FEDERAL AID FINAL
RESEARCH PERFORMANCE REPORT

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
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PROJECT TITLE: Demographics and spatial ecology of Dall sheep in the central Brooks Range

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FEDERAL AID GRANT PROGRAM: Wildlife Restoration

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WORK LOCATION: Unit 24A, eastern Brooks Range

STATE: Alaska

PERIOD: 1 July 2007–30 June 2014

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

The trans-Alaska pipeline (TAP), Dalton Highway, and two adjacent gas pipeline rights-of-way cross the Bureau of Land Management (BLM)-managed utility corridor planning area in the Brooks Range, Alaska. BLM has identified 5 areas of critical environmental concern (ACEC) in this area, which are intended to protect Dall sheep habitat. The Alaska Department of Fish and Game (ADF&G) and BLM administer separate state and federal Dall sheep hunts in the area under their respective authorities. An estimated 40% decline in the sheep population occurred in the area surrounding the utility corridor during the early 1990s. No data are available on the causes of this decline, or why the population did not recover during the relatively mild winters that followed. Potential factors that may affect sheep in the utility corridor include 1) unlimited guided sport hunting that occurs on state and federal land; 2) upgrades to the Dalton Highway that will facilitate travel and increased human use of the area; 3) proposed changes to state law that currently prohibits the use of ORVs within 5 miles of the Dalton Highway in the Brooks Range; and 4) intense interest in resource development in the area, including a proposed gas pipeline, increased mining activity, and ecotourism. The effects of land management decisions and human activity on Dall sheep in the utility corridor are difficult to predict due to the lack of basic information about this population.

II. REVIEW OF PRIOR RESEARCH AND STUDIES IN PROGRESS ON THE PROBLEM OR NEED

ADF&G conducted aerial minimum count surveys of sheep in the upper Chandalar River watershed from 2002 to 2007 (Caikoski 2008). Population estimates from these surveys varied greatly among years, indicating either differing rates of mortality and fecundity or irregular movements of animals into and out of the area. However, no data are available to help with interpreting this information.

III. APPROACHES USED AND FINDINGS RELATED TO THE OBJECTIVES AND TO PROBLEM OR NEED

OBJECTIVE 1: Investigate seasonal and annual distributions and movement patterns of Dall sheep in relation to survey units and the Dalton Highway utility corridor.

Twenty-one adult ewes were captured by helicopter net-gunning and fitted with GPS-equipped radio collars during March 2009. Eight additional collars were obtained from another project and one collar was recovered from a sheep that died during 2009. These collars were refurbished and deployed on 9 additional ewes during March 2010. One collared ewe died of unknown causes within a few days of capture in March 2009. Because this ewe may have been affected by capture-related stress, she was not included in this analysis. Thus, we monitored movements of a total of 29 ewes.

One GPS collar failed during September 2011. Collars were recovered from sheep that died during the study, and the 21 functioning collars still deployed at the completion of fieldwork were released automatically on 1 March 2012. These collars were recovered and the location data stored onboard the collars were downloaded and entered into a geodatabase. Locations of collared sheep were mapped to identify areas of frequent use, and movements of sheep were examined in relation to boundaries of BLM's designated ACEC, mining claims, and established survey units used during sheep abundance surveys conducted by ADF&G.

Location data recorded by the GPS collars indicated that collared sheep could be classified into 3 distinct groups separated by natural and man-made barriers. Collared sheep did not cross the valley formed by the Dietrich River and the middle fork of the Koyukuk River, which was oriented north–south and included the Dalton Highway-TAP corridor. This feature divided sheep populations into eastern and western groups. The Bettles River valley, running east–west and joining the Dietrich River from the east, further subdivided sheep populations on the east side of the TAP corridor. Sheep habitat on the west side of the TAP corridor was contiguous with additional habitat to the west, and sheep habitat east of the corridor and north of the Bettles River was contiguous with additional sheep habitat further east. Thus, these subpopulations were likely to come into contact with other sheep in neighboring areas. However, sheep inhabiting the Poss Mountain area, south of the Bettles River and east of the TAP corridor, appeared to be isolated from other nearby sheep ranges (Fig. 1).

OBJECTIVE 2: Estimate annual birth rates for Dall sheep ewes.

This objective proved to be impractical due to difficulty in scheduling frequent survey flights during the lambing season. Thus, this objective was abandoned.

OBJECTIVE 3: Estimate survival of lambs to yearling age class and determine causes of mortality.

