Susitna-Watana Hydroelectric Project (FERC No. 14241)

Dall's Sheep Distribution and Abundance Study Plan Section 10.7

Study Completion Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

Alaska Department of Fish and Game and

ABR, Inc.—Environmental Research & Services

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LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Abbreviation	Definition
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
APA	Alaska Power Authority
FERC	Federal Energy Regulatory Commission
GMU	Game Management Unit
ILP	Integrated Licensing Process
ISR	Initial Study Report
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project No. 14241
RSP	Revised Study Plan
SPD	Study Plan Determination

1. INTRODUCTION

This Dall's Sheep Distribution and Abundance Study, Section 10.07 of the Revised Study Plan (RSP) approved by the Federal Energy Regulatory Commission (FERC or Commission) for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241, focuses on the distribution, abundance, and use of mineral licks by Dall's sheep in the Susitna-Watana Project area.

A summary of the development of this study, together with the Alaska Energy Authority's (AEA) implementation of it through the 2013 study season, appears in Part A, Section 1 of the Initial Study Report (ISR) filed with FERC in June 2014 (ABR and ADF&G 2014a). As required under FERC's regulations for the Integrated Licensing Process (ILP), the ISR describes AEA's "overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule." (18 CFR 5.15(c)(1)).

Since filing the ISR in June 2014, AEA has continued to implement the FERC-approved plan for the Dall's Sheep Distribution and Abundance Study. For example:

- On October 21, 2014, AEA held an ISR meeting for the Dall's Sheep Distribution and Abundance Study work completed in 2013.
- Two site visits to mineral licks used by Dall's sheep were completed in May and June 2014.
- The second and final aerial survey of Dall's sheep distribution in the study area was completed in July 2015.

In furtherance of the next round of ISR meetings and FERC's SPD expected in 2016, this report contains a comprehensive discussion of results of the Dall's Sheep Distribution and Abundance Study from the beginning of AEA's study program in 2012, through the end of calendar year 2015. It describes the methods and results of the Dall's Sheep Distribution and Abundance Study, and explains how all Study Objectives set forth in the Commission-approved Study Plan have been met. Accordingly, with this report, AEA has now completed all field work, data collection, data analysis, and reporting for this study.

2. STUDY OBJECTIVES

The goal of this study is to obtain sufficient information on the minimum population size, summer distribution, and current use of mineral licks by Dall's sheep—an important species of big game in the Project area—to use in evaluating potential Project-related effects and identifying measures to avoid, minimize, or otherwise mitigate those effects.

The study objectives are established in RSP Section 10.7.1:

1) Estimate the current minimum population size of Dall's sheep in the study area.
2) Delineate the summer range of Dall's sheep in the study area.
3) Evaluate the current condition of mineral licks in and near the Project area.

4) Analyze and synthesize data from historical and current studies of Dall's sheep in the study area, as a continuation of the 2012 study (AEA 2012a).

3. STUDY AREA

As established by RSP Section 10.7.3, the study area consists of that portion of Game Management Unit (GMU) Subunit 13E located east of the Parks Highway and south of the Denali Highway, encompassing the proposed Project facilities, potential access and transmission line corridors, and reservoir inundation zone (Figure 3-1). All suitable Dall's sheep habitat within the study area was surveyed by airplane and the mineral licks at Jay Creek and Watana Creek were visited on the ground.

As described in the ISR Overview (Section 1.4) filed in June 2014 and subsequently the *Proposal to Eliminate the Chulitna Corridor from Further Study* filed with FERC September 17, 2014, AEA explained that it had decided to pursue the study of an additional alternative north-south corridor alignment for transmission and access from the dam site to the Denali Highway, referred to as the "Denali East Corridor Option," and to eliminate the Chulitna Corridor from further study. This change to the study area did not impact this study, because surveys were only conducted in suitable Dall's sheep habitat within the study area, which does not include any of the access corridors considered.

4. METHODS AND VARIANCES

The study comprised three components:

- Aerial surveys for summer distribution and minimum population estimation.
- Inspection of the Jay Creek and Watana Creek mineral licks to assess their current condition and general level of use.
- Analysis of historical (1980s) data and synthesis with current Alaska Department of Fish and Game (ADF&G) monitoring results.

4.1. Aerial Surveys

AEA implemented the methods described in the Study Plan, with the exception of the variances described below in Section 4.1.1.

The study team enlisted the services of experienced biologists and fixed-wing survey pilots in July 2013 and July–August 2015 to document sheep distribution and to develop a minimum population estimate. The survey covered all suitable sheep habitat in the study area and followed standard ADF&G protocols for summer surveys after lambing and before the sheep hunting season begins in early August. Optimal survey conditions include a lack of turbulence, a lack of precipitation, minimal glare from direct sunlight, and clear visibility with no portion of the study area obscured by clouds or fog.

The study team divided the aerial survey study area into three survey blocks, based on the distribution of suitable habitat in GMU Subunit 13E: the Chulitna Mountains block southeast of Cantwell, the West Kosina Hills block south of the proposed reservoir inundation zone, and the Watana Creek Hills block north of the proposed reservoir inundation zone (Figure 4.1-1). The team surveyed each block using a small fixed-wing aircraft (Piper PA-18 "Super Cub") flown along elevation contours at altitudes of 300–700 feet above ground level and airspeeds of 60–80 mph. If necessary for adequate coverage in areas of rough terrain, the team completed two flight passes. The study team classified sheep into the following categories: rams, lambs, ewes and ewe-like sheep. In addition to ewes, the ewes and ewe-like sheep category may include yearling rams, which are sometimes difficult to distinguish from ewes. The "kde" tool in the program Geospatial Modeling Environment (available online from spatialecology.com/gme) was used to map relative sheep densities in the study area.

