), a small population (100-150 animals) of pronghorn summered in the Jackson Hole area during the late 1800's. By the turn of the century unrestricted hunting had nearly extirpated pronghorn from the JHV and the GVRD. An estimated 55,000 pronghorn hides were shipped down the Yellowstone River in 1881 alone (Creek 1967, Greenquist 1983). Although the first Wyoming hunting season was established in 1875, enforcement was nonexistent and market hunting continued to the turn of the century (Creek 1967). It is believed hunting pressure on pronghorn increased after the last wild bison were killed in 1889 (Cadieux 1986). Hunting seasons were finally closed in 1909 and did not resume until 1927, and then only on a limited basis in 1 area. Between 1906 and the early 1950's pronghorn were observed only occasionally in the Jackson Hole Valley and it was assumed no viable population existed, despite growing populations across other portions of the state. The WGFD made several attempts to transplant pronghorn into the Jackson Hole area (WGFD 1954, Negus and Findley 1959), but the results of those efforts are unknown. Low numbers on the west side of the Green River prompted WGFD officials to transplant 69 pronghorn into portions of Lincoln and Uinta counties during the winter of 1941 because the Green River was believed to be a natural barrier (Creek 1967).

Enforcement of game laws likely allowed pronghorn numbers to recover and steadily increase through the 1960's and 70's. By 1980 the WGFD had established the first legal hunting season for hunt area (HA) 85 in the GVRD. This season included

30 any-antelope tags and ran from mid-October through mid-November. The WGFD continues to allow a harvest of 20-30 pronghorn each fall, with current seasons typically running from mid-September through October. This season structure is designed to provide hunting opportunity and harvest animals from both the GVRD and GTNP population segments (D. Brimeyer, pers. commun., WGFD, 1999). The WGFD also conducts annual pronghorn classifications in GTNP and the GVRD to estimate numbers, sex/age composition, and monitor population trends. The numbers of pronghorn observed in these classification surveys represent a minimum population estimate and fluctuates from 150 to 400. These data indicate the pronghorn population has remained stationary (200-300 animals) or slightly increased since the early 1980's.

Pronghorn occasionally attempt to winter on the WGFD's upper Green River elk feedground (D. McWhirter, pers. commun. WGFD, 1999). Harper (1985) made no mention of historical records or accounts of pronghorn wintering in the JHV, GTNP, or the GVRD. However, during the 1990's Segerstrom (1997) documented several attempts by small pronghorn groups to overwinter in the JHV, most often on the NER. Overwinter survival rates have generally been low, except during the mildest of winters. Pronghorn attempted to winter in the JHV every winter beginning in 1992-93, until all perished during the 1997-98 winter. Pronghorn made no attempts to overwinter in the JHV, GTNP, GVRD, or upper Green River since 1998. It is unclear why some pronghorn decide to migrate out of the JHV and others choose to stay for the winter, but over time the selection process appears to favor those that migrate.

Migration is an adaptive behavioral strategy that allows animals to avoid resource bottlenecks in temperate regions (Baker 1978) and find greater food resources prior to breeding (Sinclair 1983). Migrations between summer and winter ranges often follow traditional routes that are learned and passed on from mother to young (McCullough 1985). In the case of the GNTP pronghorn it is possible the need to migrate an extremely long distance through difficult terrain has produced a separate population relative to other pronghorn in Wyoming. Anecdotal evidence suggests GTNP pronghorn give birth and mate at least 2 weeks late, which could result in genetic isolation and preclude reproductive success of pronghorn not native to GTNP (Segerstrom 1997). Additionally, fawn:doe ratios in GTNP are generally much lower than other areas, suggesting either: 1) many GTNP females are barren or, 2) fawn mortality in GTNP is unusually high. Identifying annual movements and distribution patterns of radio-collared pronghorn should provide insight on factors that may influence migration and reproductive success.

OBJECTIVES

The objectives of this study were intended to provide the necessary information to develop a conservation strategy for pronghorn that summer in GTNP and the GVRD.

1) Identify the specific travel route(s) used by pronghorn during spring and fall migrations.

2) Identify potential bottlenecks or barriers that may threaten migration routes.

3) Determine the extent of the winter range(s) used by the Jackson Hole population and fidelity to winter range(s).

4) Determine extent of fidelity of pronghorn to GTNP and GVRD summer range(s).

5) Determine affect of spring weather conditions and snowpack on spring migration patterns.

6) Estimate survival rates of radio-collared pronghorn.

STUDY AREA

The study area was defined by pronghorn distribution in GTNP and the GVRD (Fig.1). This included Baseline Flats, the Potholes, south Antelope Flats, and the Kelly hay meadows in GTNP. Small groups of pronghorn were occasionally found outside GTNP in the Uhl Hill and NER areas. Gentle slopes and large homogenous stands of sagebrush (*Artemisia sp*.) between 6,600-7,000 feet (2,011-2,133 m) characterized most pronghorn habitat in GNTP. Pronghorn often shared these sagebrush habitats with elk (*Cervus elaphus*), bison (*Bison bison*), and a variety of potential predators including coyotes (*Canis latrans*), wolves (*Canis lupus*), red fox (*Vulpes fulva*), and Golden eagles (*Aquila chrysaetos*).

Compared to GTNP, pronghorn habitat in the GVRD was more steep, rugged, and at higher elevation. Most pronghorn occupied areas on the north side of the GVRD, between Upper Slide Lake and Bacon Ridge. The south facing sagebrush slopes of the upper GVRD ranged from 7,200-8,800 feet (2,194-2,682 m). Although pronghorn in the GVRD were usually found in or near sagebrush habitats, they also utilized areas of secondary succession in burns and mesic mountain meadows that may exceed 9,100 feet (2,774 m). Refer to Loope (1971), Sabinske and Knight (1978), Mattson and Despain (1985), Love and Love (1988), Schroeder and Allen (1992), Whitlock (1993), and/or Doyle et al. (1998) for detailed descriptions of the vegetation, climate, and geology of GTNP and the GVRD.

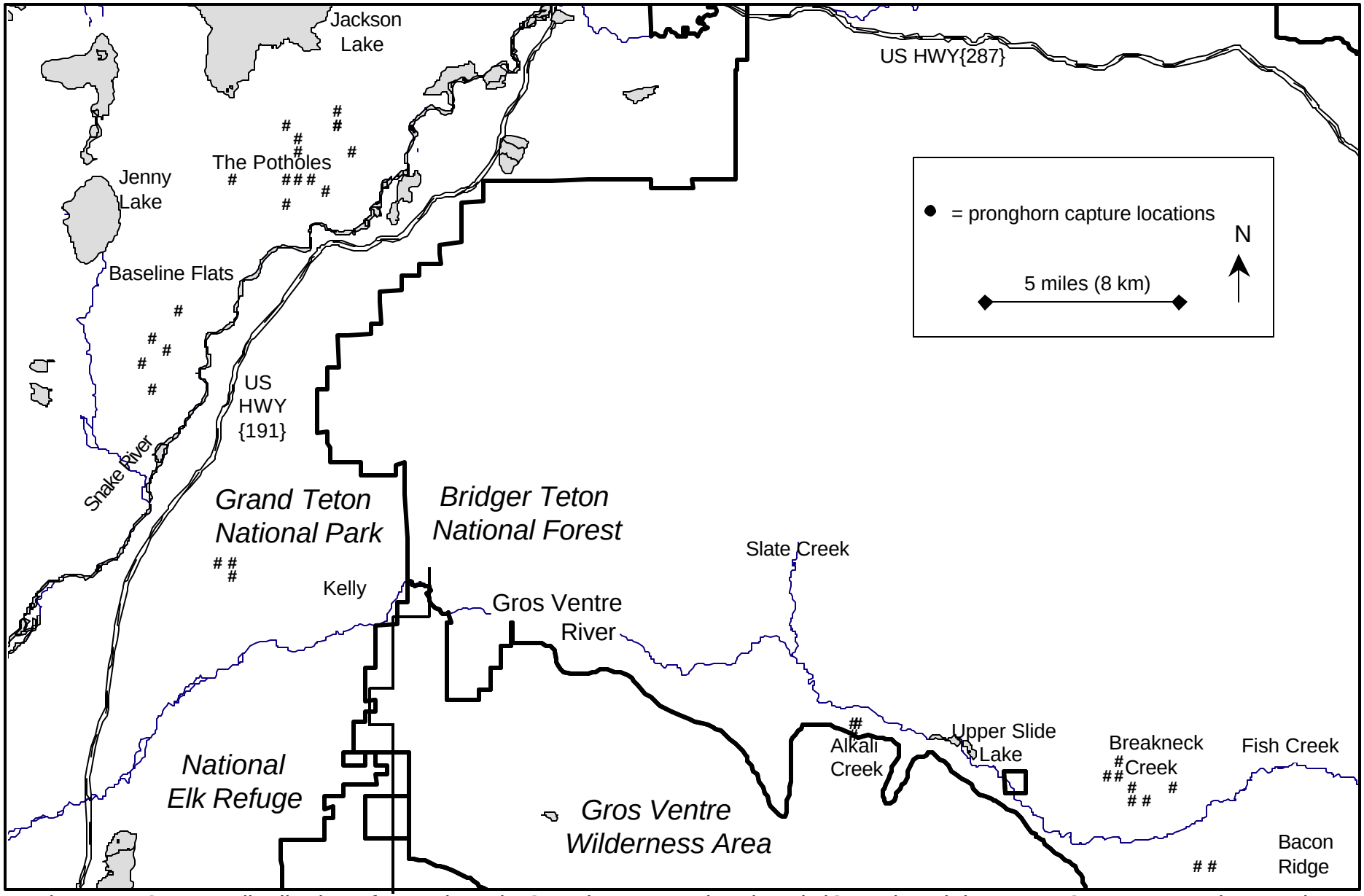

Figure 1. Capture distribution of pronghorn in Grand Teton National Park (GTNP) and the upper Gros Ventre River Drainage (GVRD), July 1998.

METHODS

Helicopter net-gunning techniques were used to capture and radio-collar adult female pronghorn. Radio-collars were manufactured by Advanced Telemetry Systems (ATS) and consisted of lightweight (<200 grams) packages with black transmitters and maroon colored webbing. All radio-collars were equipped with mortality sensors and transmitted at 150 Mhz. Pronghorn were hobbled and blindfolded to facilitate the handling process and minimize injuries. Serum samples were collected for brucellosis testing and the reproductive status (lactating/non-lactacting) was determined for each pronghorn. Capture work was restricted to early morning hours (0600-1000 hrs) to avoid running pronghorn in hot (>75^{o}F , 24^{o}C) conditions. A pre-capture survey flight was conducted to determine numbers and distribution of pronghorn in GTNP and the GVRD.

Radio-collared pronghorn were occasionally monitored from August through September, 1998 by TSS. When the fall migration began in early to mid-October, pronghorn were located from the air once a week through November. Telemetry flights were reduced to once a month during the winter. Pronghorn were located from the ground and air during the spring migration to obtain as many locations as possible. Winter and summer fidelity was examined by comparing locations of individual pronghorn among consecutive years. Pronghorn were considered to exhibit site fidelity when seasonal ranges were $\leq$ 5 miles (8 km) apart in consecutive years. Annual (June 1- May 31) adult survival rates were estimated using telemetry records (Kaplan and Meier 1985). Observational data were used in conjunction with telemetry data to determine pronghorn arrival and departure from GTNP.

Movement data and distribution maps were analyzed and generated using ARCVIEW (vers.3.2) software. Digital base maps (vegetation, hydrography, land status, road networks, etc.) were obtained from the University of Wyoming's Spatial Data and Visualization Center (1999).

RESULTS

Capture:

Thirty-four adult female and 1 yearling female pronghorn were radio-collared on July 20 and 21, 1998 (Table 1). The capture sample reflected the proportionate distribution of pronghorn across the study area, with approximately 2/3 of the radio-collars distributed in GTNP and the other 1/3 in the GVRD. Capture efforts in GTNP concentrated west of the Snake River, in the Baseline Flats and Potholes region, where 20 pronghorn were radio-collared. Another 3 were captured east of the Snake River in the Kelly hay meadows near Blacktail Butte. No pronghorn were captured on the NER, Antelope Flats, or Uhl Hill area because none were observed during the pre-capture survey flight. With the exception of Alkali Creek, capture efforts along the GVRD focused on the north side of the river, from Upper Slide Lake upstream to Bacon Ridge, where 12 radio-collars were distributed.

Table 1. Capture location, date, frequency, and lactation status of 35 pronghorn captured in Grand Teton National Park (GNTP) and the Gros Ventre River Drainage (GVRD) during July, 1998.