Twenty lambs were captured during 20–22 May 2009; 25 lambs were captured during 17–19 May 2010; and 24 lambs were captured during 18–19 May 2011. Lambs were equipped with expandable, breakaway VHF radio collars and monitored by aerial radiotracking weekly during May and June and twice-monthly thereafter through May of the following year, excluding the months of December and January.

All radio collars contained a motion-sensor to indicate when sheep had died. We determined probable dates of death for ewes by examining the GPS data recorded by the collar and identifying the date when the ewe became immobile. For lambs, we estimated approximate dates of death as the midpoint between the last date when radiotracking data indicated that the lamb was alive and the first date it was found to be dead. We used Kaplan-Meier procedures to estimate survival rates of ewes during 1-year periods extending from April to March of 2009–2010, 2010–2011, and 2011–2012. Survival of lambs was estimated from date of capture through 15 May at the end of their first year of life.

First-year survival of lambs from cohorts born during 2009–2011 was 0.68, 0.48, and 0.28, respectively (Table 1). Of the 2009 cohort, 6 lambs died and 1 shed its collar; 13 lambs of the 2010 cohort died; and 13 lambs of the 2011 cohort died and 6 shed their collars. The most common causes of death were drowning (*n* = 6 lambs) and predation by golden eagles (*n* = 7) and wolverines (*n* = 6). Grizzly bears and wolves each killed 2 lambs, and 2 lambs died from falls or other accidents. Unidentified predators killed 6 lambs, and cause of death could not be determined for 1 lamb. Four of the 6 drowning deaths occurred during a 3-day period in May 2011, shortly after the peak of lambing. Heavy rain and sudden warming during that period caused rapid snowmelt and high water levels at a time when many lambs were especially vulnerable. Although this unusual event contributed to the low survival rate for the 2011 cohort, even if these deaths are not included in the survival estimation, survival of the 2011 cohort was only 0.38 and was the lowest recorded during the study.

Annual survival for adult ewes during 2009–2010, 2010–2011, and 2011–2012 was 0.85, 0.88, and 0.77, respectively (Table 1). Of the 11 ewes that died during the study, 8 were killed by wolves, 2 by grizzly bears, and 1 by an unidentified predator (probably either wolves or bears).

OBJECTIVE 4: Evaluate nutritional status of sheep in comparison to other populations.

We collected samples of feces and urine (frozen in snow) from areas used by sheep as winter range during late March 2010 and 2011. Samples were sent to the University of Alaska Fairbanks for analysis of nitrogen isotope ratios as an indicator of the quality of winter forage (N content of metabolized forage). Analysis of these samples is pending.

OBJECTIVE 5: Assess changes in abundance and age/sex structure of the population.

We conducted aerial surveys of sheep abundance in the study area during July 2009 and 2012. Surveys were carried out using single-engine fixed-wing aircraft (Piper Super Cub) and consisted of the pilot and one observer intensively searching for sheep within designated survey units. Sheep were counted and classified as lambs; ewes and yearlings; or rams. Rams were further classified by horn size as either less than full curl or greater than or equal to full curl.

Aerial survey data indicated that the sheep population in the areas occupied by collared sheep increased from 1,107 during 2009 to 1,282 during 2012, continuing a trend that began in 2003 (Tables 2 and 3). Similar increases were noted in an adjoining survey unit and in Gates of the Arctic National Park (Schmidt et al. 2012), suggesting that the population increase was widespread and not due to immigration from neighboring areas. However, the ratio of lambs:ewes was only 0.19 during 2012, compared to 0.32 during 2009. This suggests that lamb survival, which declined during 2009–2011, remained low during 2012.

OBJECTIVE 6: Prepare annual and final reports.

Annual and final reports were prepared.

IV. MANAGEMENT IMPLICATIONS

Movements of collared sheep east of the TAP corridor and north of Bettles Creek were contained within the boundaries of the corresponding survey unit used during sheep population surveys from 2002 to 2009 (Fig. 1), suggesting that between-year variation in counts of sheep in this area was not due to movements of sheep into or out of the survey unit. In contrast, sheep from the Poss Mountain subpopulation regularly crossed Minnie Creek, which delineated the southern boundary of the Poss Mountain survey unit. To minimize variation due to sheep movements, future surveys of this area should include the adjoining sheep habitat south of Minnie Creek and north of Slate Creek.

The relatively small Nugget Creek and Poss Mountain ACEC units were consistently used by collared sheep (Fig. 2). Both of these areas contain mineral licks that warrant special management attention. However, the larger Snowden Mountain ACEC did not include an area encompassing the headwaters of Mathews Creek that was frequently used by all collared sheep from that subpopulation. The Snowden ACEC is situated along the western slope of the Snowden Mountain massif, whereas more sheep activity occurred on the northern and eastern slopes of that ridge, east of the ACEC boundary. To adequately protect important sheep habitat, the Snowden ACEC should be extended to include sheep habitat above 1,000 m elevation between the current eastward edge of the ACEC and the boundary of BLM land near Mathews Creek (Fig. 2).