4.1.1. Variances

No variances from the methods described in the Study Plan were implemented in 2013. Due to a lack of adequate survey conditions in 2014, the second year of aerial surveys was instead conducted in 2015. During the 2015 aerial surveys, a small portion of the Chulitna Mountains block was missed due to pilot miscommunication. On the last day of surveying, the two fixed-wing survey pilots conducting the survey communicated that they would survey up to either side of Portage Creek in the southern portion of the Chulitna Mountains block. One pilot surveyed up to the eastern edge of the East Fork of Portage Creek and the other pilot surveyed up to the western edge of the West Fork of Portage Creek. Due to this error, a small area between the East and West Forks of Portage Creek was not surveyed in 2015 (depicted in Figure 5.1-2).

4.2. Mineral Lick Surveys

AEA implemented the methods described in the Study Plan, with the exception of the variance described below in Section 4.2.1.

The study team visited the Jay Creek and Watana Creek mineral licks (Figure 3-1) twice in 2013, once during May (May 28–29) and once in June (June 19–20), and twice in 2014, once during May (May 28–29) and once in June (June 18–19) to provide a qualitative assessment of lick condition and levels of use. Results were compared with those from ground-based surveys of mineral licks conducted in the 1980s (Tankersley 1984). Conducting site visits in both 2013 and 2014 provided information on annual variability.

4.2.1. Variances

As described in ISR Part A, Section 4.2.1, in 2013, a time-lapse camera was deployed at the Jay Creek mineral lick. This variance was also repeated in 2014. During the May site visits to the Jay Creek mineral lick, the study team deployed a time-lapse camera to record sheep presence on the main cliff face of the mineral lick, thereby providing a greater volume of data on lick use than would have resulted from the two site visits per year proposed in RSP Section 10.7.4. The time-lapse camera (Model PC900 from Reconyx, Inc., Holmen, WI) was programmed to record photographs at 10-minute intervals for 24 hours each day, although the cliff was only visible in photos taken during daylight hours. The study team placed the camera approximately 600 m from

the main cliff face at the lick in both years. That distance was relatively far for distinguishing sheep in the photographs but, because of local topography, the location selected was the best one from which to photograph the cliff face. The data obtained from the time-lapse photography provide additional information to use in achieving the study objective regarding characterization of mineral lick use.

4.3. Analysis of Historical Data

In 2013, AEA completed the methods as described in the Study Plan, with no variances. These results were also described in the ISR, Part A (ADFG and ABR 2014a).

The study team reviewed and synthesized data from historical and current studies of Dall's sheep in the study area, as a continuation of the 2012 study (AEA 2012a). Aerial survey data and mineral lick observation data were compiled from various sources, including ADF&G management reports (Didrickson 1980, Kavalok 2005, Peltier 2011), the final report for the APA Project study in the 1980s (Tankersley 1984), and unpublished survey data and maps. Historic and current survey and observation data for Dall's sheep were summarized to determine habitat use within the Project area, changes in population size, and use of the Jay Creek and Watana Creek mineral licks.

4.3.1. Variances

No variances from the methods described in the Study Plan were implemented.

5. RESULTS

Because animal location data collected during ADF&G population surveys are restricted under Alaska State Statute (AS 16.05.815(d)), the location coordinates of the Dall's Sheep observed during the previous population surveys analyzed for the ISR (ADF&G and ABR 2014a, Section 5.1) or for this report are not included in the data posted on the Project website.

Data developed in support of this study are available at: http://gis.suhydro.org/SIR/10-Wildlife/10.7-Dall's_Sheep/

See Table 5-1 for details.

5.1. Aerial Surveys

The study team counted a total of 512 Dall's sheep in the study area over 32 survey hours during July 11–30, 2013 (Figure 5.1-1) and a total of 454 sheep over 30 survey hours during July 31–August 2, 2015 (Figure 5.1-2). The weather was clear and calm during the survey flights in 2013, providing excellent survey conditions. The weather varied from high overcast to clear during the survey flights in 2015, providing good to excellent survey conditions. The majority of the sheep (54 percent in 2013 and 55 percent in 2015) were counted in the Chulitna Mountains (Tables 5.1-1 and 5.1-2). That survey block was the largest (2,375 km^2) and had the most rugged terrain, so two flight passes (one at higher altitude and one at lower altitude) often were required to cover the area adequately. The Watana Creek Hills survey block was the smallest (522 km^2) and only 41

sheep were counted in that area in 2013 and 33 were counted in 2015. A count of 194 sheep in 2013 and 172 sheep in 2015 was recorded in the West Kosina Hills, the third survey block (Tables 5.1-1 and 5.1-2).

The ram/ewe and lamb/ewe ratios were similar among the three survey blocks in 2013, ranging from 62.6 to 63.6 rams per 100 ewes and 22.0 to 33.3 lambs per 100 ewes (Table 5.1-3). The ram/ewe ratios varied greatly in 2015 because fewer rams and ewes were observed in all three survey blocks than in 2013 (Tables 5.1-1, 5.1-2, and 5.1-4). The lamb/ewe ratio increased in 2015, ranging from 43.6 to 53.8 lambs per 100 ewes (Table 5.1-4). Relative density of observed sheep during the 2013 and 2015 aerial surveys is shown in Figures 5.1-1 and 5.1-2.

In addition to sheep, two male mountain goats (*Oreamnos americanus*) were observed in the southern portion of the Chulitna Mountains survey block during the 2015 survey.

5.2. Mineral Lick Surveys

5.2.1. 2013

As reported in ISR Part A, Section 5.2, Dall's sheep were observed at the Jay Creek and Watana Creek mineral licks during site visits in May and June 2013 (Table 5.2-1). During the first visit on May 28–29, three rams were observed near the Watana Creek lick and another seven sheep were visible on the surrounding mountains. Three rams and one ewe were observed at the Jay Creek lick on the May visit. During the observation period, two of the rams left the cliff above Jay Creek and moved to the mountains north of the lick.

