10.5. Moose Distribution, Abundance, Productivity, and Survival

10.5.1. General Description of the Proposed Study

The moose study will be conducted by the Alaska Department of Fish and Game (ADF&G). The moose study began in 2012 and will continue through 2013 and 2014. ADF&G will continue to survey and monitor radio-collared moose throughout the lifespan of the radio-collars deployed for the study (approximately 2016).

This study plan outlines the objectives and methods for characterizing moose distribution, movements, population size, productivity, and habitat use in the study area through geospatial analysis. Radio telemetry surveys via fixed-wing aircraft will be used to monitor distribution, productivity, harvest potential, and habitat use of moose in the study area. In addition to standard Very High Frequency (VHF) radio collars, satellite-linked GPS collars will be deployed to evaluate fine-scale spatial distribution and movements of cows and bulls. Winter surveys will be flown to enumerate moose in and near the reservoir inundation zone. GeoSpatial Population Estimation (GSPE) techniques (Ver Hoef 2002, Kellie and DeLong 2006) and traditional count methods in portions of the study area will be used to generate population estimates. Browse surveys will be used to monitor habitat utilization of the inundation zone, access and transmission corridors, and area downstream from the Project area.

10.5.1.1. Study Goals and Objectives

The goal of the study is to obtain sufficient population information to evaluate the potential effects of the Project on moose.

Specific study objectives include the following:

- Document the moose population and composition in the study area;
- Assess the relative importance of the habitat in the inundation zone, proposed transportation corridors, and the riparian area below the Project;
- Document the productivity and calf survival of moose using the study area;
- Document the level of late winter use of adults and calves in the proposed inundation area;
- Document moose browse utilization in and adjacent to the inundation zone and the riparian area below the Project;
- Assess the relative importance of the habitat in the inundation zone and proposed transportation corridors to moose;
- Document the amount of potentially available habitat for improvement through crushing, prescribed burning, or other habitat enhancement; and
- Analyze and synthesize data from historical and current studies of moose as a continuation of the 2012 big-game distribution and movements study (AEA 2012).

10.5.2. Existing Information and Need for Additional Information

Moose studies during the early 1980s for the original APA Susitna Hydroelectric Project were comprehensive and annual monitoring of moose populations in the general area has been conducted by ADF&G, but more recent data specific to this Project are needed to accurately

characterize the current moose population size, distribution, and habitat use. New information is also needed to assess current issues pertaining to human use of the population in the Project region.

For management purposes, moose in Game Management Unit (GMU) 13 are monitored annually using aerial trend-count surveys. Within GMU subunits 13A, B, and E, a group of continuous count areas (CAs) are surveyed annually (including CA 14; Figure 10.5-1); additional trend-count areas are surveyed periodically. These surveys, which provide managers with population composition and general trend data, have been conducted in this area since the 1950s.

Additional areas such as CA 7, which includes Watana Creek in GMU 13E (Figure 10.5-1), are not surveyed regularly. CA 7 was surveyed annually between 1980 and 1986 (776–1284 moose observed; 0.9–1.5 moose per square mile). The most recent aerial trend-count survey in that area was conducted in 2001 (776 moose observed; 0.9 moose per square mile). In addition, an intensive population survey was conducted in spring 2012, a year of heavy snowfall. A total of 441 moose (381 adults and 60 calves) were observed in an area of 277.7 square miles, for a density estimate of 1.6 moose per square mile. The density estimate is likely to increase after the estimate is adjusted for sightability (R. Schwanke, AD&G, 2012, pers. comm.). An additional intensive population survey will be conducted of the area downstream from the proposed dam location.

