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Susitna–Watana Hydroelectric Project (FERC No. 14241)

Past and Current Big Game and Furbearer Harvest Analysis

2012 Technical Memorandum

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

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ABR, Inc.—Environmental Research & Services

February 2013

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LIST OF ACRONYMS AND SCIENTIFIC LABELS

Abbreviation	Definition
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
APA	Alaska Power Authority
BOG	Board of Game
DCH	Delta Caribou Herd
FERC	Federal Energy Regulatory Commission
GMU	Game Management Unit
ILP	Integrated Licensing Process
km	kilometer
NCH	Nelchina Caribou Herd
NEPA	National Environmental Policy Act
ORV	off-road vehicle
Project	Susitna-Watana Hydroelectric Project
RM	river mile
RSP	Revised Study Plan
UCU	Uniform Coding Unit
USFWS	U.S. Fish and Wildlife Service

SUMMARY

The objective of this study was to acquire and analyze big game and furbearer harvest and population data from the Alaska Department of Fish and Game (ADF&G) and U.S. Fish and Wildlife Service (USFWS) to characterize past and current trends in hunting and harvest locations, and hunter access modes. Data from harvest reports were compiled and reviewed for their adequacy to address Project-specific changes in human access, total harvest, and harvest locations; identify remaining data gaps; and inform development of 2013–2014 study plans.

The study area includes state Game Management Unit (GMU) Subunit 13E and parts of 13A, 13B, 14B, 16A, and 20A (Figure 1), including the Project area that may be influenced either directly or indirectly by construction and operations, including the dam and associated facilities, reservoir inundation zone, and access and transmission corridors. Virtually the entire Project area is located in GMU 13E.

The proposed Susitna–Watana Hydroelectric Project (Project) may alter use of the area by subsistence and sport hunters and trappers and change the spatial and temporal characteristics of harvests due to potential changes in game numbers and distribution and hunter access. Big game and furbearer harvest data were examined to explore patterns of hunter effort, harvest levels, and transportation mode in the Project area prior to development. These analyses will provide insight into possible impacts of the Project on post-construction use of the area by hunters and identify potential Project-induced changes that could alter hunter access or harvest patterns.

Harvest data were acquired from ADF&G and subsistence harvest data on federal lands were obtained from USFWS to examine patterns of hunting effort and harvest in the Project area and adjacent areas. ADF&G combined data from its harvest database, furbearer sealing database, and bear sealing database into one file for the years 2003–2011. The federal subsistence data included data from 1994–2011 for caribou and moose in all of GMU 13. To analyze harvest statistics, three analytical scales were identified that were consistent with the spatial precision of the harvest databases, starting with the broadest scale (GMU 13E), then focusing at an intermediate scale (aggregated major units), and then the most precise harvest location (aggregated Uniform Coding Units, or UCUs). Although ADF&G was very helpful in providing the available harvest data, the spatial resolution of the data and its sensitive nature created some unanticipated analytical constraints. In addition, high-quality harvest data were available only for 2003–2011 and the completeness and accuracy of the data varied among species.

At the broadest scale of analysis (GMU 13E; Figure 2), annual harvests averaged 146 moose, 392 caribou, 88 Dall's sheep, 58 brown bears, 60 black bears, 37 wolves, 40 beavers, 10 wolverines, and 9 lynx. Most (90%) of the moose harvest occurred in September, with the majority of harvest (57%) by hunters using off-road vehicles (ORVs), who also had the highest success rate (31%) among access modes. The overall success rate for moose hunters was 20%. Most caribou harvest (81%) occurred in August–September, with the majority of harvest (57%) by hunters using ORVs. The overall success rate for caribou hunters was 73%, with the highest success rate (90%) for hunters using horses or dog teams. Most brown bear harvest occurred in August–September, with the most harvests by hunters using ORVs (27%) or airplanes (26%). Most (78%) of the sheep harvest occurred in August, with the majority of harvests (55%) by hunters using airplanes, who also had the highest success rate (31%). The overall success rate for sheep hunters was 14%.