During the second site visit (June 19–20), two rams were observed near the Watana Creek lick and at least 15 other sheep were observed in the surrounding area. Two sheep were observed in a previously undescribed low-elevation mineral lick north of Watana Creek, approximately 1.2 miles northwest of the Watana Creek lick. Seven sheep (two rams, three ewes, one yearling, and one lamb) were present at the Jay Creek Lick on June 20. During the observation period, one ewe, the yearling, and both rams departed the lick and moved into the mountains to the northwest of the lick.

The time-lapse camera deployed at the Jay Creek lick on May 29 was knocked at an angle on May 30, most likely by a brown bear, but the majority of the main cliff face at the lick on the west side of the creek was still visible in photos. The long distance and displaced camera made identifying sheep in photos challenging, but sheep in open habitat were visible under good light conditions. The daily maximum number of sheep visible in each photo varied from 1–2 in late May and early June to 4 on June 10. The peak count from the photos was five sheep on June 18 (Figure 5.2-1). No sheep were visible in photos during June 12–14. On June 15, at least three sheep were visible on the hill east of Jay Creek, opposite the lick.

5.2.2. 2014

Dall's sheep were observed at the Watana Creek mineral licks during site visits in May 2014 but not in June 2014 and Dall's sheep were not observed at the Jay Creek mineral lick during either site visit (Table 5.2-2). During the first visit on May 28–29, nine sheep including at least five rams,

were observed near the Watana Creek lick and another six sheep were visible on the surrounding mountains. No sheep were observed at the Jay Creek lick on the May visit.

During the second site visit (June 18–19), no sheep were observed near the Watana Creek lick but seven sheep were observed in the surrounding area. No sheep were present at the Jay Creek lick.

The time-lapse camera was deployed at the Jay Creek lick on May 29. The long distance made identifying sheep in photos challenging, but sheep in open habitat were visible under good light conditions. No sheep were visible in photos taken before June 4 or after June 11. Between June 4 and 11 between zero and a maximum of three sheep were visible daily. The peak maximum daily count of three sheep visible in photos occurred on four days between June 7 and 11 (Figure 5.2-1).

5.3. Analysis of Historical Data

Historical survey data for GMU 13E were compiled from ADF&G management reports (Didrickson 1980, Kavalok 2005, Peltier 2011), the APA Project final report on Dall's sheep (Tankersley 1984), and unpublished data in ADF&G files.

6. DISCUSSION

6.1. Aerial Surveys

Survey conditions were excellent for the Dall's sheep surveys in 2013 and good to excellent in 2015. Fewer rams and ewes were observed in all three survey blocks in 2015 compared to 2013. The total number of rams observed declined 27% and 40% and the total number of ewes observed dropped 21% and 5% in the Chulitna Mountains and West Kosina Hills, respectively, from 2013 to 2015 (Tables 5.1-2 and 5.1-3). The number of sheep observed did not decline in the remainder of the Talkeetna Mountain sheep survey area in 2015 (ADF&G, unpublished data). Although counts declined 2013 to 2015, the number of sheep observed can be influenced by factors that affect the sightability of sheep during a survey, such as weather conditions or the experience level of each observer and it cannot be said with confidence that regional numbers declined. However, the winters of 2013/2014 and 2014/2015 both were late and icy conditions were persistent in higher elevations of the study area which may have contributed to a higher over-winter mortality rate for Dall's sheep. Other factors that could affect sheep mortality include predation and or skewed population age structures. It is also possible that the change in the number of sheep observed in the study area could be explained by emigration of Dall's sheep out of the study area to surrounding mountains. Without additional data, the potential causes for a decline are purely speculative.

The observed lamb/ewe ratio increased 143% and 137% in the Chulitna Mountains and Watana Creek Hills, respectively, from 2013 to 2015 (Tables 5.1-4 and 5.1-5). The high lamb/ewe ratios observed are consistent with data from other Dall's sheep surveys in the Talkeetna Mountains in 2015 (ADF&G, unpublished data). The increase in numbers of lambs was likely due to the favorably warm spring that occurred in 2015, which presumably allowed for increased lamb survival. The high number of lambs will likely result in an increase in overall sheep numbers in upcoming years, provided that the 2015/2016 winter conditions are not severe. Because the density

of sheep in the southern portion of the Chulitna Mountains block was very low (Figure 5.1-2), it is unlikely that many sheep were missed in the area between the East and West Forks of Portage Creek that was accidentally skipped during the 2015 survey.

The distribution of Dall's sheep in the survey areas was generally similar in both 2013 and 2015 surveys (Figures 5.1-1, 5.1-2). The highest densities in the Chulitna Mountains survey area were highest in the northwestern portion of the survey area. The highest densities in the West Kosina Hills survey area were south of the center of the study area. The Watana Creek survey area had low densities overall but the highest densities were in the north-central portion of the survey area.

The total number of sheep observed in the Watana Creek Hills was lower in 2013 and 2015 than has been documented in previous years and was less than a third of the population size documented during the 1983 sheep survey for the APA Project (Table 5.3-1; Tankersley 1984). The population in the Talkeetna Mountains (including the Watana Creek Hills) has not rebounded from the severe decline that occurred after the harsh winter of 1999/2000 (Peltier 2011). The ram/ewe ratio was higher in the Watana Creek Hills during the 2013 survey than has been observed historically in that area (Table 5.3-1), but was similar to the ram/ewe ratios observed in the Chulitna Mountains and West Kosina Hills survey blocks in 2013 (Table 5.1-3). The ram/ewe ratio observed in the Watana Creek Hills was much higher in 2015 than in 2013. The difference may be attributed to the reduction in the number of sheep observed and the relatively small sample size. The lamb/ewe ratio observed in 2015 was the second highest recorded since 1968 (Table 5.3-1).

The 2013 survey areas in the Chulitna Mountains and West Kosina Hills were more extensive than were the survey areas covered historically, including the 1980s sheep surveys for the APA Project (Figure 4.1-1). Although a change in population size has not been documented in those two survey areas, it is likely that sheep there also experienced a population decline in the winter of 1999/2000, along with the Watana Creek Hills and other surveyed portions of the Talkeetna Mountains (Peltier 2011).