Capture Location	Capture Date	Frequency	Lactation Status [b]
GTNP/Baseline Flats	7-20-98	150.442	NL
GTNP/Baseline Flats	7-20-98	150.473	NL
GTNP/Baseline Flats	7-20-98	150.553	NL
GTNP/Baseline Flats	7-20-98	150.653	NL
GTNP/Baseline Flats	7-20-98	150.683 [a]	NL
GTNP/Baseline Flats	7-20-98	150.695	L
GTNP/ Baseline Flats	7-20-98	150.773 [a]	L
GTNP/Baseline Flats	7-20-98	150.844	L
GTNP/Potholes	7-20-98	150.423	NL
GTNP/Potholes	7-20-98	150.482	NL
GTNP/Potholes	7-20-98	150.493	NL
GTNP/Potholes	7-20-98	150.503	NL
GTNP/Potholes	7-20-98	150.543	NL
GTNP/Potholes	7-20-98	150.603	NL
GTNP/Potholes	7-20-98	150.623	NL
GTNP/Potholes	7-20-98	150.633	NL
GTNP/Potholes	7-20-98	150.753	NL
GTNP/Potholes	7-20-98	150.763	NL
GTNP/Potholes	7-20-98	150.823	L
GTNP/Potholes	7-20-98	150.883	NL
GTNP/Blacktail Butte	7-20-98	150.523	L
GTNP/Blacktail Butte	7-20-98	150.533	L
GTNP/Blacktail Butte	7-20-98	150.893	NL (yearling)
GVRD/Alkali Creek	7-21-98	150.563	NL
GVRD/Alkali Creek	7-21-98	150.713	NL
GVRD/Alkali Creek	7-21-98	150.902	L
GVRD/Dry Cottonwood	7-21-98	150.403	L
GVRD/Dry Cottonwood	7-21-98	150.743	L
GVRD/Dry Cottonwood	7-21-98	150.857	L
GVRD/Breakneck Creek	7-21-98	150.413	L
GVRD/Breakneck Creek	7-21-98	150.463	NL
GVRD/Breakneck Creek	7-21-98	150.662	L
GVRD/Breakneck Creek	7-21-98	150.783	L
GVRD/Bacon Ridge	7-21-98	150.433	L
GVRD/Bacon Ridge	7-21-98	150.723	L

[a] capture-related mortality
[b] NL= non-lactating, L= lactating at time of capture

Serology: Serologic tests conducted by the Wyoming State Veterinary Lab indicated no pronghorn had been exposed to brucellosis (*Brucella abortus*).

Lactation Status: Only 26% (n=6) of the pronghorn captured in GTNP were lactating, compared to 75% (n=12) in the GVRD (Table 1).

Movement and Distribution Data:

Seasonal ranges and migration routes were identified using 918 aerial locations obtained from 33 radio-collared pronghorn. Fieldwork conducted during spring migrations resulted in additional observations of collared and non-collared pronghorn moving between The Mesa and Bacon Creek. Continuous observation of migrating radio-collared pronghorn was often possible and helped determine specific migration routes.

Fall 1998 Migration:

Observations made by the TSS indicated pronghorn distributions in GTNP shifted slightly around September 1, as several groups moved from the west to east side of the Snake River, near Blacktail Butte, Ditch Creek, and Antelope Flats. These movements may have been in response to the breeding season rather than migratory behavior, but nonetheless they moved closer to the GVRD and the starting point of their 100+ mile (161 km) fall migration.

Pronghorn began to move easterly through the GVRD towards Bacon Ridge and the upper Green River in early to mid-October. Despite mild weather conditions, 7 of 21 radio-collared pronghorn had left GTNP by October 13. Many of the GTNP pronghorn were found along the Antelope Flats Road, near Ditch Creek, and most pronghorn in the GVRD occupied the extreme north end of Bacon Ridge, between Bacon Creek and the Gros Ventre River (near Poison Creek). Both areas appeared to be transition or staging areas where pronghorn congregated, sometimes for several days, before continuing the migration. The 30-mile (48 km) movement from Kelly to Bacon Ridge/Poison Creek appeared to be a quick (1-2 days) movement unrelated to snowpack and restricted almost exclusively to the north side of the GVRD. Pronghorn movements along the south side of the river appeared restricted to areas from Crystal Creek to Upper Slide Lake and Goosewing Creek to Soda Lake.

Distribution patterns shifted slightly by October 17th, when more of the GTNP pronghorn concentrated along Ditch Creek and the Kelly hay meadows, while the GVRD pronghorn congregated in a herd of 70-90 animals near Alkali Gulch (not Alkali Creek); a south-facing slope adjacent to Bacon Creek. Almost one-third of the radio-collars were spread out from the upper Green River, near Wagonfeur Creek, to the Jonah Oil Field northwest of Farson, Wyoming. While nearly half the pronghorn had traveled 100+ miles (161 km) and reached winter ranges by October 26, 7 remained in GTNP and 11 in the GVRD. Most radio-collared pronghorn in the GVRD were members of a herd of about 50 animals spread along Poison Creek, on the northwest end of Bacon Ridge.

Harper (1985) and Segerstrom (1997) assumed pronghorn moving from the Poison Creek/Alkali Gulch area to the hydrographic divide separating the Gros Ventre and Green River watersheds, migrated through the 8-10-mile (13-16 km) stretch southeasterly along Bacon Ridge and either dropped off to the south into Kinky/Tepee Creeks or easterly across the north end of Mosquito Lake to Wagon Creek and descended to the Green River. However, we located no radio-collared pronghorn on or south of Bacon Ridge between Sunday Peak and the Green River, including Tepee Creek and Kinky Creek. Locations and observations of radio-collared pronghorn during the spring migration documented a slightly different route that followed the slope on the north side of Bacon Creek to the hydrographic divide at 9,100 feet (2,774 m) (see Spring Migration).

Although 8 pronghorn remained in GTNP (n=4) and the GVRD (n=4) on November 5, all had reached the Green River Basin by November 11. Pronghorn appeared to move directly from the upper Green River to the Cora Butte and the Mesa country (35-50 miles, 56-80 km) rather quickly, as few locations were collected between the BTNF boundary and Cora Butte. The precise migration route taken was unclear, but pronghorn presumably moved south between U.S. Highway {191} and WY Highway {352} (the Cora Road). The fall migration was complete by mid-November and while it took 4-5 weeks for all radio-collared pronghorn to reach their respective winter ranges, most animals likely made the 100+ mile (161 km) trip in 7-10 days.

Fall 1999 Migration:

Pronghorn used the same migration routes and staging areas in 1999 as they did in 1998. However, the timing of these movements was much different between years (Table 2). Generally pronghorn movements were 2 to 4 weeks later in 1999. Despite several mild snowstorms, radio-collared pronghorn remained in GTNP well into December 1999; while all had left by November 11, 1998.

Table 2. Timeline of fall migration and observations of pronghorn in GTNP and the GVRD, 1998-1999.

Fall 1998	
October 13:	About ¼ of the radio-collared GTNP and GVRD pronghorn had started to migrate, with 2 already on winter range.
October 17:	Mild weather, 14 radio-collared pronghorn remained in GTNP and 8 in the GVRD.
October 21:	Radio-collared pronghorn continued to migrate, 8 remained in GTNP.
October 26:	7 radio-collared pronghorn remained in GTNP.
November 5:	4 radio-collared pronghorn remained in GTNP.
November 11:	All radio-collared pronghorn were located on winter ranges in the Green River Basin.
December 8:	Doug Brimeyer (WGFD) observed 2 small bucks near Alkali Creek in the GVRD.
December 26:	Mac and Cathy McFarland observed a lone young buck at the GVR junction in GTNP.
January 31, 1999:	Bill Long (WGFD) observed lone buck near the fish hatchery on the NER.
Fall 1999	
September 12:	Substantial movements of pronghorn on Green River, but no radio-collared GTNP or GVRD pronghorn had migrated.
October 6:	No radio-collared GTNP or GVRD pronghorn had migrated.
October 20:	Only 1 radio-collared pronghorn from GTNP or GVRD had migrated to Green River side of hydrographic divide.
November 6:	Approximately half of the radio-collared GTNP and GVRD pronghorn had migrated……8 remained in GTNP and 8 in GVRD.
November 7:	Doug Brimeyer (WGFD) observed 62 pronghorn on Fish Creek Feedground in GVRD.
November 17:	One pronghorn (#150.783), which had migrated earlier in the month, returned to GTNP from the upper Green……9 radio-collars remained in GTNP and 5 in the GVRD.
November 23:	Doug McWhirter (WGFD) and Hall Sawyer (UW) observed 30-40 pronghorn running along the upper Green at the BTNF boundary.
December 4:	All radio-collared pronghorn had migrated from the GVRD, but 3 remained in GTNP.
December 4:	Lloyd Dorsey (WWF) observed 44 pronghorn near Kelly.
December 5:	Doug Wacob (TSS) observed 52 pronghorn near Kelly.
December 9:	Mike Sawyer (TSS) observed 48 pronghorn near Kelly.
December 23:	Employees of Bruce Smith (NER) observed 15 pronghorn south of Flat Creek.
January 14, 2000:	All radio-collared pronghorn were located on winter ranges in the Green River Basin. No other reports of pronghorn in the JHV.

Winter Range Distribution and Designation:

An estimated 1,500-2,000 pronghorn, including ~85% (n=27) of the radio-collars, wintered along the southern end of the Mesa and the Sand Springs Draw area, adjacent to the New Fork River (Fig.2). Much of this winter range is designated as crucial winter range by the WGFD and is included in the Pinedale Anticline Oil and Gas Project Area (USDI-BLM 2000). Several pronghorn drifted between the New Fork winter range and the Yellow Point Ridge/Sand Draw country in the Jonah Field. Few pronghorn (15%, n=5) spent the majority of winter south of the New Fork winter range and WY Highway {351} (Fig.3). Three of these shifted between the Jonah Field and the Big Sandy River, while 2 remained in the Fourmile Gulch area near Seedskadee, approximately 150 miles (241 km) from their summer range. All radio-collared pronghorn remained east of the Green River and west of U.S. Highway {191}.

Radio-collared pronghorn were usually distributed among 15-20 distinct herds that totaled about 2,000 animals. Winter (November-April) distribution of GTNP and GVRD pronghorn was similar and mixing of groups common. There were no reports of pronghorn attempting to over-winter in the JHV, GTNP, GVRD, or upper Green River during the course of the study.

Winter Range Fidelity:

Fidelity to winter range was examined for 28 radio-collared pronghorn. Most (86 %, n=24) pronghorn demonstrated a high fidelity to winter ranges, occupying consecutive wintering areas ≤ 3-5 miles (5-8 km) apart. Periodic southerly movements of 10-20 miles were made by 8 of the 24, but only for brief time periods. It is generally believed that this pronghorn population moves further south as winter severity increases. The 4 (14%) pronghorn that did not use the same winter ranges during consecutive years appeared to be very mobile and never remained in one area for long. It was not uncommon for these pronghorn to move 20-40 miles (32-64 km) at any given time during the winter.

Spring 1999 Migration (Figs. 4,5):

> "Early in the spring of 1890, a party consisting of two trappers and three prospectors, besides myself, were going up the western side of the Green River, in Wyoming, as rapidly as the melting snow would allow. The wild animals were going up the river valley at the same time. Large bands of Antelope travelled parallel with us, and being unmolested (as for a number of days not a shot was fired), they would dash by within a hundred yards of us."
>
> ---excerpt from *Lives of Game Animals* by Ernest Thompson Seton

Because pronghorn movements were restricted by snowpack, migration data collected during the spring was more complete than the fall. Pronghorn were observed migrating during all daylight hours, but no information on night movements was collected. Mild weather conditions in March,1999 melted most snow on the Mesa and surrounding sagebrush habitats. Pronghorn began the northerly spring migration by shifting from the gentle southern breaks to the top of the Mesa. This shift in distribution occurred at the same time as radio-collared mule deer (*Odocoileus hemionus*) began leaving the Mesa (Sawyer and Lindzey 1999). An estimated 1,500 pronghorn occupied the top portion of the Mesa through early April, until they continued north from the Mesa

to Cora Butte using the same migration route as radio-collared deer. They traveled across the top and western edge of the Mesa, then moved through the narrow (0.5 mi, 0.8 km) Trapper's Point Bottleneck. The bottleneck appeared to be a result of pronghorn preference to remain in sagebrush habitats while moving, rather than the riparian bottoms of the Green River to the southwest and New Fork River to the northeast. Archaeological records suggest this area has been a migratory bottleneck for thousands of years (Miller et al. 1999).

Weather patterns in April included cool temperatures and consistent precipitation. Although Cora Butte was relatively snow-free, the entire Green River Basin to the north continued to hold significant amounts of snow. An estimated 1,000 pronghorn were on the Mesa and another 300 near Cora Butte during a telemetry flight on April 13. Pronghorn on Cora Butte shared the sagebrush slopes with ~2,000 mule deer. It wasn't until late April and early May that snow conditions allowed pronghorn to move north into the 40-Rod Flat country. Most pronghorn moved directly north of Cora Butte through the irrigated meadows near Sunset Reservoir and into the sagebrush breaks north of the 40 Rod Road. All but 1 radio-collared pronghorn migrated west of WY Highway {352} (Cora Road) and east of the U.S. Highway {191}. The exception was pronghorn #150.463, which migrated from the Seedskadee area and was found east of WY Highway {352}, between Willow and New Fork Lakes.

Pronghorn continued north in mid-May, usually traveling through sagebrush habitats directly west of the WY Highway {352}. Pronghorn crossed the Green River approximately 2 miles (3 km) south of Black Butte in the same area where mule deer from the Pinedale Front cross the Green River enroute to the Hoback Basin (Sawyer and Lindzey 1999). From the Spring Creek area southwest of Black Butte, pronghorn moved exclusively on the west side of the Green River, traveling in a northeasterly direction across Little Twin and Wagonfeur Creeks to the boundary of the BTNF. The Green River drainage narrows near the BTNF boundary and creates a geographic bottleneck for about 3 miles (5 km). Pronghorn began to maneuver through the bottleneck on May 22, using a narrow (100-400 m) strip of sagebrush along the west side of the Green River.