Changes in hunter access due to the proposed Project will be evaluated. Hunter demand for moose in GMU 13 is very strong and continues to grow. Due to this trend and with implementation of moose population composition objectives in the early 1990s, the GMU 13 moose population composition has been monitored closely to maintain a sustainable harvest and high hunter satisfaction rates. Existing annual monitoring efforts for moose in GMU 13A and 13E address abundance, distribution, and recruitment for the purposes of assessing annual moose population trends and related harvest regulatory strategies. These data, however, are insufficient to address potential Project-related impacts or to identify potential mitigation for moose. Data collected through standard VHF radio-telemetry, satellite-linked GPS telemetry, and aerial surveys of population composition, density, and calf production will document currently used areas, as well as provide data on the timing and duration of seasonal range use and the proportion of the regional moose population that uses the Project area. Previous habitat evaluations were based on vegetation cover types that were mapped within 16 kilometers (10 mile) on each side of the Susitna River between Gold Creek and the Maclaren River (TES 1982). However, that vegetation mapping was conducted over 30 years ago.

Both the vegetation and wildlife habitat mapping and the wildlife habitat evaluation will be updated during Project studies (see Sections 11.5 and 10.19, respectively). The wildlife habitat evaluation completed in the early 1980s was based largely on vegetation types. The current study will go beyond vegetation mapping to document both habitat use by moose and the actual biomass removed by browsing. Moose locations derived from this study will be used to develop a stratified sampling design (Paragi et al. 2008) and to identify habitats that may be suitable for treatment to enhance habitat for moose and other wildlife species using early successional stages of vegetative communities.

The information developed will be used to inform development of appropriate protection, mitigation, and enhancement measures for the Project in support of ADF&G management objectives for moose in GMU 13.

10.5.3. Study Area

The moose study will reflect the relative use of the Project area by moose (Figure 10.5-1). The study area will include the majority of GMU 13E east of the Parks Highway and the Alaska Railroad from the Denali Highway south to upper Chunilna Creek. The study area will also include a small portion of northwest GMU 13A from Kosina Creek east to the Oshetna River drainage. This area encompasses the impoundment, access and transmission corridors, and associated Project infrastructure. To assess the relative use of these primary focus areas, the study area must be somewhat larger to fully evaluate the seasonal habitat preferences of moose likely to use the focus areas.

10.5.4. Study Methods

10.5.4.1. Moose Movements, Productivity and Survival

To assess moose movements in the Project area, as well as productivity and survival, a sample of cow and bull moose will be radio collared. Additionally, satellite-linked GPS collars will be deployed on bulls and cows to detect fine-scale movements by both sexes.

Moose will be captured and collared in late March and October–December, depending on various factors including the physical condition of moose and hunting seasons. Radio collars are expected to function for 5 to 7 years, whereas GPS collars have a 2-year lifespan. If greater than expected collar malfunctions or hunting losses occur, additional captures and collar replacement outside the outlined schedule may be required to maintain a sufficiently large sample size.

In October 2012, approximately 30 radio collars will be deployed, 20 on cows and 10 on bulls. At the same time, approximately 20 GPS collars will be deployed; 13 on cows and 7 on bulls.

Another 30 radio collars will be deployed in March 2013, 20 on cows and 10 on bulls, as well as an additional 20 GPS collars, 13 on cows and 7 on bulls. The two separate capture periods will help address the spatial variability of a migratory moose population, as well as potential loss of collared animals during the hunting season. GPS collars will be removed in November 2014 and/or March 2015.

The sample size of 60 radio-collared moose, with a 2:1 ratio of cows to bulls, is expected to adequately record movements and productivity of moose in the study area and to provide context on the relative importance of the Project area in terms of available habitat throughout the year.

Monthly aerial radio-tracking surveys in fixed-wing aircraft will be conducted to document the distribution of radio-collared moose in the study area. During the spring calving (May 10–June 15) and fall hunting seasons (September 1–20), aerial surveys will be conducted weekly to document more frequently the distribution of moose in the study area. Additionally, to accurately document productivity and associated calf loss, surveys will be conducted daily during peak calving (May 15–31). Small fixed-wing airplanes (Piper PA-18 or similar) will be used for these radio-tracking flights.