The majority of the sheep counted in the Chulitna Mountains survey area in both 2013 and 2015 were west of the Jack River and north of the East Fork of the Chulitna River (Figures 5.1-1 and 5.1-2). The 1980s surveys in the Chulitna Mountains covered only the peaks east and south of that area because of their proximity to the transportation corridors proposed at that time (Figure 4.1-1). In the surveys conducted in July 1980 and June 1983, 72 and 52 sheep were counted, respectively, in that portion of the Chulitna Mountains (ADF&G, unpublished data; Tankersley 1984). In the July 2013 survey, 66 sheep were counted in the same area covered by the 1980s surveys. The results of the 2013 West Kosina Hills survey are not comparable to the results from the 1980 and 1981 surveys due to differences in the areas surveyed (Figure 4.1-1; ADF&G, unpublished data).

The two mountain goats observed during the 2015 survey were near the area where a single mountain goat was observed in 2012 and a small population of mountain goats were observed in 1982 and 1983 by ADF&G personnel (Tankersley 1984). Long distance dispersal of mountain goats (especially 2–5 year old males) is not uncommon (Schafer 2011) but, with only two males, this group is not a viable breeding population.

6.2. Mineral Lick Surveys

During the APA Project study conducted in the 1980s, up to 31 sheep were observed daily using the various locations comprising the Jay Creek mineral lick (Tankersley 1984). Some marked sheep remained at the lick for two to 15 days. Sheep of various sex and age classes used the lick, but only rams were present until May 28 and few rams were present after June 14. When at the lick, sheep spent 57.5% of the time on the main cliff face west of the creek, which is the area monitored by the time-lapse camera in May–June 2013 and 2014. During the much less intensive observations conducted in 2013, the maximum count at the lick was seven sheep at one time, similar to the maximum count of five sheep in the time-lapse photos. The time-lapse photo counts are most likely undercounts of the total number of sheep using the lick, however, because only sheep in the open portions of the main cliff face were visible in the photos. Nevertheless, the observations in 2013 indicated that fewer sheep were using the Jay Creek lick than in the 1980s, consistent with the decline in the local sheep population observed in the time series of aerial surveys described above. Fewer sheep were observed using the Jay Creek lick in 2014 than in 2013 and photographs suggested that sheep were present for a shorter duration in 2014.

6.3. Analysis of Historical Data

Periodic aerial surveys of Dall's sheep in summer have been conducted by ADF&G in the Watana Creek Hills since 1968 to develop minimum population estimates. Between 130 and 209 sheep were counted in the Watana Creek Hills during summer surveys from 1968 to 1994, whereas only 50 sheep were counted in the same area in 2003 (Table 5.3-1). Sheep populations in the Talkeetna Mountains (including the Watana Creek Hills) declined steeply after the winter of 1999/2000 and have since remained stable but low (Peltier 2008, Peltier 2011). Winter surveys in March 1968, 1981, and 1983 documented 97, 56, and 87 sheep, respectively, in the Watana Creek Hills (ADF&G, unpublished data). Sightability of sheep is low during winter, so winter surveys are typically used to delineate winter range and are not used as population indices.

Dall's sheep were studied more extensively in the Project region from 1977 to 1983 with additional survey areas in the northern portion of the West Kosina Hills (directly south of the proposed Watana impoundment) and in the Chulitna Mountains north and west of the proposed access corridors (Figure 4.1-1; ADF&G, unpublished data; Tankersley 1984). In 1977, 34 sheep were observed on Mount Watana (in the northern portion of the West Kosina Hills). No sheep were counted on Mount Watana during sheep surveys conducted in July 1980 or March and July 1983 (ADF&G, unpublished data; Tankersley 1984). In July 1980 and March 1981, nine and 22 sheep were counted, respectively, in the northern portion of the West Kosina Hills. However, the results of these surveys are not comparable due to differences in the areas surveyed (Figure 4.1-1; ADF&G, unpublished data).

A portion of the Chulitna Mountains north of the Chulitna access corridor alternative and west of the Denali West access corridor alternative was surveyed in July 1980 and in March and June 1983, yielding counts of 72, 30, and 52 sheep, respectively (Figure 4.1-1; ADF&G, unpublished data; Tankersley 1984). Most of those sheep were found in the East Fork of the Jack River and the upper Tsusena Creek drainage. No sheep were found within 2.5 miles of the access corridor alternatives (ADF&G, unpublished data; Tankersley 1984).

During the 1980s research, mineral licks were identified on lower Jay Creek and upper Watana Creek (Tankersley 1984). Sheep used those licks mainly between mid-May and mid-June. A total of 21 sheep in the Watana Creek Hills were color-marked with paint pellets in April 1983. At least 31 percent of the sheep population observed in the Watana Creek Hills in 1983 traveled 5 miles or more to the Jay Creek lick (Tankersley 1984).

7. CONCLUSIONS

From 2012 to 2015, AEA completed two aerial surveys of Dall's sheep distribution and abundance in the study area and completed two years of site visits to the Jay Creek and Watana mineral licks to assess their use by Dall's sheep. The field work, data collection, data analysis, and reporting for this Dall's Sheep Distribution and Abundance Study successfully met all study objectives in the FERC-approved Study Plan. The results of this Dall's Sheep Distribution and Abundance Study are reported herein and earlier by AEA (ADF&G and ABR 2014a, 2014b, 2014c). With this report, AEA has now completed the Dall's Sheep Distribution and Abundance Study.

8. LITERATURE CITED

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9. TABLES

Table 5-1. Server Location and File/Folder Names for the Field Data for Dall's Sheep Collected in 2013–2015.