The second level of spatial precision was an aggregation of 4 of ADF&G's "major units" (Figure 2). Some data from GMU 13E could not be used at this scale because harvest locations were not reported specifically enough, and the analysis did not include federal subsistence data, which is recorded at the GMU level only. During 2003–2011, harvests in these major units totaled 898 moose, 1,670 caribou, 344 brown bears, 447 black bears, and 135 Dall's sheep. Most moose harvest (94%) occurred in September, with most of the harvest (48%) being taken by hunters using ORVs, who had a success rate of 36%. The overall success rate for moose hunters in the major unit area was 24%. Most caribou harvest (97%) occurred in August and September, most of which (57%) was by hunters using ORVs. The overall success rate for caribou hunters in the major unit area was 73%. Most brown bear harvest occurred in August and September, with the greatest proportion (40%) by hunters using airplanes. Most sheep harvest (78%) occurred in August, again with the majority of harvests (89%) by hunters using airplanes, who also had the highest success rate (37%). The overall success rate for sheep hunters was 21%.

The third and most precise level of spatial analysis was an aggregation of 13 adjacent UCUs (Figure 2), which again resulted in additional loss of data due to imprecise reporting of harvest locations and which did not include federal subsistence data. During 2003–2011, 277 moose, 398 caribou, 55 brown bears, 37 black bears, and 13 Dall's sheep were harvested in these UCUs. Most moose harvest (97%) occurred in September, with the majority of harvests (65%) from hunters using ORVs. The overall success rate for moose hunters in the UCU area was 30%, with the highest success rate for hunters using ORVs (81%). Most caribou harvest (99.5%) occurred in August and September, with most harvests (45%) by hunters using ORVs. The overall success rate for caribou hunters was 75% with the highest success rate for hunters using ORVs (79%). Most brown bear harvest occurred during April–May and August–September, with most harvests (37%) by hunters using ORVs. Most sheep harvest (62%) occurred in August, with the majority of harvests by hunters using airplanes (77%), who also had the highest success rate (28%). The overall success rate for sheep hunters was 9%.

To facilitate comparisons among these differently sized zones (GMU 13E, aggregated major units, and aggregated UCUs) and levels of spatial precision, the annual averages were divided by area to calculate an average annual harvest rate per 1,000 square kilometers (km^2), which allowed general comparisons of harvest rates among zones. The UCU zone reflected harvests nearest to the reservoir zone, whereas the other two zones provided a broader regional perspective. The harvest rate for all species except wolves was lower in the UCU zone than in GMU 13E. Much of the lower harvest rates in the UCU zone was likely due to difficult access.

Improved access after Project construction is likely to result in a major change in harvest effort and success. Big-game hunters use a variety of transportation methods to access the area including ORVs, boats, airplanes, and highway vehicles, but ORVs are the predominant transportation method currently used in the area. Changes in access can be managed by developing regulations regarding public access to Project roads, transmission corridors, and the reservoir. An increase in boat traffic in the region also is likely as hunters access the reservoir either along the proposed road corridors or on the Susitna River from the Denali Highway or Lake Louise area. ORV trails are likely to change in the area if new access sites become available along the access road. Additional changes in harvest may result if wildlife distribution changes as a result of direct and indirect habitat loss and disturbance from the Project.

1. INTRODUCTION

The Alaska Energy Authority (AEA) is preparing a License Application that will be submitted to the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project (Project) using the Integrated Licensing Process (ILP). The Project is located on the Susitna River, an approximately 300-mile-long river in Southcentral Alaska. The Project's dam site would be located at river mile (RM) 184.

The Susitna River basin (Figure 1) is an important region for subsistence and sport hunting and trapping because much of it is easily accessible by road from Anchorage and Fairbanks and has sizable game populations. The proposed Project has the potential to alter use of the Project area and adjacent areas by subsistence and sport hunters and trappers by affecting the spatial and temporal characteristics of harvest due to potential changes in wildlife populations and distribution and in human access. Access to the Project area would be altered through construction of an access road, power transmission corridors, and a reservoir that could improve boat and floatplane access.