Fine-scale movements will be monitored with the 40 GPS collars deployed on 26 cows and 14 bulls. Due to the relatively consistent annual moose habitat use and movement patterns, the relatively short 2-year lifespan of GPS collars should be sufficient for documenting fine scale movements of moose in this area. Considering that the Project area is used year round by moose, gathering daily locations with the use of GPS collars is the only way to ensure that habitat use

and travel patterns, particularly during calving, hunting season, and the rut for both sexes are accurately identified.

GPS locations of collared moose will be used to evaluate spatial distribution and movements of cows and bulls. Location, date, reproduction, and survival status will be documented for each moose located during scheduled radio-tracking flights. Data mapping and spatial analyses will be accomplished using ArcGIS software.

10.5.4.2. Population Monitoring

Moose populations will be evaluated using three survey techniques. Conventional survey methods pertaining to optimal snow conditions, daylight, flight patterns, etc. (Ballard and Whitman 1988) will be used for all surveys to maximize survey precision, maintain consistency among surveys, and facilitate comparisons with existing datasets. To assess winter use of the inundation area, ADF&G surveyed the reservoir inundation zone in late winter (March 20–22) 2012 and will do so again in 2013. Due to the seasonal absence of antlers, it will not be possible to distinguish bulls from cows during late-winter surveys, but numbers of calves and adults will be reported.

Intensive population estimates use GeoSpatial Population Estimation (GSPE) techniques (Ver Hoef 2002, Kellie and DeLong 2006) or the Gasaway method (Gasaway et al. 1986). The timing of population estimates will depend on weather conditions and snow cover, logistical considerations, and potential scheduling conflicts with other concurrent moose surveys. The preferred approach is to estimate moose populations above and below the proposed dam within the study area during one GSPE sampling event, currently planned for November 2012. A total of at least 200 randomly selected 6-square-mile sample units will be surveyed. If suitable survey conditions do not occur in 2012, then the GSPE survey will be postponed until November 2013. Sample units will be flown at a high search intensity (>6.5 minutes per square mile). Counts will be corrected for sightability using established methods (Gasaway et al. 1986, Kellie and DeLong 2006).

Previously established trend count areas CA 7 and CA 14 (Figure 10.5-1) will be surveyed in November 2012, 2013, and 2014 to obtain current data for comparison with data from previous years.

10.5.4.3. Moose Browse Survey and Habitat Assessment

Techniques developed by Seaton (2002) and used subsequently by Paragi et al. (2008) and Seaton et al. (2011) will be used to estimate the proportion of browse biomass removed by moose. Current annual growth (CAG) of important browse species such as willow (*Salix* spp.), aspen and balsam poplar (*Populus* spp.), and Alaskan birch (*Betula neoalaskana*) will be estimated. Only plants with CAG and between 0.5 meters and 3 meters in height will be sampled. Three plants per species at each sample plot will be selected and 10 twigs on each plant will be measured. The diameter at the base of CAG (or the point where twig is browsed, if older than last annulus) and the diameter at the point of browsing will be noted. The duration of sampling will be 8 to 10 days each year in March 2013 and 2014. Sampling must occur after most of the winter browse activity has occurred but before spring green-up. Small helicopters will be used to access study plots. The browse study will be conducted for two years to account for annual variability in snow depth and other conditions.

The seasonal use and importance of the inundation zone and transportation corridors will be quantified primarily by analysis of radio and satellite tracking data to determine moose movements and habitat preferences. Browse utilization surveys will further refine the relative importance of habitat within the study area by documenting the impact of moose on vegetation. Browse utilization surveys will cover available habitat above and below the dam within the extent of the GSPE survey grid. Vegetation and other studies conducted in association with the Project licensing process will be used to identify areas where potential habitat improvement may be considered to mitigate for the loss of habitat in the Project area.