Server Pathway or File/Folder Name	Description
/http://gis.suhydro.org/SIR/10-Wildlife/10.7-Dall's_Sheep	Pathway to data files
DASH_10_07_Data_2013_2015_ABR_ADFG.gdb	Geodatabase file containing spatial layers of the Dall's sheep study area boundary, the Dall's sheep aerial survey areas flown in the 1980s, 2013 and 2015, the historical mineral lick polygons, mineral lick locations (point), and aerial survey density maps.
DASH_10_07_Data_2013_2014_ABR.accdb	Access table of the number of Dall's sheep counted on photos taken by a time-lapse camera at Jay Creek mineral lick deployed May–June 2013 and 2014.
Photos (folder)	Photos (JPEG) of the main Jay Creek mineral lick taken by a time-lapse camera deployed May-June 2013 and 2014.

Table 5.1-1. Dall's Sheep Survey Data for GMU Subunit 13E, 2013.

Survey Block	Survey Dates	Rams	Ewes[1]	Lambs	Total Sheep	Count Time (hr)
Chulitna Mountains	July 11–13	94	150	33	277	24.05
Watana Creek Hills	July 29–30	14	22	5	41	2.20
West Kosina Hills	July 27–29	62	99	33	194	5.83
TOTAL		170	271	71	512	32.08

Note:

1 The number of ewes includes young rams and yearlings of both sexes.

Table 5.1-2. Dall's Sheep Survey Data for GMU Subunit 13E, 2015.

Survey Block	Survey Dates	Rams	Ewes[1]	Lambs	Total Sheep	Count Time (hr)
Chulitna Mountains	July 31-Aug 2	68	118	63	249	22.2
Watana Creek Hills	Jul 31	13	13	7	33	3.25
West Kosina Hills	Aug 1	37	94	41	172	4.97
TOTAL		118	225	111	454	30.42

Note:

1 The number of ewes includes young rams and yearlings of both sexes.

Table 5.1-3. Dall's Sheep Population Composition Data for GMU Subunit 13E, 2013.

Survey Block	Rams/100 Ewes[1]	Lambs/100 Ewes	% Lambs in Flock	Total Sheep	Sheep/Hour
Chulitna Mountains	62.7	22.0	12%	277	11.5
Watana Creek Hills	63.6	22.7	12%	41	18.6
West Kosina Hills	62.6	33.3	17%	194	33.3

Note:

1 The number of ewes includes young rams and yearlings of both sexes.

Table 5.1-4. Dall's Sheep Population Composition Data for GMU Subunit 13E, 2015.

Survey Block	Rams/100 Ewes[1]	Lambs/100 Ewes	% Lambs in Flock	Total Sheep	Sheep/Hour
Chulitna Mountains	57.6	53.4	25%	249	11.2
Watana Creek Hills	100	53.8	21%	33	10.0
West Kosina Hills	39.4	43.6	24%	172	34.6

Note:

1 The number of ewes includes young rams and yearlings of both sexes.

Table 5.2-1. Number of Dall's Sheep Observed at Two Mineral Licks during Site Visits in May and June, 2013 and 2014.

Year	Dates	Jay Creek	Watana Creek	Total
2013	May 28–29	4	3[1]	7
	June 19–20	7	2[2]	9
2014	May 28–29	0	9[3]	9
	June 18–19	0	0[4]	0

Notes:

1 Seven other sheep were visible in the general area.

2 At least 15 other sheep were visible in the general area.

3 Six other sheep were visible in the general area.

4 Seven other sheep were visible in the general area.

Table 5.3-1. Summer Survey Data for Dall's Sheep in the Watana Creek Hills, 1968–2015.

Year	Rams	Rams/ 100 Ewes	Ewes[1]	Lambs	Lambs/ 100 Ewes	% Lambs in Flock	Total Sheep Observed	Sheep/ Hour
1968	16	–	134	33	–	–	183	–
1973	10	7.9	126	40	31.7	23%	176	–
1976	4	4.2	96	30	31.3	23%	130	–
1977	4	3.5	115	33	28.7	22%	152	–
1978	5	3.3	150	34	22.7	18%	189	–
1980	28	26.9	104	42	40.4	24%	174	69.6
1981	39	30.7	127	43	33.9	21%	209	63.3
1982	19	13.3	143	38	26.6	19%	200	–
1983	34	35.4	96	19	19.8	13%	149	33.1
1994	38	38.8	98	23	23.5	14%	159	72.3
1999	24	42.9	56	17	30.4	18%	97	44.1
2003	10	30.3	33	7	21.2	14%	50	21.7
2008	17	58.6	29	17	58.6	27%	63	26.3
2011	15	42.9	35	12	34.3	19%	62	38.8
2013	14	63.6	22	5	22.7	12%	41	18.6
2015	13	100	13	7	53.8	21%	33	10.0

Note:

1 The number of ewes includes young rams and yearlings of both sexes.

Sources: Didrickson 1980; Kavalok 2005; Peltier 2011; ADF&G, unpublished data.