Between May 23 and May 28, pronghorn movements were monitored intensively from the ground and air. Daily observations were made of migrating pronghorn along a 15-mile (24 km) portion, from the BTNF boundary upstream to Wagon Creek, then northwesterly into the Mosquito Lake region. Migration routes through this section were well defined and consistent among pronghorn groups. Pronghorn moved directly through the 3-mile (5 km) bottleneck near the BTNF boundary, often trotting the entire way along the narrow strip of sagebrush on the west side of the Green River. The river drainage widens just north of the Kendall Cabin and Whiskey Grove Campground, where pronghorn usually delayed movements to rest and/or forage on the open, south and east facing sagebrush slope directly north of Eagle Creek. An estimated 250-300 pronghorn migrated north onto the BTNF and upper Green River (above the Kendall Cabin) between May 23-28.

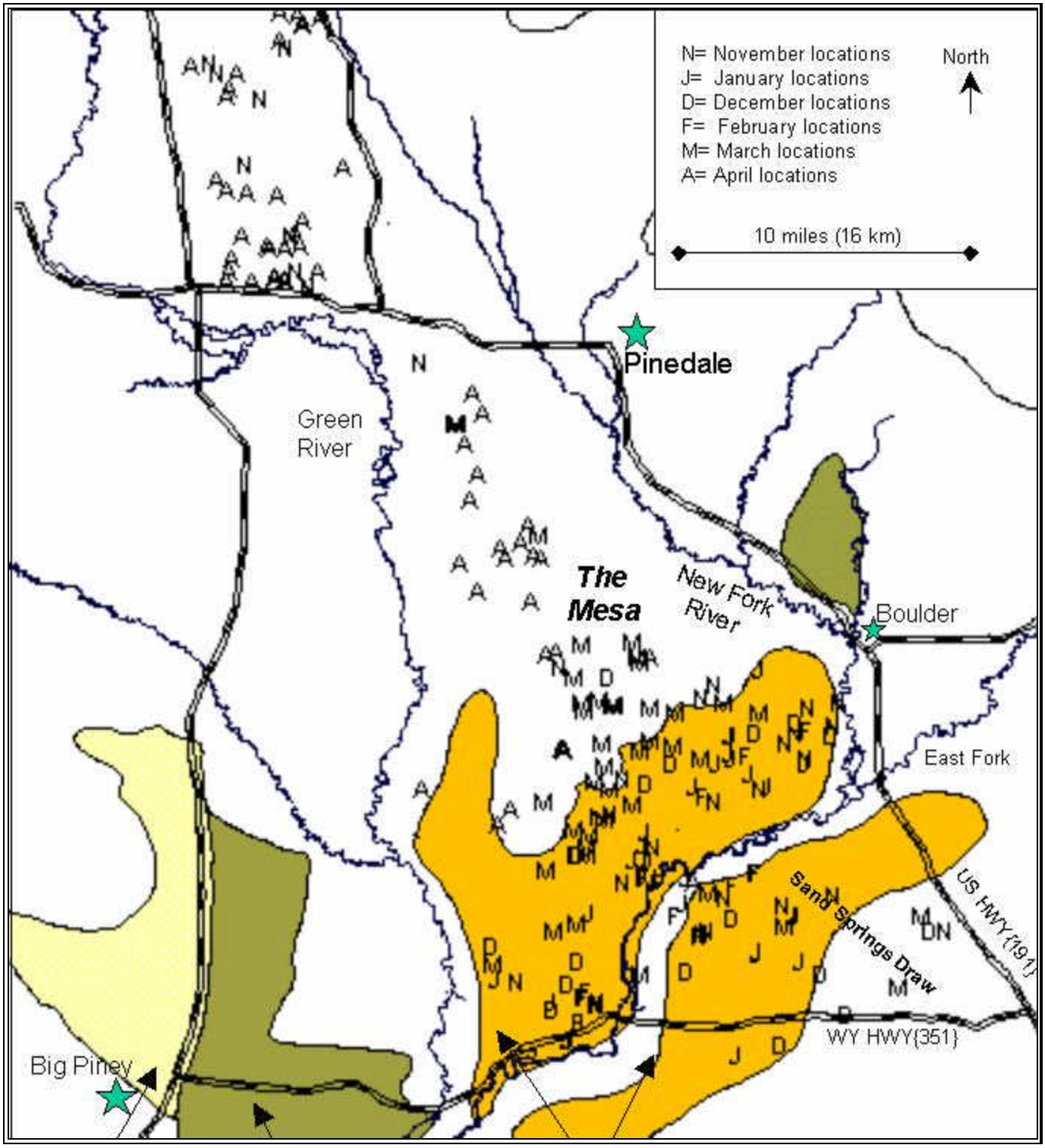

Figure 2. Winter (November-April, 1998-2000) distribution of radio-collared pronghorn north of Wyoming Highway{351} and location of pronghorn winter ranges designated by the Wyoming Game and Fish Department.

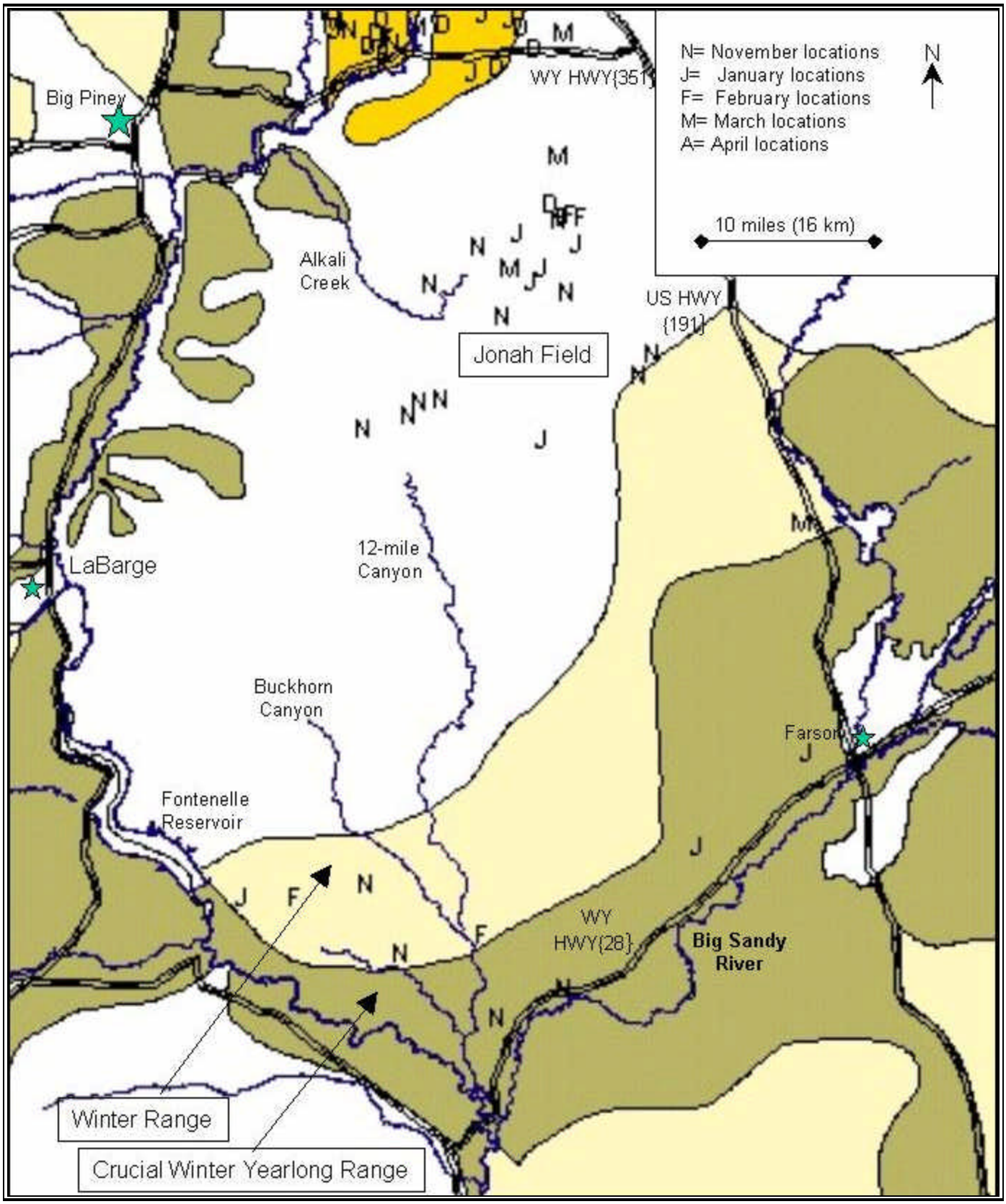

Figure 3. Winter (November-April, 1998-2000) distribution of radio-collared pronghorn south of Wyoming Highway {351} and location of pronghorn winter ranges designated by the Wyoming Game and Fish Department.

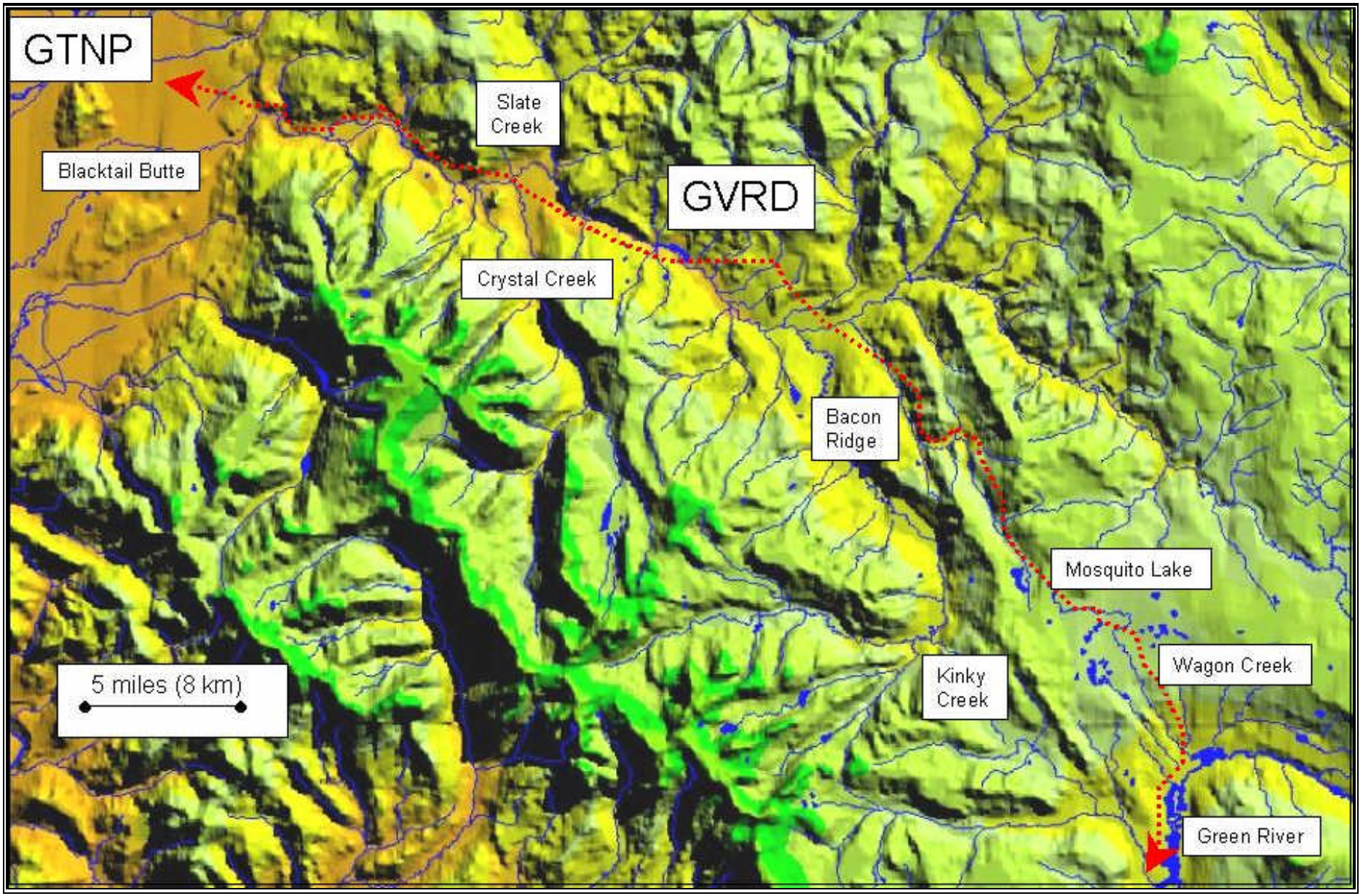

Figure 4. Pronghorn migration route between Grand Teton National Park (GTNP) and the upper Green River. River.