This technical memorandum presents the 2012 results of the study titled *W- S2: Past and Current Big Game and Furbearer Harvest Study.* This is a multi-year study initiated in 2012 that will continue in 2013-2014, as is described in Section 10.20 (*Wildlife Harvest Analysis)* of the Revised Study Plan for the Project filed with the Federal Energy Regulatory Commission on December 14, 2012. If sufficient data become available from the recently initiated monitoring of small game harvests by the Alaska Department of Fish and Game (ADF&G), the 2013–2014 study will also include analysis of grouse, ptarmigan, and snowshoe hare (*Lepus americanus*) (see Section 10.20.1 in AEA 2012b), but no data on those species were available for the 2012 study.

This study provided data to inform the 2013–2014 licensing study program, Exhibit E of the License Application, and FERC's National Environmental Policy Act (NEPA) analysis for the Project license.

2. STUDY OBJECTIVES

The principal objective of this study was to identify, acquire, and analyze big game and furbearer harvest and population data available from state and federal agencies to examine hunter access modes, hunting locations, and harvest locations prior to Project development. These analyses were intended to provide insights into potential impacts of the Project on post-construction use of the area by hunters and trappers. Other objectives were to assess whether watershed tributary-scale data are adequate for detecting and predicting potential Project-related changes in total harvest and harvest locations; assess the need to collect additional data on hunter access or harvest; identify potential Project-induced changes that might alter hunter access or harvest patterns; identify any remaining data gaps; and inform development of the 2013–2014 study plan (see Revised Study Plan [RSP] Section 10.20 [AEA 2012b]).

3. STUDY AREA

ADF&G has divided the state into 26 Game Management Units (GMUs) and subunits for use in managing wildlife populations, hunting, and trapping, including recording of harvest information. The area for which harvest data were obtained for this study comprised GMUs 13, 14, and 16, to ensure inclusion of all areas that may be influenced directly or indirectly by Project construction and operations, including the dam and associated facilities, three potential access road and power transmission corridors, and the reservoir inundation zone (which are indicated as the Project area in Figures 1 and 2). Nearly all of the Project area lies within GMU 13E; therefore, this analysis focused on that subunit, although additional data were included for some adjacent harvest reporting areas. The area of analysis may expand in 2013–2014 to accommodate the needs of other investigations, such as the subsistence and recreation studies described in the Revised Study Plan (AEA 2012b). As is described in the Methods section below, analyses were conducted at different spatial scales in three overlapping zones (Figure 2).

4. METHODS

Harvest data were obtained from ADF&G and subsistence harvest data on federal lands were obtained from the U.S. Fish and Wildlife Service (USFWS) to examine patterns of hunting effort and harvest in the Project area. ADF&G combined data from its harvest database, furbearer sealing database, and bear sealing database into one file for the years 2003–2011. Harvest data are reported on the basis of the regulatory year, which extends from July 1 through June 30 of the following calendar year, and harvest data are summarized by the calendar year in which the regulatory year ends. The ADF&G database included data on effort (days hunted), whether or not an animal was harvested, the sex of harvested animals, date of harvest, approximate location of harvest, commercial services used, and transportation method. The transportation method was the primary means used for access to the hunting area, as reported by the hunter. Some hunters may have used more than one transportation method. Ten different categories were reported: airplane; horse/dog team; boat; 3- or 4-wheeler; other off-road vehicles; snowmachines (an Alaska term for snowmobiles); highway vehicles; foot; airboat; and other or unknown. The completeness of the data varied widely among years and species.

Harvest data are based on returns of harvest tickets. ADF&G endeavors to obtain a high rate of return of harvest tickets by linking that reporting to subsequent eligibility to hunt. Hunters on the failure-to-report list are ineligible to receive drawing, registration, or subsistence hunt (Tier I or Tier II) permits in the following year. Despite this fact, some harvest tickets are not returned and some of those that are returned do not contain complete information.

Subsistence harvest data for hunts on federal lands that require federal permits are collected by the USFWS. The federal subsistence data available for this study included harvest records for the period 1994–2011 for caribou (*Rangifer tarandus*) and moose (*Alces americanus*) in GMU 13. Records from subsistence harvests on federal lands that do not require specific federal permits are collected under the state system that ADF&G uses to compile its harvest database. Such data include federal subsistence harvests of bears and wolves (*Canis lupus*) in GMU 13. For GMUs 14 and 16A, there were either no open federal seasons or all federal harvest that occurred was reported in the ADF&G system. The available data included the number of people hunting,

whether or not they were successful, the number of days hunted, and the sex of harvested animals.