10. FIGURES

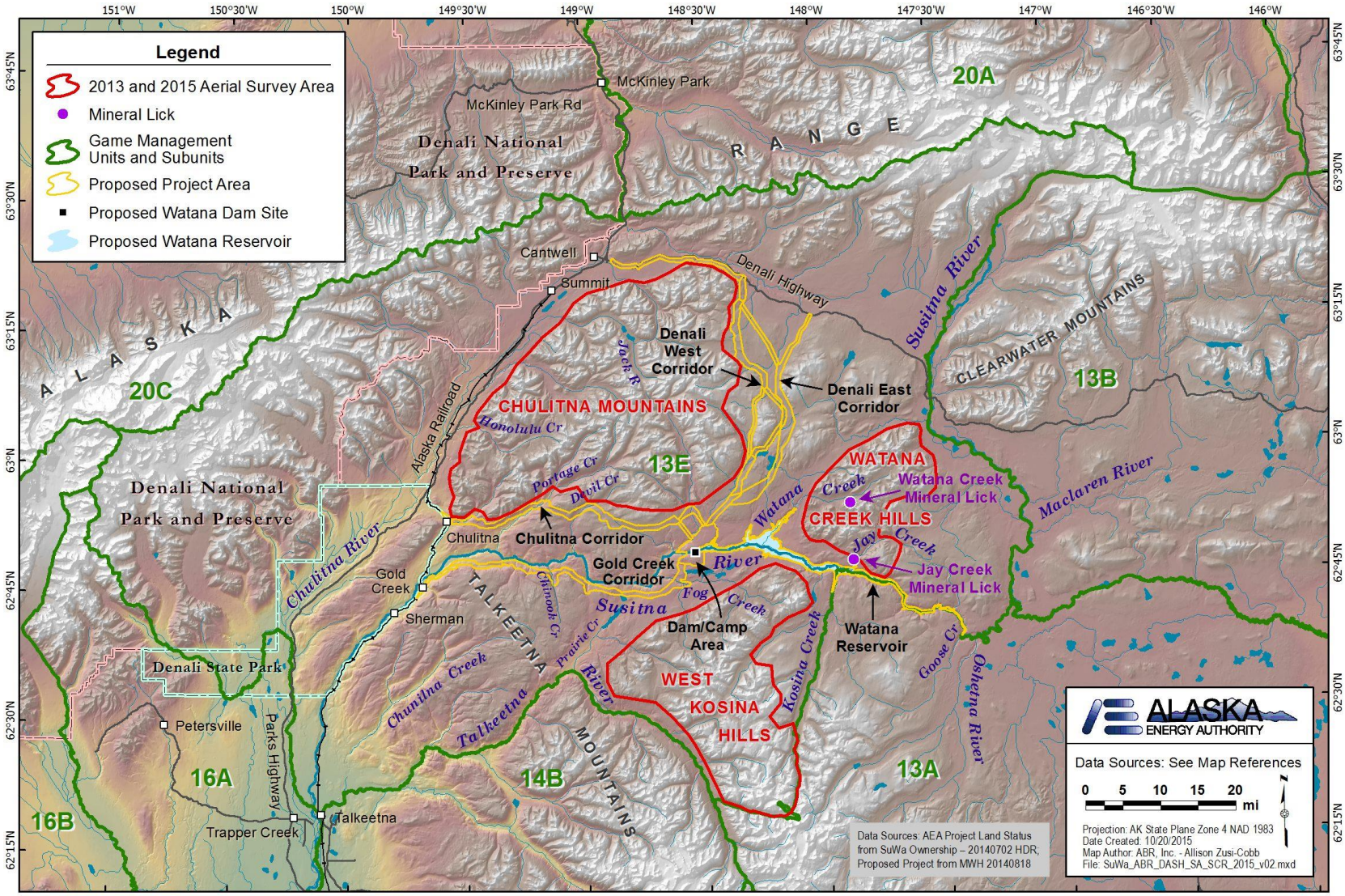

Figure 3-1. Dall's Sheep Study Area, 2013–2015.

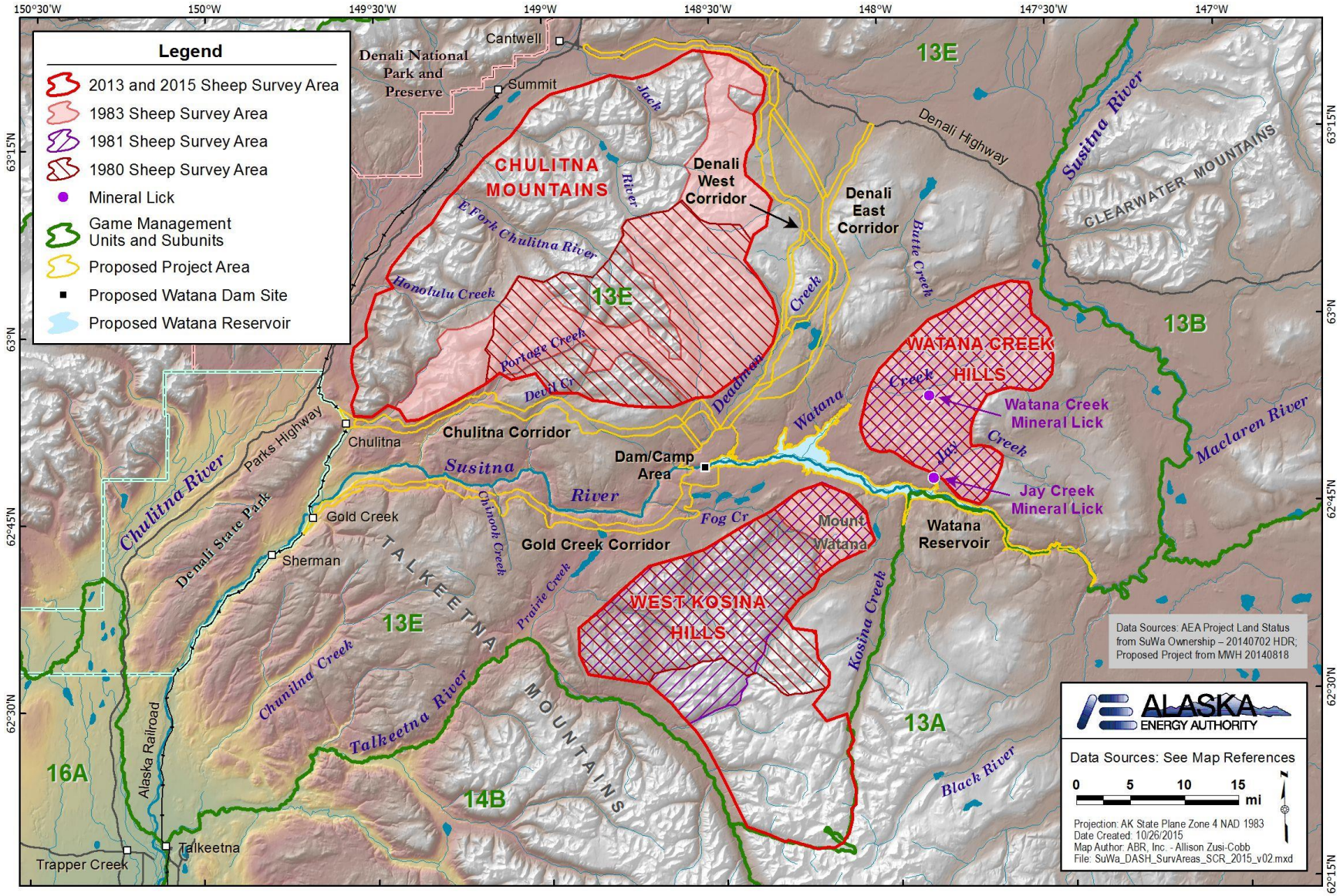

Figure 4.1-1. Dall's Sheep Survey Areas, 1980s and 2013–2015.