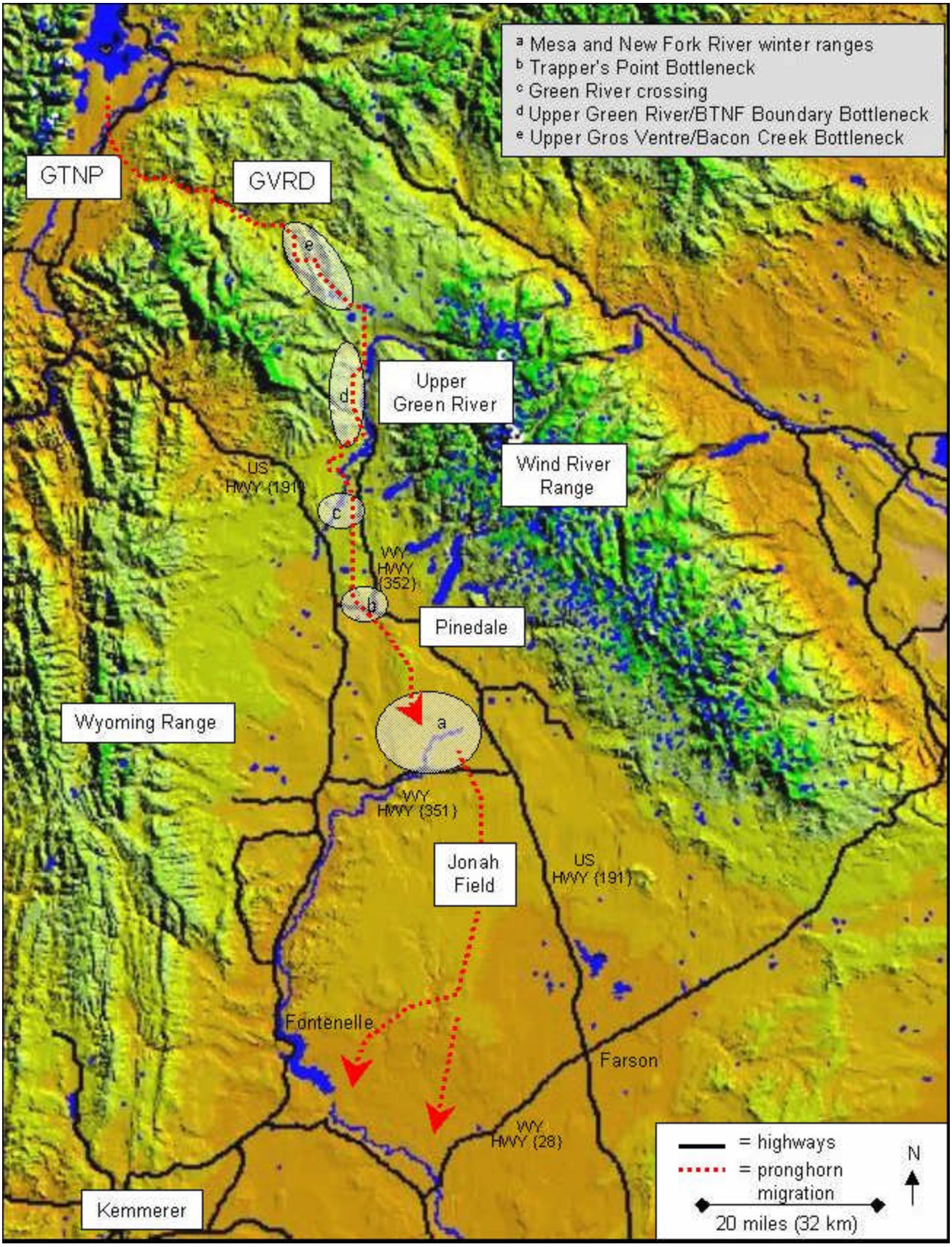

Figure 5. General migration route of pronghorn that summer in Grand Teton National Park (GNTP) and the Gros Ventre River Drainage (GVRD) and winter in southwestern Wyoming.

Pronghorn then moved another 6-7 miles (10-11 km) at a steady pace (2-3 mph), until they reached the Big Bend of the Green River and the open south facing slopes that begin south of Wagon Creek and extend east to the Roaring Fork. USFS Road 660 runs north/south with the Green River on the east and a series of narrow sagebrush slopes on the west. Pronghorn consistently used this road as a migratory corridor between Eagle Creek and Wagon Creek. Most of the road contained heavy snowpack (10-30 in, 25-76 cm) between May 23-25, however pronghorn were able to travel across the top of the snow previously packed by snowmachines. Observation work was conducted on a 4-wheeler and it was common for pronghorn to follow the 4-wheeler tracks through sections of snowpack. Pronghorn also used bridges to cross both Tosi Creek and Wagon Creek. Only 1 of 6 groups observed crossing creeks went through the water rather than using a bridge. Pronghorn usually ran across bridges in single file, preferring to travel across the middle of the bridge. Run-off was extremely high during this week, especially in the afternoons. Snowpack quickly receded after May 25 and, while some pronghorn did move through the sagebrush along the west side of USFS Road 660, most continued to use the road as a travel corridor between Eagle Creek and Wagon Creek. No pronghorn movements into the Tosi Creek or Tepee Creek areas were observed.

Pronghorn densities were highest along the south-facing slopes between Wagon Creek and Crow Creek. They foraged in a mix of lush sagebrush and grass/forb communities, as well as non-typical pronghorn habitats including cinquefoil (*Potentilla sp*.), willow (*Salix sp*.), and aspen (*Populus tremuloides*). Pronghorn groups were commonly interspersed with moose (*Alces alces*), elk, and Sandhill cranes (*Grus canadensis*), and tended to remain in the Wagon/Crow Creek area for days, sometimes weeks, before continuing the migration. On May 26 the first group of pronghorn (~6 animals) moved from the Wagon Creek area up to Mosquito Lake. Most pronghorn made the 2-3 mile (3-5 km) trek through the aspen and sagebrush pockets along the north side of Wagon Creek. Some pronghorn migrated south of Wagon Creek, but the slopes north of the creek appeared to be more accessible. Mosquito Lake Flats (an area of ponds and riparian meadows that extend ~2 miles (3 km) east and ~2 miles (3 km) north of Mosquito Lake) were mostly snow-covered and required pronghorn to break snow between small patches of open ground. Pronghorn traveled northwesterly near Wagon Creek across Mosquito Lake Flats, approximately 1 mile (1.6 km) north and west of Mosquito Lake, to the head of Bacon Creek.

It was previously assumed that from this point pronghorn moved west onto Bacon Ridge and followed the ridge to the GVRD (Harper 1985, Segerstrom 1997). However, during the last week in May, the northeast side of Bacon Ridge and the flats near the headwaters of Bacon and Wagon Creek were covered with snow. Movement onto Bacon Ridge at this time was highly unlikely and no tracks were observed in the area. Pronghorn tracks were seen breaking through snow below clearcuts on the south end of Buffalo Meadows and the north side of Wagon Creek. These tracks went northwest to Negro Creek and led into Bacon Creek, crossing the hydrographic divide at an elevation of 9,100 feet (2,774 m). The south-facing slope above Bacon Creek was snow-free from Trunk Creek down to Fish Creek. Pronghorn appeared to travel the length of Bacon Creek, at least to Water Gulch or Pond Creek, before leaving the

open south facing slopes of Bacon Creek. Pronghorn groups were observed 1 mile (1.6 km) below Trunk Creek and also at the Bang/Bacon Creek confluence. From the lower stretches of Bacon Creek pronghorn followed the same general routes through the GVRD as they did in the fall, moving predominantly along the north side of the river. Pronghorn use along the south side of the river appeared to be restricted to areas from Crystal Creek to Upper Slide Lake and Goosewing Creek to Soda Lake.

The first radio-collared pronghorn arrived in GTNP on May 28, traveling with 4 other animals. Personnel from GPWI reported 2 male pronghorn near Blacktail Butte on the same day. Rather than a large influx of pronghorn the following 2 weeks, only 4 radio-collars had moved into GTNP by June 10. Bacon Ridge, Tepee Creek, Kinky Creek and other alternate migration routes were free of snow by early June, however radio-collared pronghorn continued to use the Wagon Creek to Bacon Creek route described earlier.

Pronghorn movements into GTNP continued through June and occasionally into July. Twelve radio-collared pronghorn had reached GTNP by June 26 and 13 by July 7. The 1999 spring migration appeared to be complete around the first week of July.

Spring 2000 Migration:

Pronghorn used the same migration routes and staging areas in 2000 as they did in 1999. However, the timing of these movements differed between years (Table 3). Mild weather conditions and light snowpack apparently allowed pronghorn to migrate approximately 2 weeks earlier in 2000. Pronghorn #150.503 was the first to arrive in GTNP both years; May 28th in 1999 and May 4th in 2000. Stream run-off in May of 2000 was much less than the previous year and more pronghorn appeared to cross through Tosi and Wagon Creeks rather than using the bridges. The USFS road however, between Eagle and Wagon Creek was still heavily used by migrating pronghorn in 2000.

Summer Range Fidelity:

All pronghorn captured in the GVRD returned the next summer (1999), while nearly 40% (n=8) of the GTNP pronghorn summered in different areas (Table 4). Of the 8 that did not return to GTNP, 3 were found in the GVRD and 5 on the Green River side of the hydrographic divide. Pronghorn summering along the Green River drainage were distributed from Cora to Fish Creek Park (near Lake of the Woods and Union Pass). During the second summer (2000), 1 of those 8 died, 4 returned to their original summer area (GTNP), 2 returned to their 1999 summer range, and 1 moved to a different area. Additionally, 1 pronghorn captured in the GVRD did not return in 2000 and summered along the upper Green River, near Black Butte. While GVRD pronghorn exhibited strong site fidelity to summer ranges (90-100%), those from GTNP were more variable (60-80%) and more likely to summer in different areas.

Table 3. Timeline of the spring pronghorn migration to GTNP and the GVRD, 1999-2000.

Spring 1999
Mid-March/Early-April: Pronghorn moved off lower ranges and congregated on Mesa top.

April:	Pronghorn congregated around Cora Butte.
Early/mid-May:	Pronghorn migrated north to Green River Crossing, near Black Butte.
Late-May:	Pronghorn migrated north onto the BTNF and into the upper Green River area.
May 23rd:	Upper Green River road snowed-in beyond Kendall Cabin and Warm Springs Bridge.
Late-May to July:	Pronghorn migrated into GVRD and GTNP. First radio-collared pronghorn arrived in GTNP on May 28th.
June 26th:	Most radio-collared pronghorn were located on summer ranges in GTNP and GVRD.
July 7th:	All radio-collared pronghorn were located on summer ranges in GTNP and GVRD.

Spring 2000

Mid-March:	Pronghorn moved off lower ranges and congregated on Mesa top.
Late-March:	Pronghorn congregated around Cora Butte.
April:	Pronghorn migrated north to Green River Crossing, near Black Butte.
Late-April/Early-May:	Pronghorn migrated north onto the BTNF and into the upper Green River area. The first pronghorn (including radio-collar) arrived in GTNP on May 4th.
May 10th:	Upper Green River Road and USFS Roads were snow-free to Green River Lakes and Mosquito Lake.
Late-May to Mid-June:	Pronghorn continued to migrate into GVRD and GTNP.
June 18th:	All radio-collared pronghorn were located on summer ranges in GTNP and GVRD.

Fence Survey [a]

We counted 47 fences perpendicular to the migration route between the south end of the Mesa and Kelly. Although its possible pronghorn can move around some of these fences, we believe they must cross at least 35. Areas with many fences included the Cora Butte/40-Rod area, the Wagonfeur/Little Twin Creek area, and the BTNF boundary along the upper Green River. As mentioned in the migration section, pronghorn appear to avoid numerous wood pole/buck & rail fences near the BTNF boundary by traveling a road that accesses the private parcels, but bypasses the fences.

[a] Fence inventory data are now available in digital format through the University of Wyoming's Spatial Data and Visualization Center.