In some areas of the state, harvested animals of certain species—Dall's sheep, *Ovis dalli*; black bear, *Ursus americanus*; brown bear, *Ursus arctos*; lynx, *Lynx canadensis*; wolf,; wolverine, *Gulo gulo*; beaver, *Castor canadensis*; marten, *Martes americana*; and river otter, *Lontra canadensis*—are required to be sealed (certified and tagged by ADF&G) after harvest. Most of these species are included in the furbearer database, but Dall's sheep are included in the harvest database. Both species of bears may be included in both the harvest and sealing databases, however, so in some years and GMUs there is potential overlap and duplication, with the same bear occurring twice in the datasets (M. Burch, ADF&G, personal communication). Because the information needed to remove duplicates was not available for this analysis, all bear data were left in the dataset, but bear harvests were reported separately for each database, when possible.

In harvest-ticket responses or during the sealing process, ADF&G asks hunters to report the locations where they hunted, but the precision of the reported locations varies widely. ADF&G assigns hunting and harvest locations as specifically as possible. The most precise locations are those assigned to a specific Uniform Coding Unit (UCU), corresponding to individual, small tributary drainage basins. Groups of nearby UCUs are lumped into major units, the second most precise location identifier. If harvest location cannot be assigned to a single UCU or major unit, then it is simply assigned to the correct GMU subunit or overall GMU. To protect confidential hunter information, the locations and harvest records for specific UCUs are not publicly available. Hence, our analysis was confined to the larger reporting units or aggregations of UCUs.

To analyze harvest statistics, analytical zones were defined that were consistent with the spatial precision allowed by the harvest database and ADF&G policies, resulting in three levels of spatial resolution. First, harvest data reported from GMU 13E are examined for the entire subunit (18,695 square kilometers). Although most of the Project area is in GMU 13E (Figure 1), that subunit includes areas north of the Denali Highway and west of the Parks Highway that may not experience direct effects from the Project. Some areas adjacent to the reservoir that may be affected by the Project are not included in GMU 13E. Nevertheless, analyzing data for the entire subunit uses the greatest amount of harvest data, because both the state and federal data are summarized at that level of precision.

To examine a finer scale of resolution, data were analyzed at a second level of spatial precision, the major unit. Major units in the northern Susitna River basin, located mainly south of the Denali Highway and east of the Parks Highway and encompassing the Project area, were aggregated for analysis. This zone comprised 14,643 square kilometers and included a small area north of the Denali Highway (because it was a portion of a major unit closer to the Project area) and another small area outside of the Susitna River basin (Figure 2). It did not include the northernmost portion of the Denali access corridor but included some parts of adjacent Subunits 14B and 13A in the Talkeetna Mountains south of Subunit 13E. This zone did not include any major roads but contained the Alaska Railroad between Talkeetna and Chulitna. Federal subsistence data were excluded from this analysis because the analytical zone was smaller than the minimum reporting area (GMU subunit) for those data.

To obtain the finest scale of resolution, the third analytical zone was an aggregation of 13 UCUs encompassing most of the Project area, with an area of 4,477 square kilometers (Figure 2). This

zone did not include the Alaska Railroad or any major roads and excluded the ends of the alternative access road and transmission corridors, a small portion of the eastern end of the reservoir inundation zone, and some areas adjacent to the reservoir zone. Although this third zone was examined to obtain fine-scale results, some additional harvest data had to be excluded because they were not recorded at a sufficiently detailed level of spatial precision. Again, federal subsistence harvest data could not be used at this analytical scale because those data were summarized only by GMU subunit.

Deviations from Study Plan

The original intent of this study was to examine data from the past several decades, but ADF&G considered only harvest data reported for the 2003–2011 regulatory years to be of suitable quality for analysis. In addition, the completeness and accuracy of the data varied by species.