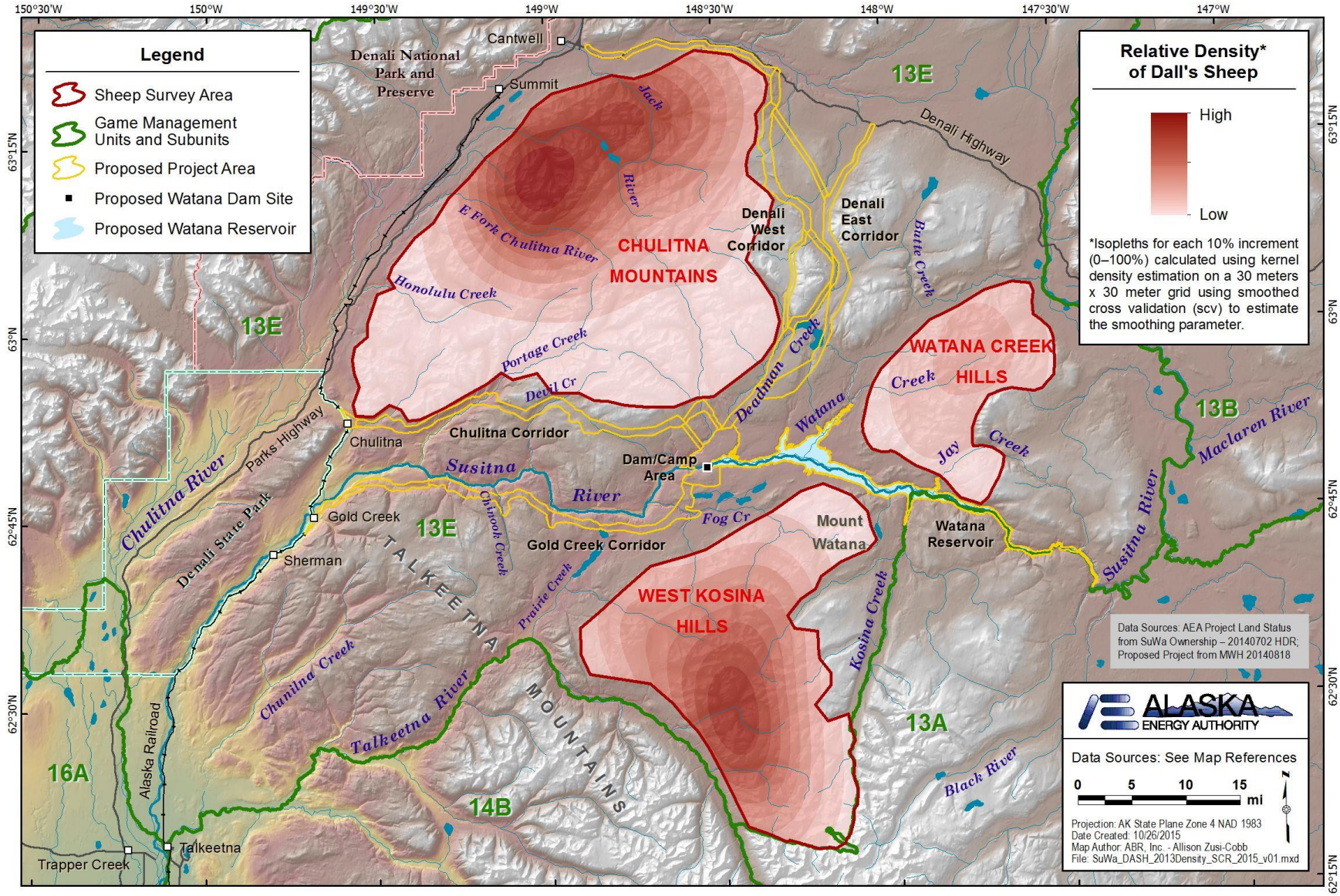

Figure 5.1-1. Relative Density of Dall's Sheep Observed during Aerial Surveys, 2013.