Table 4. Geographic description of summer (July) locations for radio-collared pronghorn captured in Grand Teton National Park (GTNP) and the Gros Ventre River Drainage (GVRD), 1998-2000. (* animals that summered in different areas)

ID#	July 1998 (Capture)	July 1999	July 2000
150.403	GVRD/Dry Cottonwood/Breakneck	GVRD, lower Lightning Creek	GVRD/Lightning Creek
150.413	GVRD/Cottonwood/Fish Creek	GVRD, Breakneck/Cottonwood	GVRD/north Soda Lake
150.423	GTNP/Potholes	GTNP, Kelly Hay Meadows	GTNP/Kelly Hay Meadows
150.433	GVRD/Bacon Ridge	GVRD, north of Soda Lake	GVRD/Bacon Creek/Water Gulch
150.442	GTNP/Baseline Flats/Timbered Island	GTNP, Timbered Island	GTNP/Baseline Flats
*150.463	GVRD/Cottonwood/Fish Creek	GVRD, Breakneck/Cottonwood	upper Green/Crossing/Black Butte
150.473	GTNP/Baseline Flats	GTNP, TP Rd. west of Burned Ridge	GTNP/Baseline Flats
*150.482	GTNP/Potholes	Green River, near Franz Reservoir	GTNP/Baseline Flats
150.493	GTNP/Potholes	GTNP, Potholes	GTNP/Cow Lake
150.503	GTNP/Potholes	GTNP, Cow Lake	GTNP/Potholes
150.523	GTNP/Blacktail Butte/Kelly hay meadows	GNTP, Kelly Hay Meadows	GTNP/Kelly Hay Meadows
*150.533	GTNP/Blacktail Butte/Kelly hay meadows	GVRD, north Bacon Ridge/Poison	GVRD/north Bacon Ridge
*150.543	GTNP/Potholes	Green River/Spring Creek	DEAD
150.553	GTNP/Baseline Flats	GTNP, east of Jenny Lake	GTNP/Baseline Flats
150.563	GVRD/Alkali Creek	GVRD, Alkali/Crystal Creek Ridge	DEAD
150.603	GTNP/Potholes	GTNP, Potholes	GTNP/Potholes
*150.623	GTNP/Potholes	upper Green River, Fish Creek Park	GTNP/Potholes
*150.633	GTNP/Potholes	GVRD, Bacon Creek/Water Gulch	GTNP/Baseline Flats
150.653	GTNP/Baseline Flats	GTNP, NE Jenny Lake/TP Rd.	GTNP/Burned Ridge
150.662	GVRD/Cottonwood/Fish Creek	DEAD	DEAD
150.695	GTNP/Baseline Flats	GTNP, Baseline Flats/Snake River	DEAD
150.713	GVRD/Alkali Creek	GVRD, upper Slide Lake/Dry Dallas	GVRD/Alkali Feed Ground
150.723	GVRD/Bacon Ridge	GVRD, north of Soda Lake	GVRD/north Soda Lake
150.743	GVRD/Dry Cottonwood/Breakneck	GVRD, Cottonwood Creek	GVRD/Dry Cottonwood Creek
*150.753	GTNP/Potholes	GVRD, lower Cottonwood Creek	upper Green/Wagenfeur Creek
*150.763	GTNP/Potholes	Aspen Ridge, 2mi NW Franz Reservoir	GTNP/Potholes
150.783	GVRD/Cottonwood/Fish Creek	GVRD, lower Cottonwood Creek	GVRD/Dry Cottonwood Creek
150.823	GTNP/Potholes	GTNP, NE Potholes	DEAD
150.844	GTNP/Baseline Flats/Burnt Ridge	GNTP, Burned Ridge	GTNP/ south Baseline Flats
150.857	GVRD/Dry Cottonwood/Breakneck	GVRD, Bacon Ridge/upper Poison Creek	DEAD
150.883	GTNP/Potholes	GTNP, TP Rd, west Burned Ridge	GTNP/Baseline Flats
*150.893	GTNP/Blacktail Butte/Kelly hay meadows	Cora Road, NE 40 Rod Flat Well	north 40-Rod/Cora Highway
150.902	GVRD/Alkali Creek	GVRD, near Goose Lake	GVRD/Alkali Feed Ground

Bottlenecks/Areas of Concern

We defined "bottlenecks" as those areas along the migration route where topography, vegetation, development and/or other landscape features restrict animal movements to narrow or limited regions. Bottlenecks create management concerns because the potential to disrupt or threaten established migratory routes are much greater in these areas.

Trapper's Point:

Trapper's Point is located approximately 7 miles (11 km) west of Pinedale, near the junction of U.S. Highway {191} and WY Highway {352} (Figs. 6,7). This naturally occurring bottleneck is approximately 1 mile (1.6 km) in width and length, restricted to the southwest by the Green River riparian complex and restricted to the northeast by the New Fork riparian complex. Sagebrush habitats north and south of U.S. Highway {191} are used extensively by pronghorn and mule deer during certain times of the year. The area south of U.S. Highway {191} contains a large (~100 mi^2, 260 km^2) winter range known as The Mesa, that supports 1,500-2,000 pronghorn and 4,000-6,000 mule deer from November through April. The area north of U.S. Highway {191} is used as transition range during spring and fall migrations. Pronghorn and mule deer crossing U.S. Highway {191} use the narrow strip of sagebrush connecting the 2 areas. Although much of the sagebrush lands are administered by the BLM, portions of the bottleneck and most of the lands surrounding the area are private lands that have been subdivided, fenced and developed. Development in this area has narrowed the effective width of the bottleneck to approximately 0.5 mile (0.8 km).

Alternative migration routes through the area appear to be unavailable or inadequate. Archaeological records suggest pronghorn have migrated through the Trapper's Point Bottleneck for thousands of years. A recent dig conducted by the Office of the Wyoming State Archaeologist (Miller et al. 1999) documented a 6,000 year-old pronghorn kill site in the core of the bottleneck. Prehistoric hunters took advantage of the natural bottleneck and killed migrating pronghorn with primitive stone-tipped weapons. The development of fetal bones found at the site indicate the kills occurred in late-March or early-April, corresponding with the timing of modern-day pronghorn migrations through this corridor.

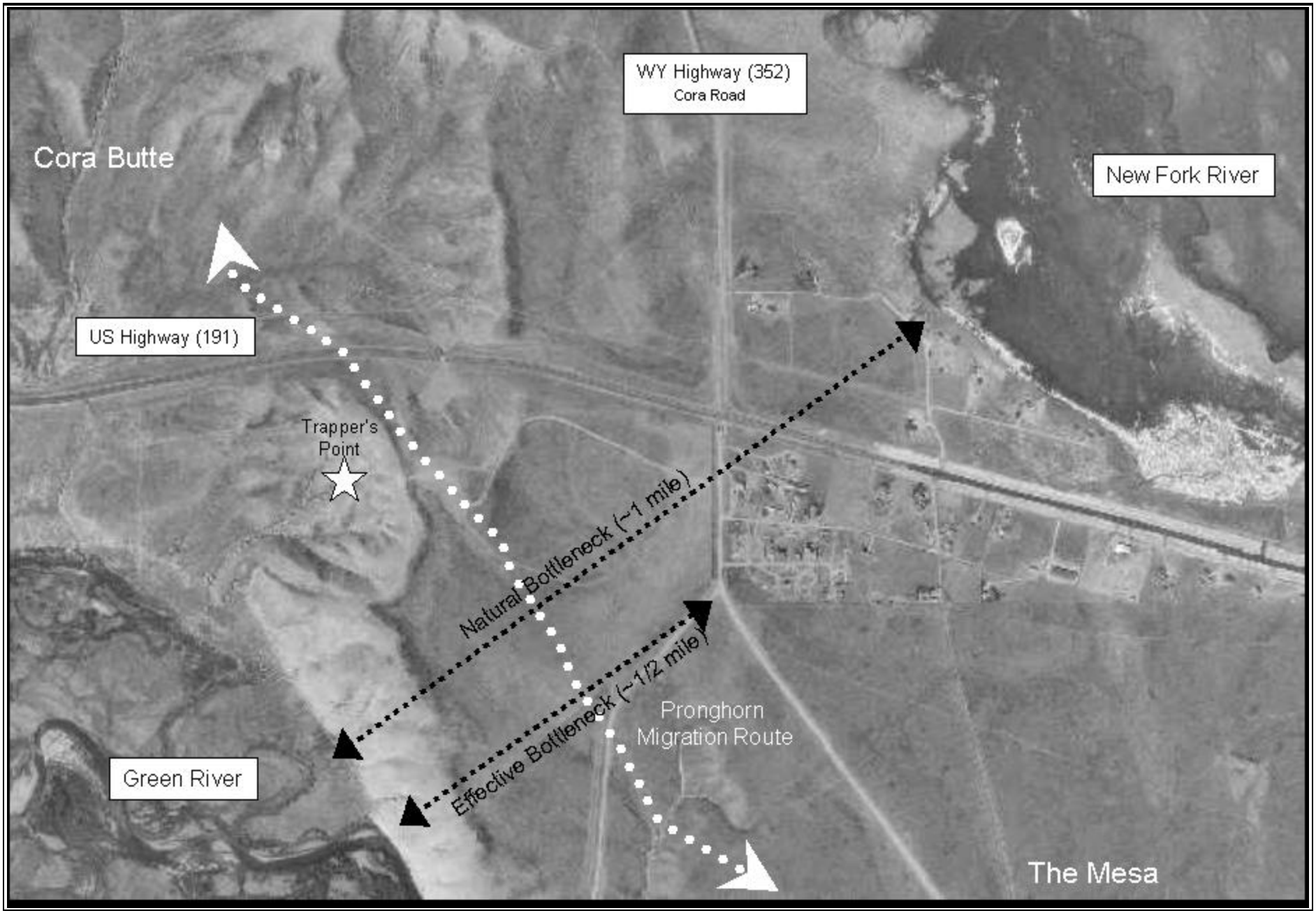

Figure 6. Orthophoto of Trapper's Point Bottleneck located along U.S. Highway {191}, 7 miles (11 km) west of Pinedale, WY.

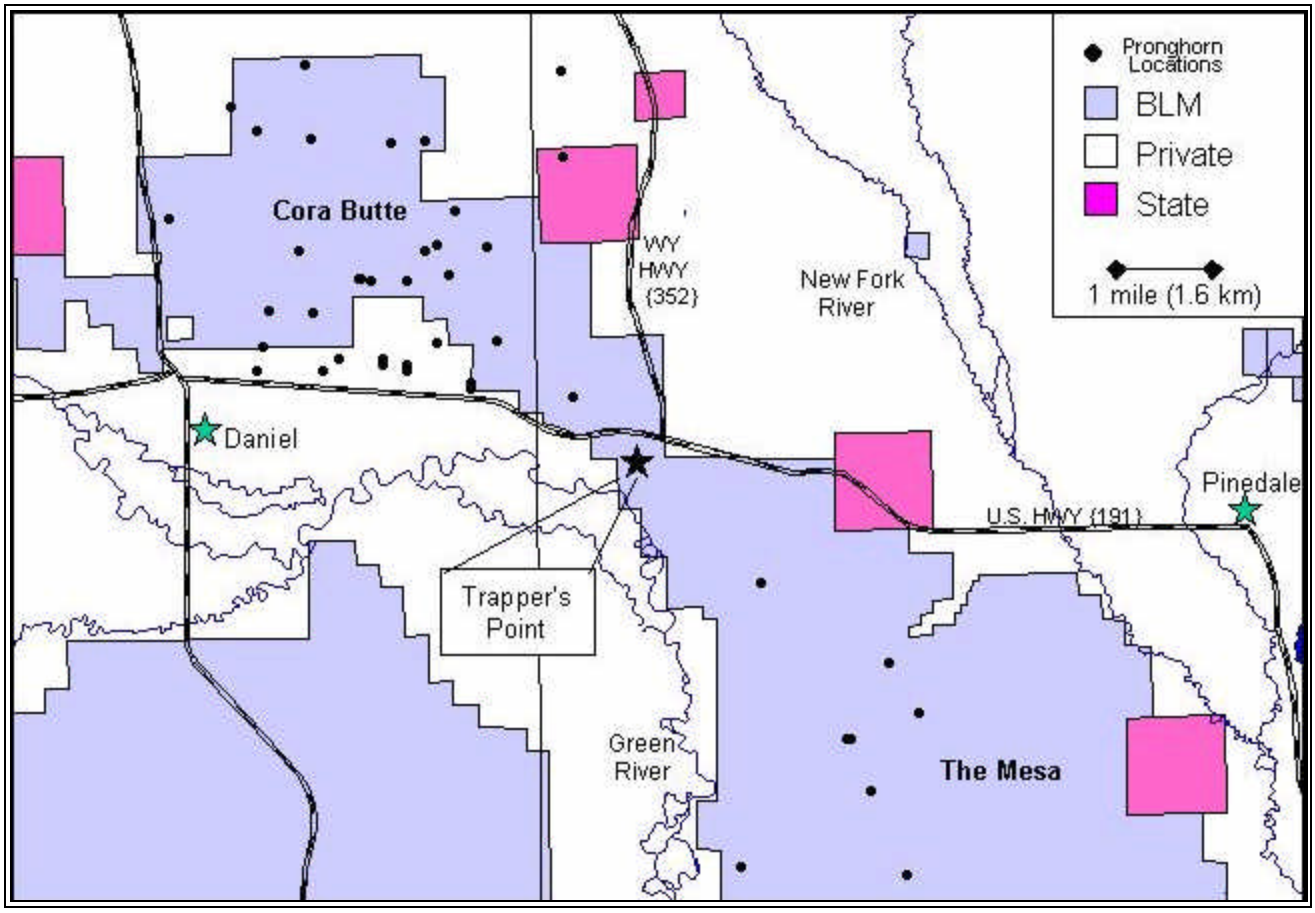

Figure 7. Location and land status of Trapper's Point Bottleneck near Pinedale, WY.

The Green River Crossing:

Twenty miles north of Trapper's Point, pronghorn cross the Green River along a 3-mile (5 km) stretch located upstream from Warren Bridge and downstream from Black Butte (Figs. 8,9). Although radio-collared pronghorn seasonally travel 70-100 miles through the Green River Basin, this appears to be the only area where they actually cross the river. Interestingly, a separate radio-telemetry study found most mule deer that winter along the Wind River Range migrated northwest to summer in different mountain ranges (Sawyer and Lindzey 1999) and nearly all of those deer crossed the Green River in the same 3-mile (5 km) stretch. There are no obvious topographic features or river channel characteristics of the area that make it such a desirable river crossing. Nonetheless, telemetry data suggests 600-900 pronghorn and 3,000-4,000 mule deer use this river crossing twice a year.