10.5.4.4. Impact Assessment

The primary potential impacts of Project construction and operation, as described in the Pre-application Document (AEA 2011), are moose habitat loss and alteration, blockage of movements, and increased mortality due to subsistence and recreational harvest facilitated by improved hunter access along transmission and access corridors. Data on the population, distribution, productivity, and habitat use of moose in the study area will be used to assess Project impacts. Location data, population data, and browse intensity data can be plotted on the wildlife habitat map that will be developed under the botanical resources study plans (see Sections 11.5, 11.6 and 11.7) to identify important moose habitats or to provide quantitative or semi-quantitative estimates of habitat value. Direct habitat loss can be calculated through geospatial analysis by overlaying the impoundment, access and transmission corridors, and related Project infrastructure onto the habitat map and evaluating the loss of important moose habitats. Indirect habitat loss and alteration and avoidance impacts can be estimated by applying various buffer distances, as determined from available information on the anticipated effects of similar projects or activities on moose. By incorporating population data from the various surveys into the analysis, the number of animals affected can be estimated. In this way, the GIS analysis will be combined with information from the literature to estimate the geographic extent, frequency, duration, and magnitude of Project effects on moose populations. The concurrent investigation of riparian habitats downstream of the dam site will provide additional data with which to assess impacts on moose, establishing baseline conditions and modeling riparian succession in areas in which habitat or browse availability may be affected by altered flow regimes. Harvest data collected by the ADF&G will be used to establish baseline harvest levels and to monitor increased harvest that may result from improved access. Data on the movements of radiocollared moose can be used to assess potential blockage of movements in the inundation area. Any necessary PM&E measures will be developed by examining the seasonal distribution and abundance of moose among habitats in relation to the geographic extent and seasonal timing of various Project activities.

10.5.5. Consistency with Generally Accepted Scientific Practice

Moose movement patterns and productivity and survival in the Project area will be studied by marking animals with radio and GPS satellite collars. The combination of these two collar types will provide both broad-scale and local-scale information on movement patterns in the Project area. These data will be necessary to evaluate broad (seasonal) movements and more local-scale movements within those areas expected to be affected by Project development. The use of these two collar types represents a robust approach to collecting data on moose movement patterns, productivity, and survival that are in widespread in Alaska and elsewhere. The outlined sample

sizes should be more than sufficient for an accurate and precise representation of moose distribution, movements, and productivity within the study area.

The capture methods employed in this study will be standard capture, handling and monitoring techniques for moose (Schmitt and Dalton 1987). Helicopters and chemical immobilization techniques will be utilized for moose captures. All methods will be fully evaluated and compliant with Alaska Interagency Animal Care and Use Committee certification. Standard permits required by the State of Alaska for animal capture and monitoring are in-hand.

Moose population monitoring will be conducted by intensively surveying randomly located plots and extrapolating those data to the study area, a technique that is widely used in Alaska and is the appropriate sampling design for determining population levels of ungulates that are widely dispersed across the landscape (Gasaway et al. 1986, Ver Hoef 2002, Kellie and DeLong 2006).

Moose browse will be studied using methods developed by ADF&G for studies in Interior Alaska to estimate the proportion of browse biomass removed (Paragi et al. 2008, Seaton et al. 2011). These currently are considered to be the most appropriate methods for quantifying moose browse in Alaska.

10.5.6. Schedule

This study is a multi-year effort that began in 2012 with a late-winter population survey in the reservoir inundation zone and initial collar deployment and radio-tracking in the fall and early winter. To meet the needs of the FERC study process, an Initial Study Report will be completed by December 2013 and the Updated Study report will be completed by December 2014. Because the battery life of the radio collars will extend beyond December 2014, however, ADF&G will continue to survey and monitor radio-collared moose throughout the collar lifespan (approximately 2016) and will produce a final technical summary report at that time. However, the 2.5 years of study information that will be summarized in the Updated Study Report is expected to provide sufficient information to assess the potential impacts of the Project on moose.