ADF&G provided the harvest data promptly and was very helpful in answering questions, but the sensitive nature of the data and restrictions on the level of spatial detail that could be reported placed some constraints on the spatial resolution of the analyses. Concern about the spatial accuracy of harvest locations constrained the analyses that could be conducted. ADF&G's objective is to assign hunting effort and harvest locations to specific UCUs but the location information provided by hunters is often insufficient to identify the correct UCU. In addition, to safeguard confidential hunting information provided by hunters, ADF&G does not allow these UCU-level data to be distributed publicly. Hence, to achieve appropriate levels of spatial precision while satisfying ADF&G's requirement for confidentiality, data from smaller units was combined into the three analytical zones described above, which were approved by ADF&G, and were not analyzed at finer spatial scales.

No data from GMU Subunit 20A were analyzed for this report. Those data were not included in the data acquired from ADF&G and that area is unlikely to provide useful information for determining harvest changes due to the Project. Although some animals from the Delta Caribou Herd (DCH; which calves in Subunit 20A) occur in GMU Subunit 13E and occasionally move south of the Denali Highway, changes in harvest in Subunit 20A due to the Project are considered unlikely and would be difficult to quantify if they did occur; therefore, no data from Subunit 20A were included in this analysis.

5. RESULTS

5.1. Hunting Regulations in GMU 13

State game regulations vary among GMUs and subunits and additional restrictions may apply to special areas within subunits. A new set of regulations is printed for each regulatory year (July 1–June 30) and regulations change over time. The hunting regulations for GMU 13 are summarized below, with particular attention to Subunit 13E. This summary focuses on current regulations and major changes but does not attempt to identify all regulatory changes that may have occurred during the period of harvest data collection for each species.

5.1.1. Moose

Because of its proximity to major human population centers, GMU 13 has provided an important area for moose hunting in Alaska for decades. Large annual harvests (1,200 bulls; 200 cows) in the region in the late 1960s and early 1970s have been attributed to liberal hunting regulations (Tobey and Schwanke 2010). Seasons were long (both fall and winter) and both sexes could be harvested. As the regional moose population decreased, however, stricter regulations were implemented. By 1972, cow moose could no longer be harvested and the hunting season was restricted to fall only. In 1980, antler restrictions for a legal bull moose were instituted, requiring an antler spread of 36 inches or three brow tines on at least one antler. Current moose hunting regulations allow both residents and nonresidents to harvest one bull with spike-fork antlers or a minimum antler spread of 50 inches, or antlers with four or more brow tines on at least one side, during September 1–20.

In addition to the general season harvest, subsistence hunts and antlerless moose hunts in GMU 13 are available by permit. Since 1990, residents of GMUs 12, 13, and 20 have been eligible for a federal subsistence registration hunt (August 1–September 20), with a bag limit of one bull of any size, on federal lands. Beginning in 1995, 150 Tier II subsistence permits were issued per year until 2009, when that hunt was cancelled. Only one permit per household was issued for each hunting season (August 15–31). In 2009, drawing hunts were available for residents to harvest any bull and for nonresidents to take one bull with a 50-inch spread or four brow tines on at least one side. The Ahtna community harvest hunt (August 10–September 20) also began in 2009, for 100 bulls with no antler restrictions. Other important changes in the regulations occurred in 2007, when the Board of Game (BOG) required meat on all quarters and ribs to remain intact until processing for consumption. That salvage requirement also included the heart and liver for Tier II moose harvests. The BOG prohibited the use of aircraft or off-road vehicles weighing over 1,500 pounds for Tier II hunts between 2007 and 2008.

5.1.2. Caribou

Similar to moose hunting, GMU 13 has also been an important area for caribou hunting due to its proximity to Anchorage and Fairbanks. The population of the Nelchina Caribou Herd (NCH) has fluctuated dramatically, from lows in the 1940s (5,000–10,000 caribou) to peak levels in the mid-1960s (approximately 70,000 caribou), so changing the bag limit has been a successful management tool to maintain consistent population and harvest levels (Tobey and Schwanke 2009a). In 1972, bag limits were reduced from three to a single caribou and the winter hunting season eliminated (Fall and Simeone 2010).The recent expansion of the DCH range into the northern portion of GMU 13E has complicated the assignment of harvested animal to a particular herd, posing a management challenge for ADF&G.