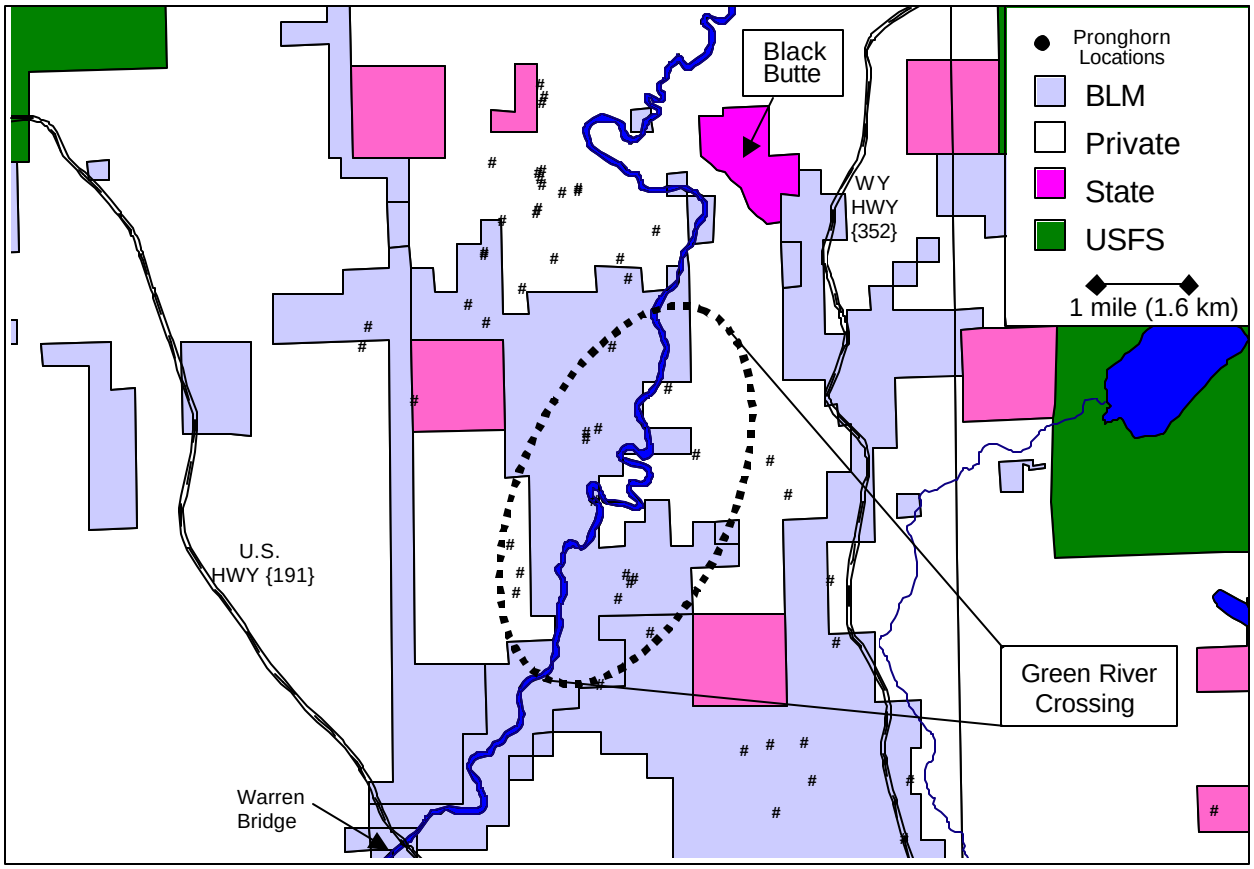

Figure 8. Location and land status of area where pronghorn migration route crosses the Green River, between Warren Bridge and Black Butte.

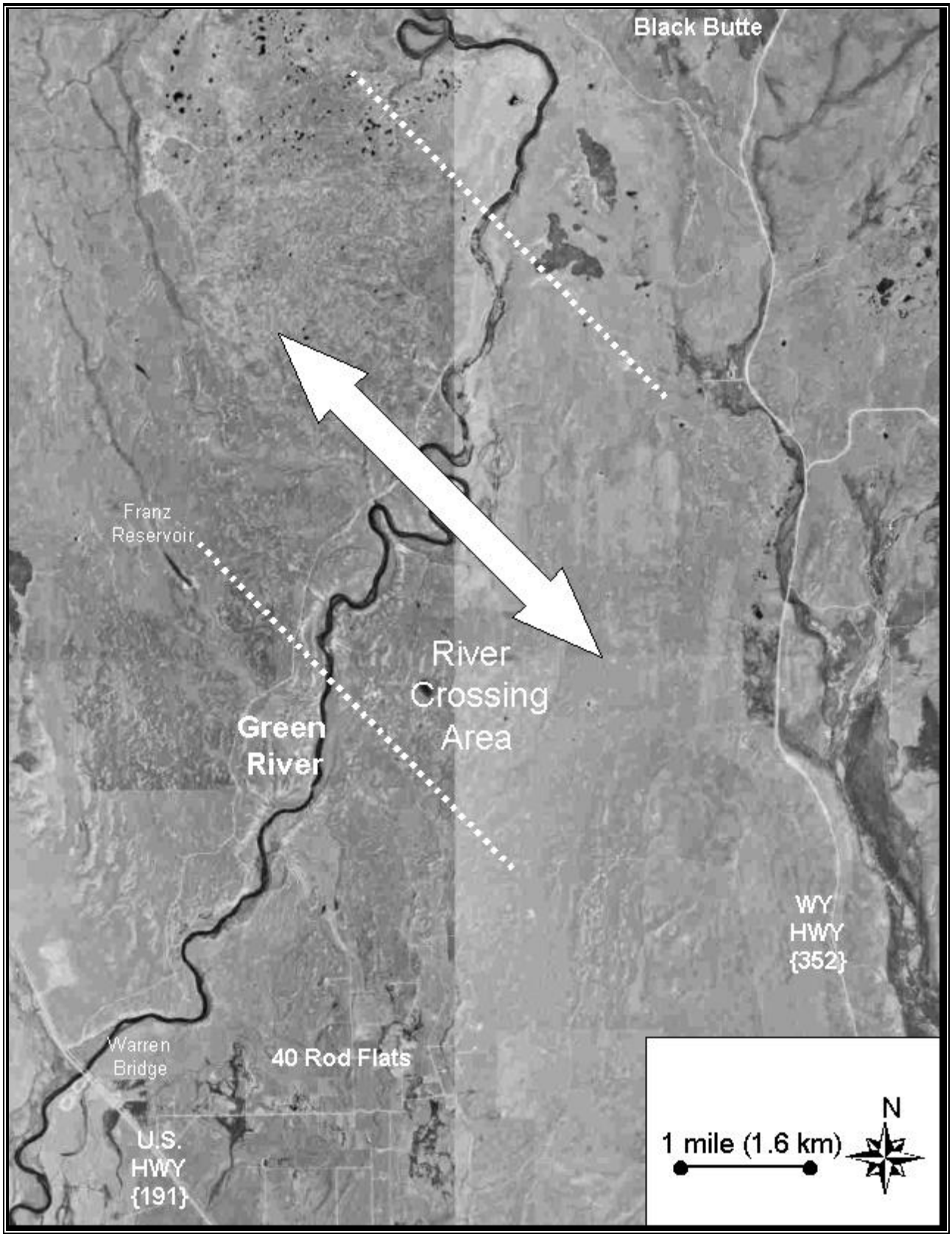

Figure 9. Orthophoto of area where pronghorn migration route crosses the Green River,
between Warren Bridge and Black Butte.

Upper Green River/BTNF Boundary:

Once pronghorn make it through the Trapper's Point bottleneck and the Green River Crossing, several bottlenecks remain between them and their summer ranges. The most sensitive of these occurs along the Upper Green River, near the BTNF boundary (Fig. 10). Here, the Green River drainage narrows and creates a 3-mile (5 km) long bottleneck for pronghorn that summer in the Upper Green River, Union Pass, the GVRD, and GTNP. Pronghorn movements are restricted to the west side of the Green River, along a narrow (100-400 m) strip of sagebrush that runs parallel to the river. The bottleneck begins about 1 mile (1.6 km) south of the BTNF boundary, where Gypsum Creek enters the Green River, and ends approximately 2 miles (3 km) north of the BTNF boundary, immediately above Eagle Creek.

Because this bottleneck is so narrow, subdivision development and fencing on private lands south of the BTNF boundary (Fig. 11) has the potential to disrupt the established migration route. Pronghorn travel quickly through this stretch and have been observed using opened gates and roads to facilitate movements where fences occur.

Gros Ventre/Bacon Creek:

Much of the 40-mile (64 km) migration route through the GVRD consists of steep hillsides adjacent to the Gros Ventre River. The travel corridor used by pronghorn rarely exceeds 1 mile (1.6 km) in width and although the entire GVRD corridor may be considered a geographic bottleneck, the Red Hills and Bacon Creek areas probably represent the narrowest portions of the migration route between Kelly and the upper Green River. Harper (1985) identified the south-facing hillside below Crystal Creek near the Red Hills Campground as a migratory bottleneck (Fig.12). Segerstrom (1997) and GPWI have filmed many pronghorn traveling across the steep, rocky hillside on a well-beaten path. Between May 25 and June 16, 1999, GPWI filmed 99 pronghorn crossing the hillside, which is less than 200 m wide.

The Bacon Creek portion of the migratory routes extends almost 10 miles (16 km), from Fish Creek up to the hydrographic divide. Pronghorn cross the hydrographic divide near the headwaters of Wagon Creek (on the Green River side) and Bacon Creek (Gros Ventre River side), about 1.5 miles (2.5 km) southwest of Buffalo Meadow and 1 mile (1.6 km) southeast of Negro Creek (Fig.13). During spring migrations, pronghorn traveled along the northeast side of Bacon Creek and appeared to restrict their movements to a narrow strip (100-400 m) of open ground above the creek and below timberline (Fig.14). This south-facing slope above Bacon Creek was always snow-free from Trunk Creek down to Fish Creek. Pronghorn appeared to travel the length of Bacon Creek, at least to Water Gulch or Pond Creek, before leaving the open south facing slopes of Bacon Creek. Pronghorn groups were observed 1 mile (1.6 km) below Trunk Creek and also at the Bang/Bacon Creek confluence. Snowpack levels, particularly during the spring likely influence the width and accessibility of travel corridors through the GVRD.

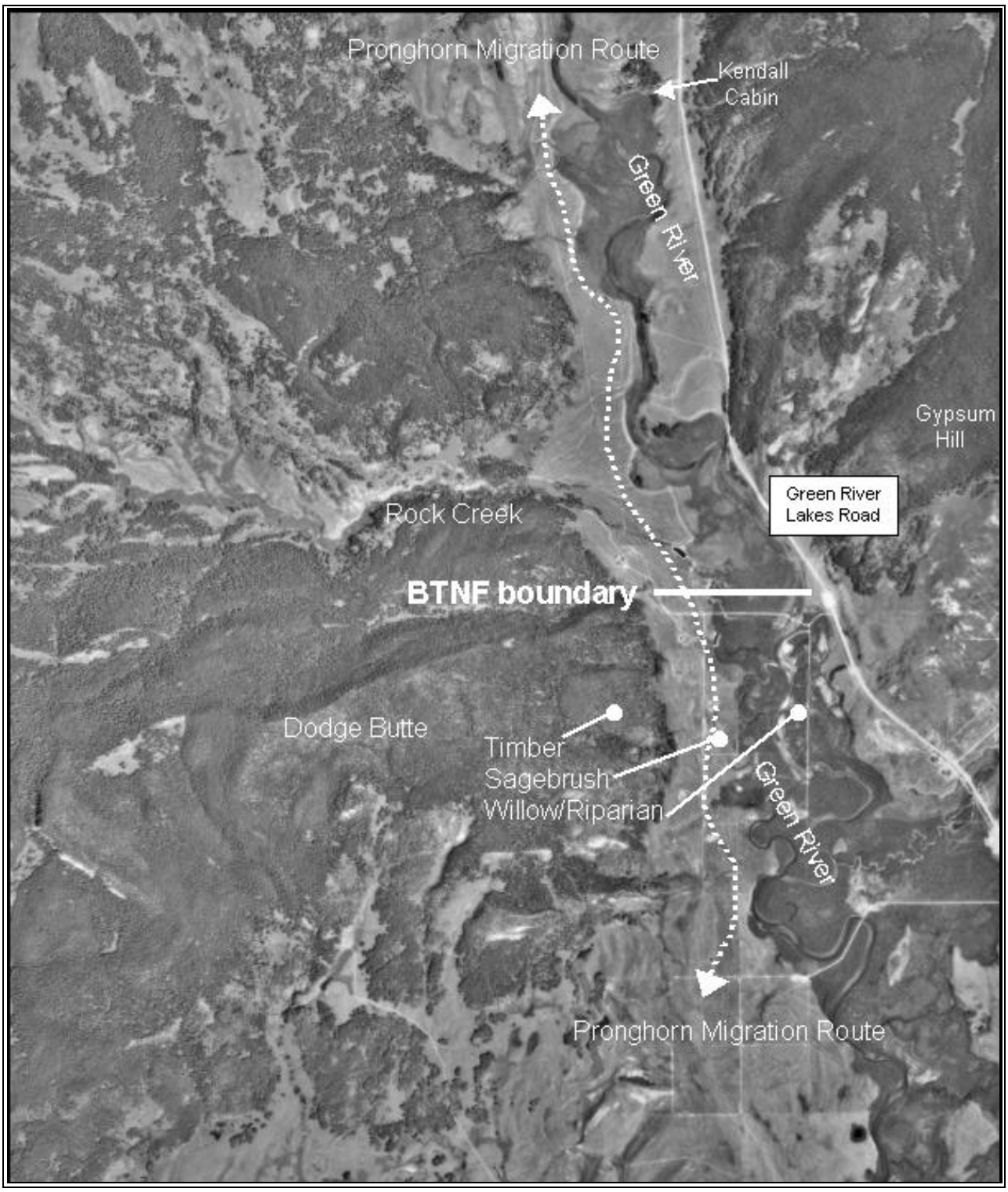

Figure 10. Location of pronghorn migration route and upper Green River/Bridger Teton
National Forest (BTNF) boundary bottleneck in western Wyoming.