Two additional mineral licks were identified that should be given special management consideration (Fig. 2). One of these is located on Gold Creek, 2.5 km east of the Dalton Highway and 1.0 km west of an active mining claim. The other lick is on Wiseman Creek, 1.5 km northwest of the Wiseman landing strip. The area surrounding the Wiseman Creek lick was also used as a travel corridor by sheep moving between winter range on Midnight Dome and summer range on Kalhabuk Mountain and adjacent habitat within Gates of the Arctic National Park.

Most mining claims in the study area were located in low-lying areas along streams. Thus, these claims are not likely to have significant effects on sheep in the area, provided that future development of the claims does not impede movements of sheep crossing these valleys. However, the largest aggregation of mining claims (currently undeveloped) encompasses most of Smith and Midnight Domes, northwest of Wiseman (Fig. 2). These domes comprised the entire winter range used by the 3 sheep that we collared west of the Dalton Highway. This small subpopulation was also the only group observed to have distinct winter and summer ranges. It is likely that a large mining operation here could significantly reduce the amount of winter range available to sheep, and reduce the abundance of sheep in the immediate vicinity of Wiseman.

V. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN FOR LAST SEGMENT PERIOD ONLY

None.

VI. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THE LAST SEGMENT PERIOD, IF NOT REPORTED PREVIOUSLY

None.

VII. PUBLICATIONS

None.

Literature Cited:

CAIKOSKI, J. R. 2008. Eastern Unit 24A and Units 25A, 26B, and 26C Dall sheep. Pages 177–196 *in* P. Harper, editor. Dall sheep management report of survey-inventory activities 1 July 2004–30 June 2007. Alaska Department of Fish and Game, Project 6.0, Juneau, Alaska.

SCHMIDT, J. H., K. L. RATTENBURY, J. P. LAWLER, AND M. C. MACCLUSKIE. 2012. Using distance sampling and hierarchical models to improve estimates of Dall's sheep abundance. Journal of Wildlife Management 76:317–327.

VIII. RESEARCH EVALUATION AND RECOMMENDATIONS

None.

IX. APPENDICES

None.

PREPARED BY: Scott Brainerd, ADF&G

DATE: 26 August 2014

Table 1. Survival estimates for radiocollared sheep, 2009–2012. Survival of ewes was estimated from 1 April of each year through 30 March of the following year. Survival of lambs was estimated from date of capture (17–22 May) through 15 May of the following year.

	Ewes			Lambs		
Status	2009	2010	2011	2009	2010	2011
n radiocollared	20	26	23	20	25	24
n known fate	20	26	22	19	25	18
Deaths	3	3	5	6	13	13
Survived	17	23	17	13	12	5
Unknown[a]	0	0	1	1	0	6
Survival	0.85	0.88	0.77	0.68	0.48	0.28
SE[b]	0.07	0.06	0.08	0.09	0.07	0.06

[a] Fate was unknown due to loss or failure of collar.
[b] Standard error of the estimate of survival.

Table 2. Results of sheep population surveys in the eastern Brooks Range, 9–12 July 2012. Counts of ewes likely included some young rams. Legal rams were those with full-curl or larger horns, or with both horns broomed. Counts of ewe-like sheep included yearlings and some young rams indistinguishable from ewes.

Unit	Total sheep	"Ewe-like"	Lambs	Sublegal rams	Legal rams	Unclassified rams	% Legal rams	% Lambs	Lambs:100 "ewes"	Survey time (hr:min)
1A	1163	799	141	211	12	0	1.0	12.1	17.6	12:10
1B	575	354	71	132	18	0	3.1	12.3	20.1	8:44
5A	119	74	23	16	6	0	5.0	19.3	31.1	1:35
5B	16	7	6	3	0	0	0.0	37.5	85.7	0:23
5C	29	9	2	14	4	0	13.8	6.9	22.2	1:54
13C	192	78	29	36	14	35	8.9	15.1	37.2	2:20
13D	35	31	4	0	0	0	0.0	11.4	12.9	1:23
13E	33	27	6	0	0	0	0.0	18.2	22.2	0:57

Table 3. Results of sheep population surveys in the primary survey area (units 1A and B), eastern Brooks Range, 2002–2012. Counts of ewes likely included some young rams. Legal rams were those with full-curl or larger horns, or with both horns broomed. Counts of ewe-like sheep included yearlings and some young rams indistinguishable from ewes. No surveys were conducted during 2008, 2010, or 2011.