Since 1977, hunting of the NCH has been available only by permit, with frequent changes in regulations being shaped by the outcomes of court cases. The Tier II subsistence permit hunt, first established in 1985, was the means by which nearly all NCH animals harvested during 1991–2008 and in 2010 were taken (Fall and Simeone 2010). In 2009, the BOG adopted a community subsistence hunt and also created a Tier I lottery to allocate a hunting opportunity every 4 years, as opposed to every year. Both of those hunts reflected a more traditional definition of subsistence use than did the Tier II system. The BOG eliminated Tier II hunts in

2009, only to adopt emergency regulations in the following year (2010) that included only Tier I and Tier II hunts. Other important changes in the regulations occurred in 2007, when the BOG required that the meat on all quarters and ribs remain intact until processing for consumption. This salvage requirement also included the head, hide, kidneys, liver, and heart for Tier II caribou harvests. The BOG also initiated a ban prohibiting the use of aircraft or off-road vehicles over 1,500 pounds for Tier II hunts between 2007 and 2008. The current 2012–2013 state regulations for GMU 13 allow residents to harvest one caribou by either registration hunt or community subsistence permit, or one bull by drawing permit. The hunting seasons for all state permits are August 10–September 20 and October 21–March 31.

Federal subsistence permit hunts for the NCH were first established in 1990 and are managed through the Bureau of Land Management. These hunts are only available to residents of Units 12, 13, and 20. The bag limit for the federal hunt is two caribou, with hunting season dates matching the state season (August 10–September 30 and October 21–March 31).

5.1.3. Black Bear

Black bear harvests have been recorded since 1973, when black bear sealing became mandatory (Tobey 2005). In 1997, the BOG required meat to be salvaged from black bears harvested between January 1 and May 31 (Tobey 2002). The current (2012) black bear harvest regulations in GMU 13 allow resident and nonresident hunters with a harvest ticket to harvest three black bears. There is no closed season for black bears in GMU 13.

5.1.4. Brown Bear

Brown bear harvest in GMU 13 has increased substantially since the 1960s, largely due to liberalization of hunting regulations that began in 1980, when a spring season was introduced. Bag limits were also increased during 1983–1988 and again since 1995 to allow each hunter to harvest one bear every regulatory year. Since 2002, brown bear harvest has been allowed at any time of year in nearly all areas of GMU 13, with no closed season. The only exception occurs in Denali State Park (in GMU 13E), where a single bear may be harvested every regulatory year during August 10–June 15. Previous regulations in Denali State Park allowed one bear every four regulatory years during the open season. The greatest numbers of brown bears have been harvested when bag limits were one bear per regulatory year and the resident hunting tag fee was waived, conditions that have been in effect annually since 1995 (Tobey and Kelleyhouse 2007). The current (2012) brown bear harvest regulations allow each resident and nonresident hunter in GMU 13 to harvest one brown bear every regulatory year.

5.1.5. Dall's Sheep

Sheep harvest records for the Talkeetna Mountains and the Chulitna–Watana Hills (including the Project area) have been maintained since 1967 (Peltier 2011). Only adult rams are harvested. Initial regulations for legal rams required 3/4-curl horns or greater between 1967 and 1978. The legal ram requirement was increased to 7/8-curl horn or greater between 1979 and 1988, and was increased again in 1989 to full-curl horns or greater. The hunting season in Subunits 13A and 13E during 2007–2009 was August 10–September 20. Current regulations (2012) allow resident and nonresident hunters to harvest one ram with full-curl horns or larger by harvest ticket in GMU 13 during August 10–September 20.

5.1.6. Wolf

Predator control efforts and liberal harvest regulations (no closed season, no bag limit) instituted by the federal Bureau of Sport Fisheries and Wildlife (now the USFWS) between 1948 and 1953 decimated the wolf population in GMU 13. After the wolf season was closed in 1959, wolf population numbers increased dramatically (Schwanke 2009). In 1971, a mandatory sealing requirement for wolf pelts and a ban on aerial shooting without a permit were instituted (Harbo and Dean 1983). Increased wolf hunting pressure in the mid-1970s resulted in stable wolf numbers and also allowed ungulate populations to increase slowly (Schwanke 2009). Land-and-shoot hunting was a common and legal method for taking wolves under general trapping regulations, until it was prohibited in 1988. The wolf population subsequently increased to record high numbers in 1999 and 2000 (Schwanke 2009). The implementation of a wolf control plan in 2000 (Subunits 13A, 13B, and 13E) and reinstitution of land-and-shoot hunting in 2004 effectively reduced the wolf population and maintained it at the state's management objective level since 2006 (Schwanke 2009). In 2005, Subunit 13C was added to the wolf control plan and in 2006 aerial shooting became legal for same-day-airborne permittees under the land-and-shoot provision. Current hunting regulations allow resident and nonresident hunters to harvest 10 wolves per day in GMU 13 during August 10–April 30.