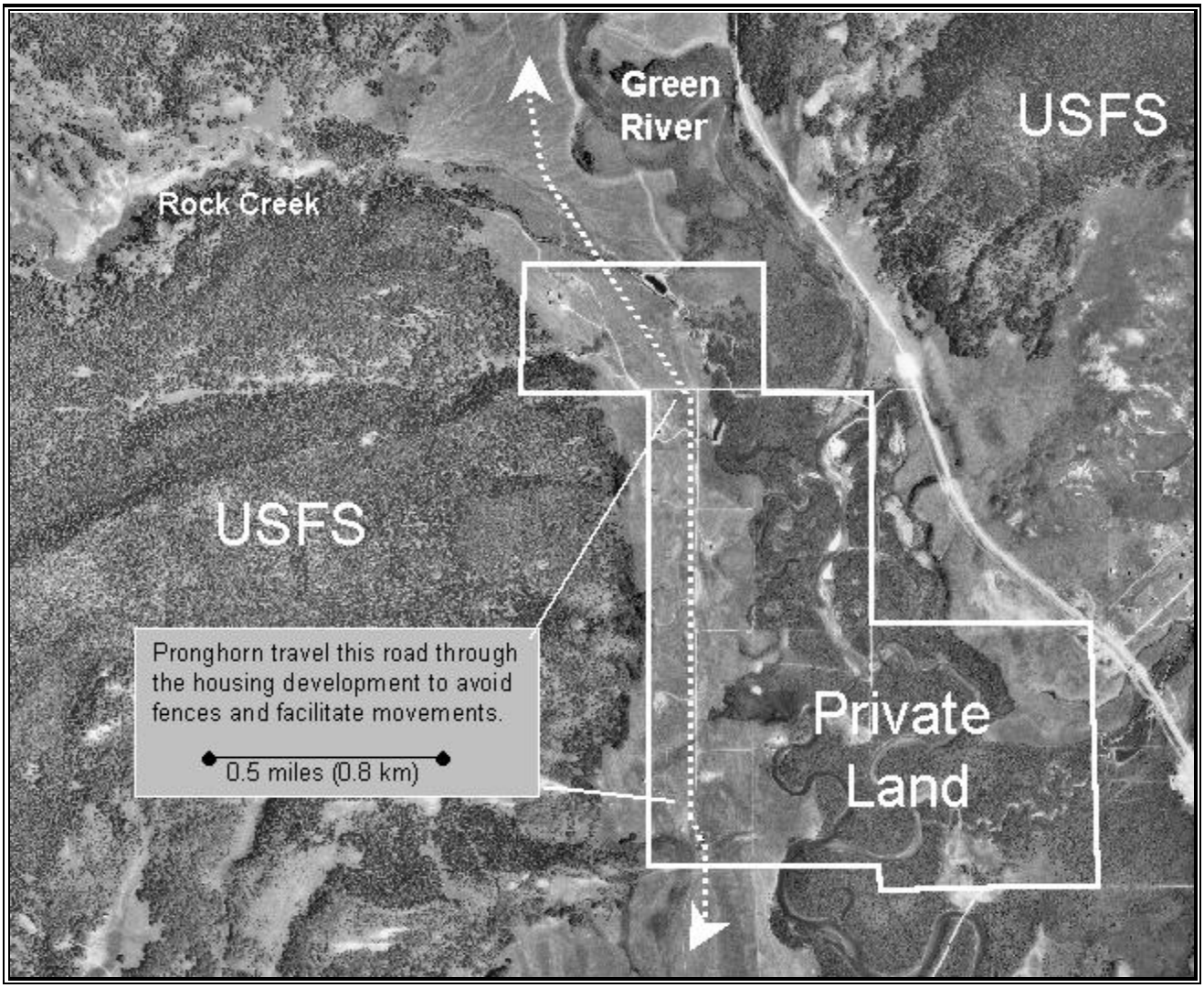

Figure 11. Location of pronghorn migration route and private land portion of the upper Green River/Bridger Teton National Forest (BTNF) boundary bottleneck in western Wyoming.

Figure 12. Location of the Red Hills bottleneck in the Gros Ventre River Drainage (GVRD).

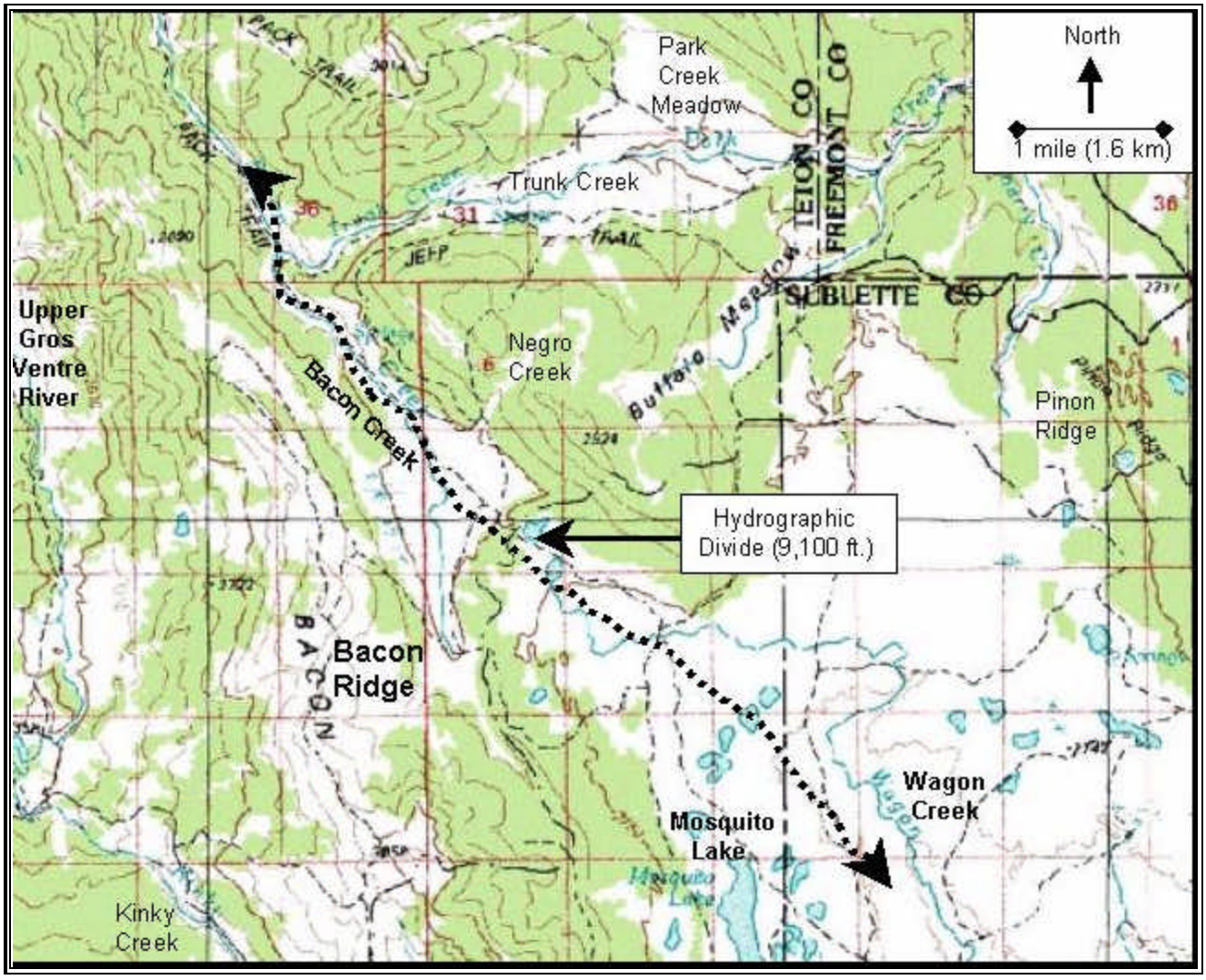

Figure 13. Section of migration route where pronghorn cross the hydrographic divide between the Green and Gros Ventre Rivers in western Wyoming.

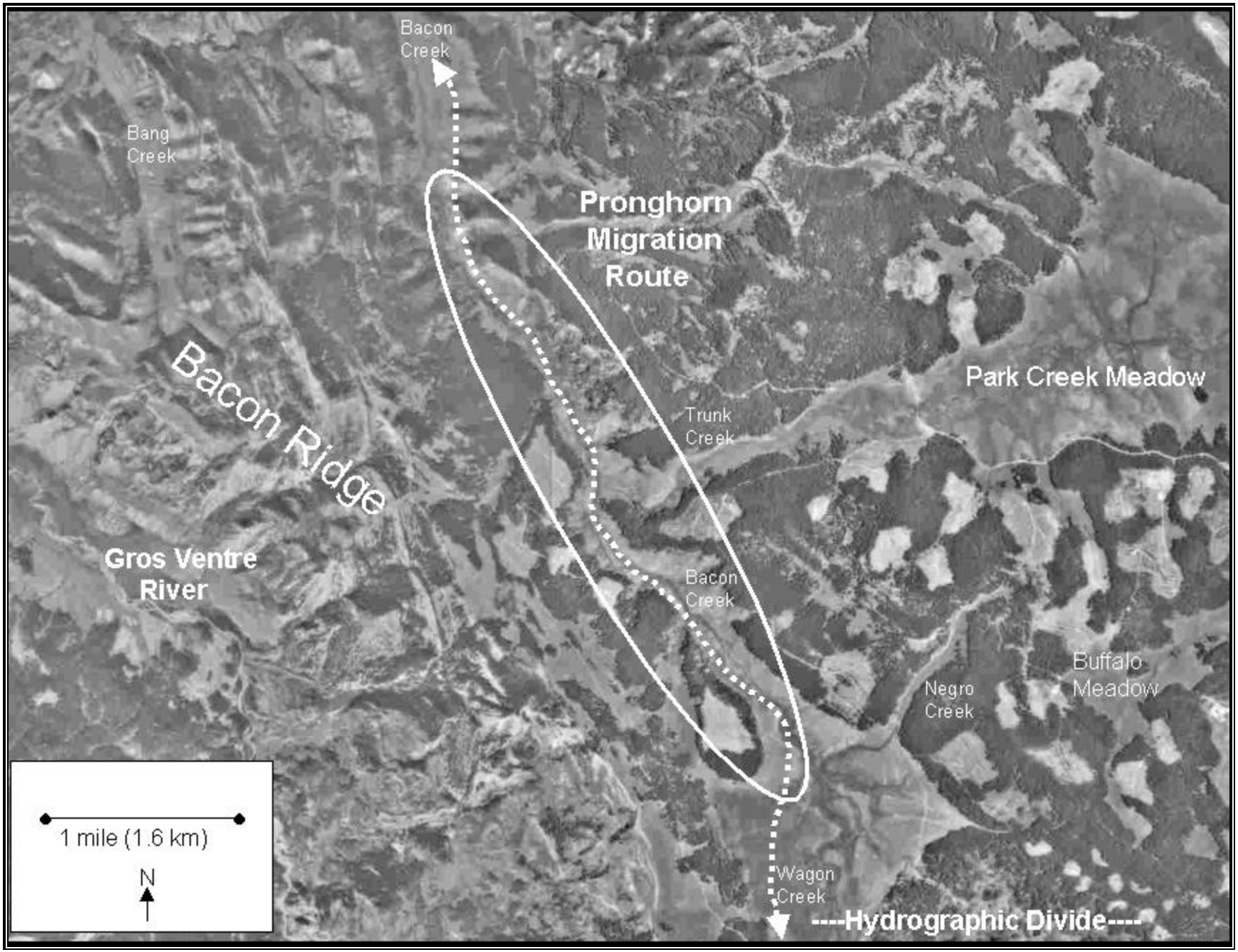

Figure 14. Location of Bacon Creek bottleneck along pronghorn migration route between Green and Gros Ventre Rivers.