Year	Total sheep	"Ewe-like"	Lambs	Sublegal rams	Legal rams	Unclassified rams	% Legal rams	% Lambs	Lambs:100 "ewes"	Survey time (hr:min)
2002	1539	884	221	380	50	4	3.3	14.4	25.0	14:05
2003	989	621	114	207	34	13	3.5	11.5	18.4	11:32
2004	1460	908	180	320	43	9	3.0	12.3	19.8	16:41
2005	1099	636	214	203	42	4	3.8	19.5	33.6	15:10
2006	1517	857	224	313	46	77	3.2	14.8	26.1	17:30
2007	1310	779	332	152	47	0	3.6	25.3	42.6	18:07
2009	1535	911	295	298	31	0	2.0	19.2	32.4	21:38
2012	1738	1153	212	343	30	0	1.7	12.2	18.4	20:54
$\bar{x}$	1398	844	224	277	40	13	3.0	16.2	27.0	16:57

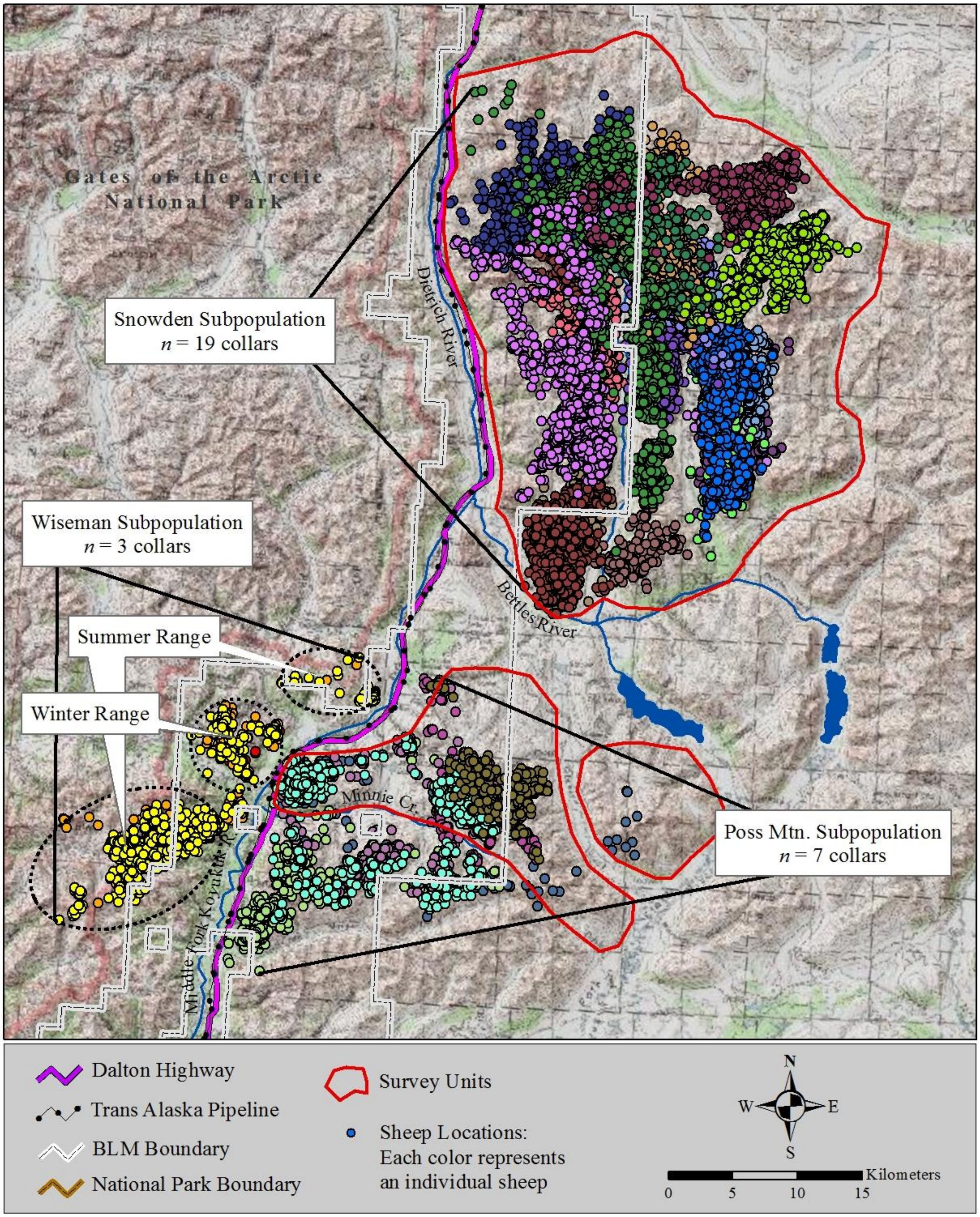

Figure 1. Locations of radiocollared Dall sheep ewes and sheep subpopulations, 2009–2012, in relation to environmental barriers and established survey unit boundaries.