2012

October	Deploy initial radio and satellite collars and monitor at least monthly.

2013

March	Deploy remaining radio and satellite collars and monitor at least monthly. Conduct adult/calf population survey of inundation zone and adjacent habitat. Conduct winter browse utilization assessment.
May 10–June 15	Monitor radio collars weekly (daily monitoring during May 15–31).
September 1–20	Monitor radio collars weekly.
November	Conduct post-rut aggregation composition surveys in CA7 and CA14 and, if not accomplished in 2012, conduct the GSPE survey for the areas above and below the proposed dam.

2014

February	Initial Study Report completed.

March	Conduct winter browse utilization assessment.
May 10–June 15	Monitor radio collars weekly (daily monitoring during May 15–31).
September 1–20	Monitor radio collars weekly.
November	Conduct post-rut aggregation composition surveys in CA7 and CA14 Remove satellite collars.
2015	
February	Updated Study Report completed.
March	Remove remaining satellite collars

10.5.7. Level of Effort and Cost

This multi-year study is estimated to total approximately $750,000.

10.5.8. Literature Cited

AEA. 2011. Pre-Application Document: Susitna-Watana Hydroelectric Project FERC Project No. 14241. December 2011. Prepared for the Federal Energy Regulatory Commission by the Alaska Energy Authority, Anchorage, Alaska.

AEA. 2012. W-S1: Big-game movement and habitat use study for the Susitna–Watana Hydroelectric Project, FERC Project No. 14241. Draft final version (March 21, 2012). Alaska Energy Authority, Anchorage.

Ballard, W. B., and J. S. Whitman. 1988. Susitna Hydroelectric Project, Final report, Big game studies, Vol. II—Moose Upstream. Alaska Department of Fish and Game. 150 pp.

Kellie, K. A., and R. A. Delong. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game, Division of Wildlife Conservation, Fairbanks. 55 pp.

Gasaway, W. C., S. D. DuBois, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Biological Papers of the University of Alaska, No. 22, Fairbanks. 108 pp.

Paragi, T. F., C. T. Seaton, and K. A. Kellie. 2008. Identifying and evaluating techniques for wildlife habitat management in Interior Alaska: moose range assessment. Final research technical report, Federal Aid in Wildlife Restoration Grants W-33-4 through W-33-7, Project 5.10. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau. 76 pp.

Schmitt, S. M., and W. J. Dalton. 1987. Immobilization of moose by carfentanil and xylazine and reversal with naltrexone, a long acting antagonist. Alces 23: 195–219.

Seaton, C. T. 2002. Winter foraging ecology of moose in the Tanana Flats and Alaska Range foothills. M.S. thesis, University of Alaska, Fairbanks. 101 pp.

Seaton, C. T, T. F. Paragi, R. D. Boertje, K. Kielland, S. DuBois, and C. L. Fleener. 2011. Browse biomass removal and nutritional condition of Alaska moose *Alces alces*. Wildlife Biology 17: 55–66.

TES (Terrestrial Environmental Specialists). 1982. Susitna Hydroelectric Project, Task 7—Environmental studies, Wildlife ecology: Wildlife habitat-value analysis. Report prepared by Terrestrial Environmental Specialists, Inc., Phoenix, NY, for Acres American, Inc., Buffalo, NY. 100 pp.

Tobey, R. W., and R. A. Schwanke. 2008. Unit 13 moose management report. Pages 151–164 in P. Harper, editor. Moose management report of survey and inventory activities, 1 July 2005–30 June 2007. Alaska Department of Fish and Game, Juneau.

Ver Hoef, J. M. 2002. Sampling and geostatistics for spatial data. Ecoscience 9: 152–161.