Mortality/Survival:

Estimated annual (June 1- May 31) survival rates for radio-collared pronghorn were generally high and varied from 0.84 to 0.97. Eight pronghorn died during the study, however 2 of those (#150.773, #150.683) deaths resulted from capture-related injuries. Four pronghorn (#150.857, #150.662, #150.695, #150.543) died from unknown causes. Pronghorn #150.695 was found in the Snake River and #150.543 near a fence, but cause of death could not be determined. Pronghorn #150.563 transmitted a mortality signal on July 7, 1999 and was retrieved 6 days later. The collar was found 2 miles south of the Gros Ventre River Road, on the ridge between Crystal Creek and Alkali Creek. No carcass was found, but the collar and a rib bone were buried in a timber stand. The transmitter package had been nearly crushed. Hair samples collected at the site were identified as canid, but could not be distinguished between coyote and wolf because of the non-typical color arrangement (T. Moore, pers. commun., WGFD, 1999). Pronghorn #150.823 was during the winter while crossing WY Highway {351}, near the Sand Springs Draw area.

Table 5. Number of radio-collared pronghorn (N_1), number of deaths (N_2), estimated annual survival rates ($\hat{S}$), and associated standard errors (SE) for pronghorn in western Wyoming, 1998-2000.

Time Period	N_1	N_2	$\hat{S}$	SE
June 1, 1998- May 31, 1999	33	1	0.97	0.03
June 1, 1999- May 31, 2000	32	5	0.84	0.06

DISCUSSION

The pronghorn of Grand Teton National Park (GTNP) and the Gros Ventre River Drainage (GVRD) were originally thought to winter in the northern portion of the Green River Basin, until the late 1980's when the WGFD trapped and marked 877 pronghorn in the Sublette data analysis unit (DAU), north of Rock Springs, Wyoming. Thirteen adult females carried radio-collars in 1986, 19 in 1987, and 16 in 1988 (Raper et al. 1989). Other captured pronghorn, of all sex and age classes, were marked with colored neckbands. Four of the neckbanded animals were observed in GTNP and the GVRD between 1986 and 1993 (Segerstrom 1997). These observations were the first indication that GTNP and GVRD pronghorn may winter as far south as Interstate-80, further complicating an already unclear migration route. Wintering in the southern portion of the Sublette DAU meant GTNP and GVRD pronghorn may travel an additional 50-80 miles (80-129 km) from the Pinedale/Mesa area, exposing themselves to more road and fence crossings, and moving through or wintering near extensive oil and gas developments.

Raper et al. (1989) reported pronghorn in the Sublette DAU exhibited strong fidelity to summer ranges, however no marked animals were observed in GTNP or the GVRD in consecutive summers. Pronghorn we radio-collared in GTNP did not demonstrate a particularly strong fidelity to summer ranges from 1998 to 1999, with only 13 of the original 21 returning the following summer. Pronghorn captured in the GVRD were more likely to return in consecutive summers than those from GTNP. Annual variation in summer ranges suggests GTNP pronghorn intermix with other populations and genetic isolation or uniqueness is unlikely.

Raper et al. (1989) identified the U.S. Highway {191} corridor, between Farson and Pinedale, as a major migration route. Radio-collared pronghorn from GNTP and the GVRD did not use U.S. Highway {191} as a migration route, rather the few pronghorn that migrated south of WY Highway {351} moved through the Jonah Field (near Yellow Point Ridge), then southwesterly (near Buckhorn Canyon) towards WY Highway {28}. All movements south of WY Highway {351} were several miles west of U.S. Highway {191}. It is possible that the pronghorn of GTNP and the GVRD may be part of a different herd segment than the marked animals Raper et al. (1989) reported using the U.S. Highway {191} corridor. It is also possible that during the 1980's and prior to large-scale development of the Jonah and Fontenelle gas fields, pronghorn movements south of WY Highway {351} were more common.

Raper et al. (1989) reported winter range distribution of marked pronghorn in the Sublette DAU varied annually and was thought to be weather dependent, similar to the findings of Bruns (1977), Hoskinson and Tester (1980), and Mitchell (1980). Other studies have documented traditional use of winter ranges in Alberta (Barret 1980) and Wyoming (Ryder et al. 1984). Winter range fidelity of GTNP and GVRD pronghorn to the Mesa/New Fork River areas appeared relatively high at 86%. Winter conditions during 1998-1999 and 1999-2000 were considered average to mild, however, and it is not known how these pronghorn disperse in severe winters. Although a general comparison of several locations from consecutive winters is not a precise measure of

fidelity, it does provide general knowledge of pronghorn winter range use during average-mild winters.

Winter distribution data collected from radio-collared pronghorn may be used to evaluate and modify current WGFD winter range designations. These data suggest current boundaries are conservative and underestimate the amount of area pronghorn consistently use November through April. Winter range designation is intended to identify areas critical to the survival of a given population. Designated winter ranges receive special protection on public lands and guide management decisions by federal agencies in situations where land-use practices may adversely impact crucial winter range. Accurate delineation of winter ranges will assist state and federal agencies with pronghorn management and improve the National Environmental Policy Act (NEPA) process by providing quality data for environmental impact statements (EIS) and/or environmental assessments (EA). Aside from parturition areas, designated winter ranges are typically the only habitats considered in EIS impact analyses for big game. Further, habitats must be designated as winter range to receive a 'high' level of value from the mitigation policy established by the Wyoming Game and Fish Commission (1998).

Consistent with other pronghorn populations (Kitchen 1974, Bruns 1977, Mitchell 1980, Ryder and Irwin 1987, Byers 1997), shifts in group size and composition were common throughout the year, particularly on winter ranges. It was not uncommon to find collared animals together one week and then in separate herds the next week. Movement data were also consistent with patterns documented by Hoskinson and Tester (1980), who found the timing of spring pronghorn migrations in Idaho were dependent upon snow conditions while the fall migrations were not. Many radio-collared pronghorn left GTNP and the GVRD in the fall prior to snow accumulation. During the spring however, pronghorn appeared to push the snowline north, moving as quickly as snow conditions allowed, at least until parturition neared. Pronghorn movements after mid- to late-May were typically not influenced by snow conditions, rather they often delayed migration and spent days or weeks in the upper Green River country before continuing to summer range. This was likely due to 1 of 2 factors, or a combination of both. First, if pronghorn were not able to make it to GTNP or the GVRD prior to parturition, they appeared more likely to fawn in the upper Green River rather than risk another 20-50 miles (32-80 km) of movement during the later stages of pregnancy. And secondly, the Big Bend/Crow Creek area of the upper Green River contains large, open south-facing slopes that green-up earlier than most areas and provide pronghorn with their first abundant, succulent forage of the year.

After June 1, the timing of pronghorn movements into GTNP and the GVRD was so variable that it was difficult to predict where (or if) fawning occurred. Segerstrom (1997) suggested pronghorn in GTNP and the GVRD gave birth 2 weeks later than other pronghorn populations. If this were the case we would expect most pronghorn to arrive in GTNP prior to June 14, but despite relatively snow-free conditions, only 4 radio-collared pronghorn had reached GTNP by June 10, 1999. It is unlikely that many radio-collared pronghorn summering in GTNP arrived early enough to give birth, even if they fawn 2 weeks later than other populations. Data collected in 1999 suggest that if radio-collared females gave birth, it probably occurred outside GTNP, either in the

GVRD or the upper Green River. In June 2000, however, all radio-collared pronghorn had reached GTNP by June 18 and had likely been there 1-2 weeks before. Periodic observations of newborn fawns in GTNP during mid- or late-June should not be considered unusual; late births consistently occur in other parts of the state (i.e., Shirley Basin, Federal) (J. Zimmer, University of Wyoming, unpub. data).

Another possibility is that many pronghorn that migrate into GTNP are barren and better able to complete the long migration with no reproductive energy costs. This would help explain the unusually low fawn:doe ratios (~36:100, Segerstrom 1997) consistently observed in GTNP. When radio-collared pronghorn were captured on July 20, 1998, only 26% were lactating. This could be evidence of a large percentage of barren does or simply an artifact of high fawn mortality. Although most ungulates cease lactating a few days after no suckling response (Baldwin 1969, Bubenik 1982), it may take 3 to 4 weeks before the udder shows no visible signs (i.e., glandular reduction, tissue regression) of milk production (H. Sawyer, pers. commun. Colorado State University, 1999). This suggests pronghorn captured on July 20 were either barren or lost their fawns during the first 2 weeks of life. Determining the factors (i.e., breeding, migration, predation) influencing the reproductive success of GTNP pronghorn was beyond the scope of this study.

Although pronghorn production and recruitment in GTNP and the GVRD appears much lower than other parts of the state, both populations have remained stationary or increased over the last 20 years. Recruitment of 20-40 fawns per 100 females, combined with low natural adult mortality and virtually no hunting loss appears adequate to maintain current population objectives. Recruitment into the GTNP population may be supplemented by pronghorn opting not to migrate, producing young in the Green River Basin, then returning to GTNP the next year.

Most pronghorn migrated out of GTNP and through the GVRD in late-October or early-November. The current pronghorn hunting season in the GVRD (HA85) consists of 25 any antelope tags and runs from September 11 through October 31. This season is designed to provide hunting opportunity and harvest animals from both the GVRD and GTNP population segments (D. Brimeyer, pers. commun., WGFD, 1999). Based on the current season structure, harvest during the first half of the season is likely restricted to GVRD pronghorn, while both GVRD and GTNP segments are vulnerable later in the season. If harvesting GTNP pronghorn as they migrate through the GVRD becomes a management concern, the WGFD may consider shortening the season to avoid unintentional harvest of the GTNP

segment. Pronghorn seasons on the Green River side of the hydrographic divide (HA87) end October 15, minimizing the probability of harvesting GTNP or GVRD pronghorn in this area.

MANAGEMENT RECOMMENDATIONS

The primary management concern for pronghorn populations in western Wyoming is the maintenance of winter ranges and migration corridors. Movement and distribution data collected during this study identified pronghorn seasonal ranges, migration routes, and migratory bottlenecks. Focusing conservation efforts on bottleneck areas may provide a sound, objective method to prioritize management concerns and direct proactive measures towards maintaining this unique long-distance migration. Again, migratory bottlenecks create special management concerns because:

1) the potential to disrupt or threaten established migration routes in these areas is much greater than in areas where animals are free to roam about,
2) most are natural constrictions and therefore more susceptible to additional impediments and/or barriers,
3) land use practices have fragmented and further restricted existing migration routes,
4) existing bottlenecks are used by thousands of pronghorn and mule deer that summer over large portions of western Wyoming, and
5) alternative migration routes appear to be inadequate or unavailable.

Because of the complexity of the issues involved, the wide range of land status, and the numerous options available with preserving the pronghorn migration, the WGFD in cooperation with the University of Wyoming, the BLM, Sublette County, and various non-government organizations (NGO) developed a 4-level approach for identifying opportunities and implementing actions to assist with the preservation the Jackson Hole pronghorn migration. These levels are not arranged in any particular order, nor is one more important than another. Rather, the 4-levels are complimentary and intended to provide a framework so that federal agencies, state agencies, local governments, private landowners, and NGO's all have an opportunity to be involved with and contribute to the preservation of the Jackson Hole pronghorn migration.

The 4-level approach includes:

- Federal and State Land Management Planning
- County Land Use Planning
- Private Land Conservation
- Education/Public Awareness

Actions to be considered with federal and state land management planning include:

- Incorporate pronghorn migration routes into BLM Resource Management Plans (RMP) and USFS Forest Plans (FP).
- Identify federally owned parcels where oil and gas leases should not be renewed or made available.
- Withhold mineral leases in sensitive areas until revisions of RMP's and FP's are complete.
- Update designated pronghorn seasonal ranges used by federal and state agencies.
- Consider impacts or improvements of migration routes when conducting land exchanges.
- Focus voluntary off-site mitigation opportunities on maintenance and improvement of migration routes.
- Coordinate available GIS technology and digital data for the region and encourage shared use among public and private sectors.
- Ensure additional fences built on federal lands are not a barrier to pronghorn movements.
- When new information is available, make use of the adaptive management strategy outlined in the Pinedale Anticline EIS prepared by the BLM.
- Coordinate with Wyoming Department of Transportation (WDOT) to ensure proper right-of-way fencing and explore the possibility of drop fences (or open gates) in key areas.

Actions to be considered with county land use planning include:

- Use maps of migration routes to modify current county planning and zoning guidelines.
- Consult with WGFD for planning and zoning guidelines and/or recommendations.
- Investigate other county plans in terms of how they deal with wildlife issues, open spaces, and conservation easements.
- Link county development plans to public awareness/education outreach program.

Actions to be considered with private land conservation include:

- Pursue conservation easements (Green River Valley Land Trust, Nature Conservancy) in key areas. Conservation easements typically involve the landowner waiving development rights on a portion(s) of their property. Conservation easements: 1) do not require public access to the lands, 2) do not change ownership of the lands, and 3) may be written to address specific concerns of the landowner.

- Inform private landowners in key areas of the migration situation and the options available to them that may help with preserving the migration route (i.e., fence management, pet control, etc).

Actions to be considered at the public awareness/education level include:

- Provide public with information on migration routes and other important wildlife issues.

- Provide public with information on wildfire-friendly fencing specifications.

- Distribute educational material through local realtors, fence contractors, developers, WGFD, and county government.

- Minimize vehicle/animal collisions by improving WDOT road signing along the Trapper's Point section of U.S. Highway {191}.

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