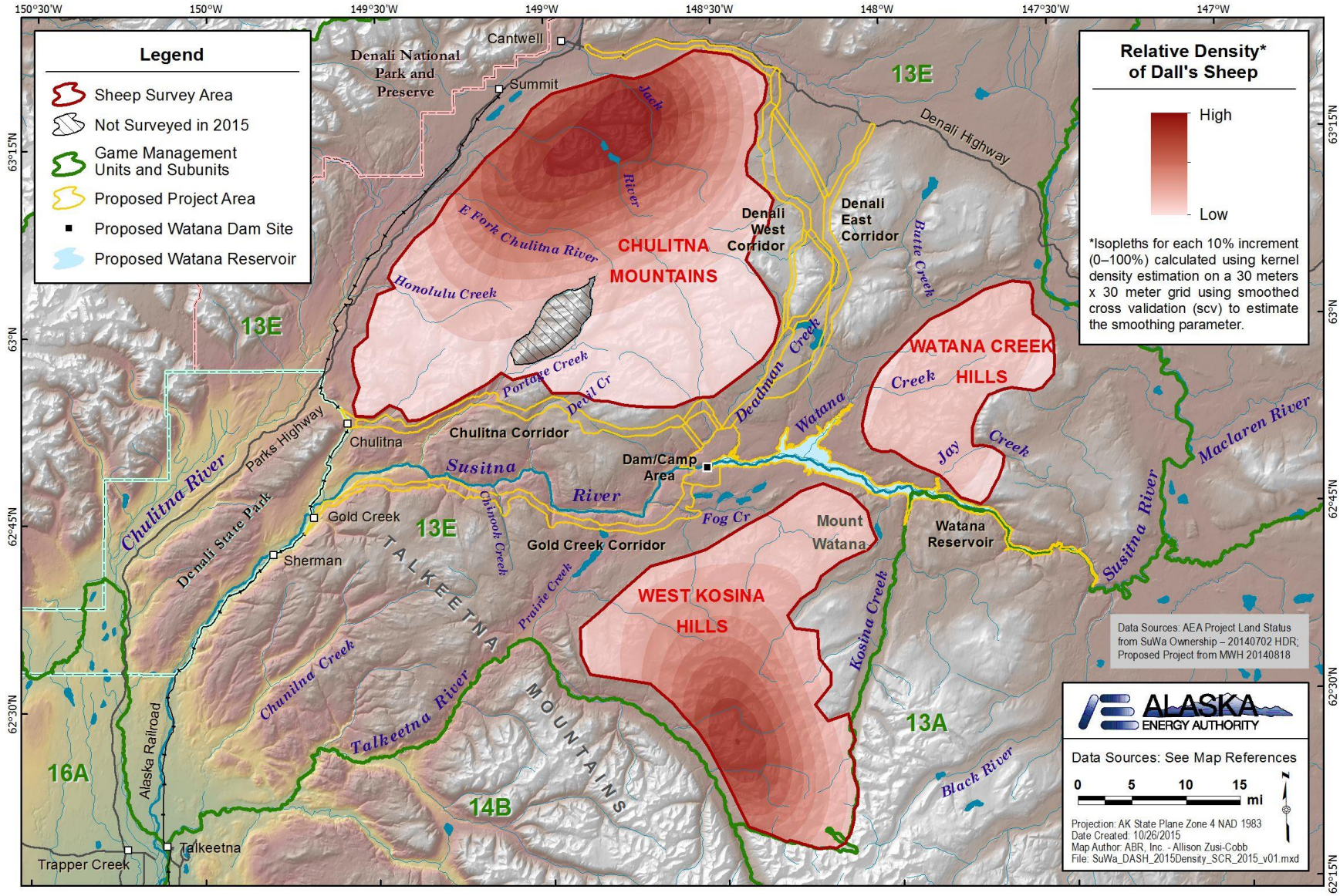

Figure 5.1-2. Relative Density of Dall's Sheep Observed during Aerial Surveys, 2015.

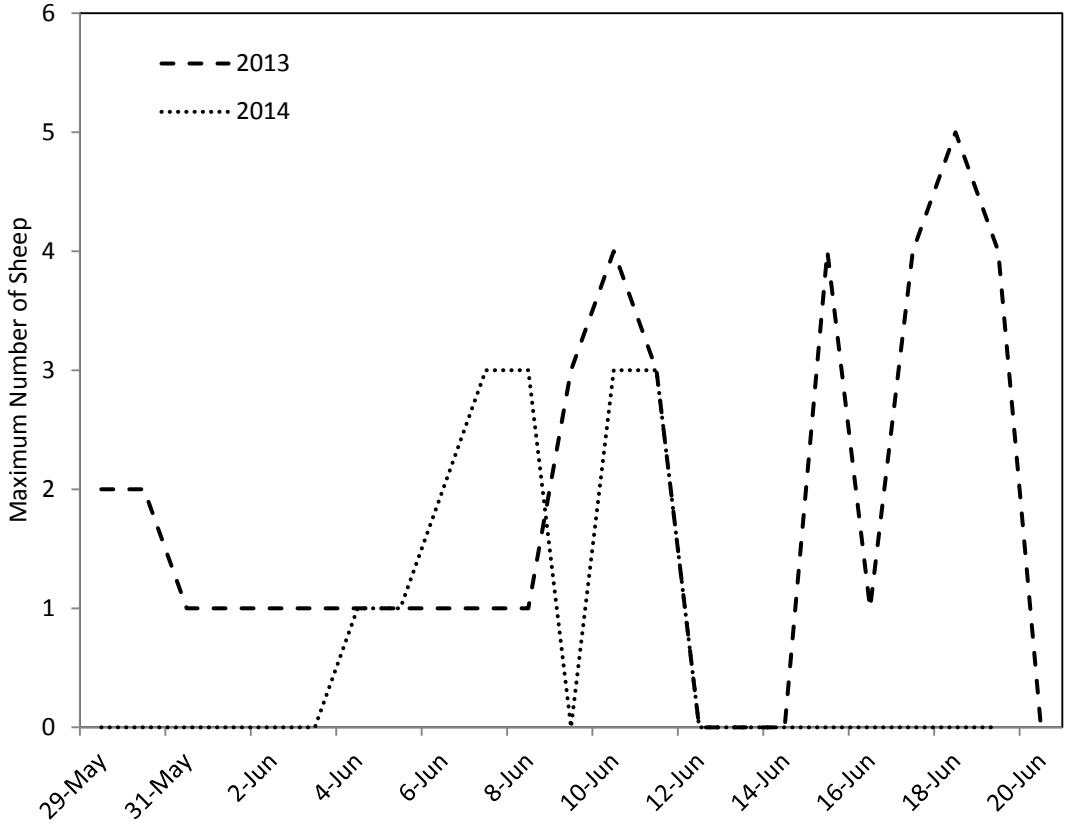

Figure 5.2-1. Maximum Daily Number of Individual Sheep Visible in Photos of the Jay Creek Mineral Lick, 2013–2014.