10.5.9. Figures

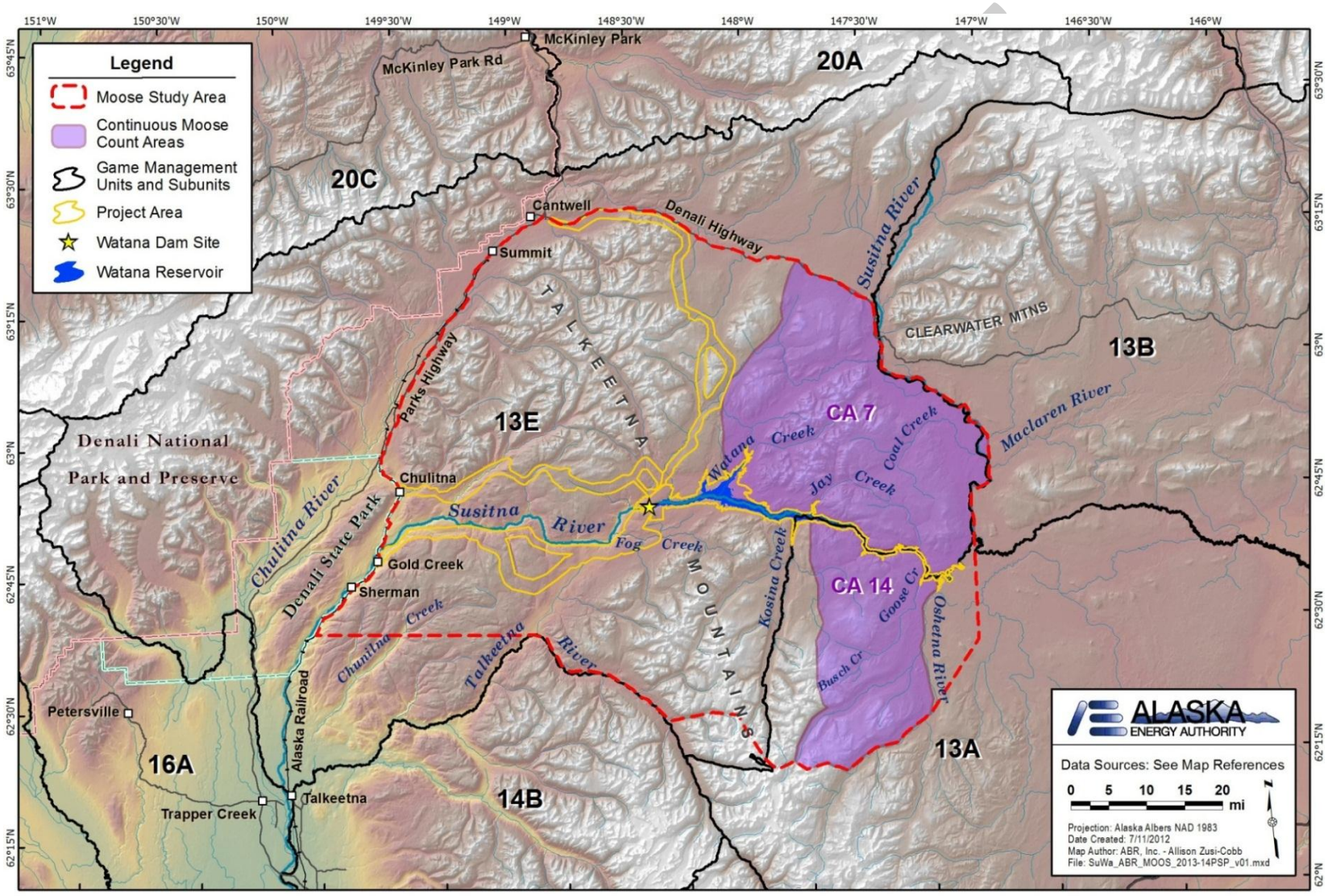

Figure 10.5-1. Moose study area. [Note: The alignment of the three potential transmission and access corridors has been further refined; this figure will be updated in the RSP]