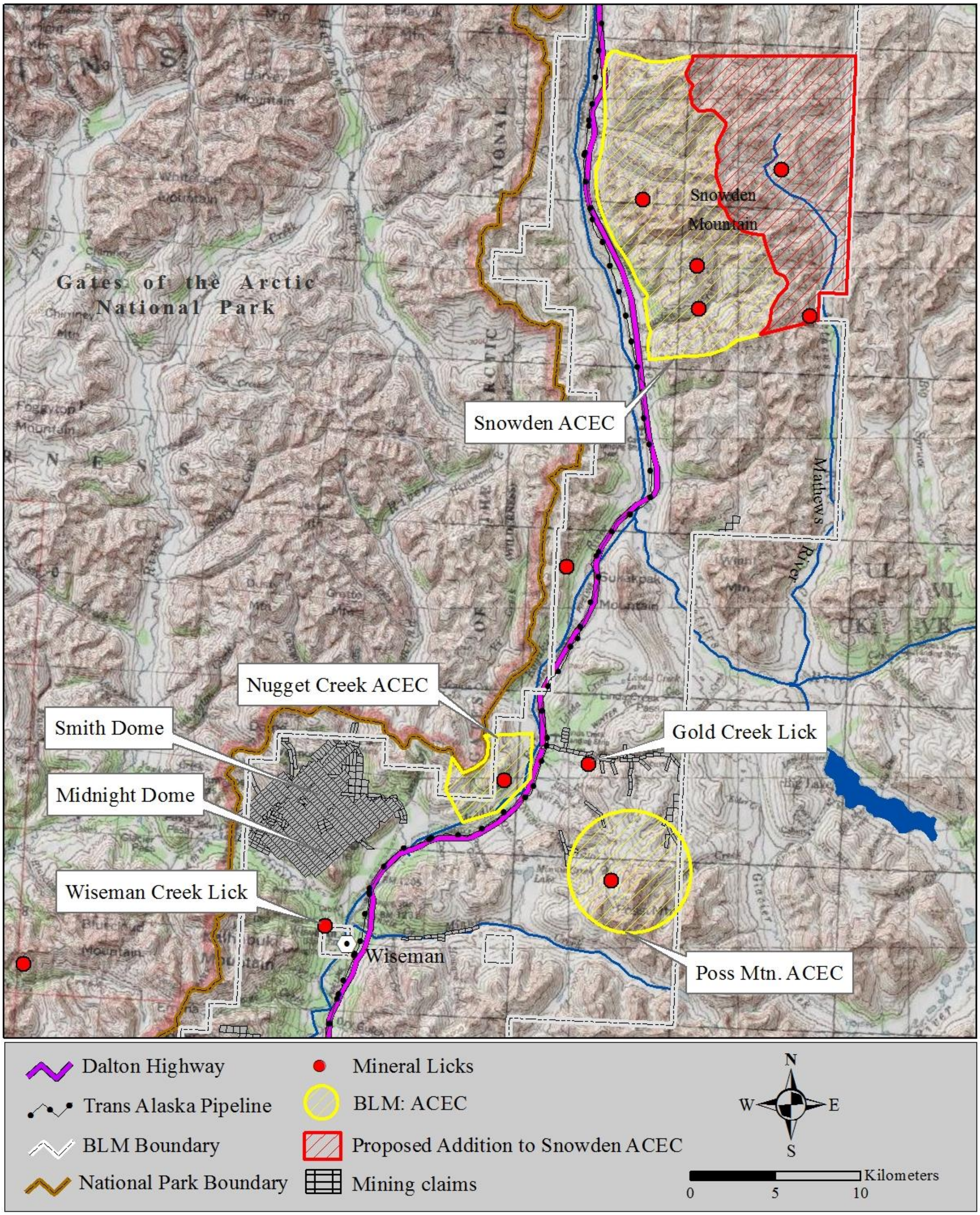

Figure 2. Locations of mineral licks, mining claims, and BLM-designated areas of critical environmental concern (ACEC). Named licks were identified during this study.