Wolves are also harvested under trapping regulations, which also were liberalized to increase harvest. Before 1994, the trapping season lasted for 141 days (November 10–March 31). The trapping season length was increased to 171 days between 1994 and 1998. Since 1998, trapping regulations have allowed for unlimited harvest of wolves during October 15–April 30 (197 days).

5.1.7. Wolverine

Before the advent of mandatory pelt sealing in 1971, records of wolverine harvest were restricted to bounty records and marginal fur buyer reports (Schwanke 2010). Since that time, hunting and trapping regulations for wolverine have changed little. The trapping season in GMU 13 between 1985 and 1991 was November 10–February 28, but in 1992 the season was shortened by a month (November 10–January 31) and has remained the same since then. A bag limit of two wolverines per season was in place between 1992 and 1996, but was deemed unnecessary by the BOG and was eliminated. There is currently no bag limit during the trapping season for wolverines, but only one wolverine may be harvested by each resident or nonresident hunter during the open hunting season of September 1–January 31 (Schwanke 2010).

5.1.8. Beaver

Before the advent of mandatory pelt sealing in 1971, records of beaver harvest were restricted to marginal fur buyer reports (Schwanke 2010). Beaver trapping between 1995 and 2000 had no bag limits, but the trapping season was slightly shorter (October 10–May 15) than is currently allowed (September 25–May 31). Unlimited bag limits have been in place since 2007. Beaver cannot be harvested with a state hunting license, but can be harvested under federal subsistence hunting regulations on federal lands during June 15–September 10. In 2007, for example, 12% of the beavers harvested in GMU 13 were taken under federal subsistence regulations (Schwanke 2010).

5.1.9. Lynx

Lynx harvest records officially began in 1977, when the sealing of pelts of this species became mandatory. The state developed a lynx harvest-tracking strategy, which adjusts trapping season duration to compensate for variations in the lynx population cycle, to avoid overharvest of lynx when the population is in cyclic decline. During the recent population low between 2002 and 2004, for example, the season was shortened to December 1–January 15. The lynx trapping season was lengthened slowly with the cyclic increase in lynx numbers to the current season of November 10–February 28, where it has remained since 2007. In response to trapper input, ADF&G intends to keep the same opening date (November 10) regardless of population levels, but will shorten the season with an earlier end date, when needed. There are no bag limits for trapper harvests. Lynx also can be harvested under hunting regulations. The current hunting season (November 10–February 28) and bag limit (two lynx) have been in effect since 2005.

5.1.10. Marten

Until recently, marten harvests in Subunit 13E were managed differently than in the remainder of GMU 13. Between 1997 and 2002, marten had to be sealed and the trapping season ran from November 10–December 31 in Subunit 13E, whereas the remainder of GMU 13 had a longer season (November 10–February 28) and no sealing requirement. In 2003, the sealing requirement was waived in Subunit 13E, so all marten in GMU 13 now are managed under the same regulations using the same season (November 10–February 28) and bag limit (none).

5.1.11. River Otter

Official records of river otter harvest began in 1977, when sealing of pelts became mandatory. The current trapping season is November 10–March 31, with no bag limit. No hunting season exists for this species.

5.2. Harvest Analyses

A total of 152,128 records of hunting and harvest data for 13 species of mammals were received from ADF&G for 2003–2010 or 2011 in GMUs 13, 14, and 16 (Table 1). Two species—bison, *Bison bison* and mountain goat, *Oreamnos americanus*—do not occur consistently in or near the Project area and no harvests of those species were recorded in adjacent GMU subunits, so they were dropped from the analysis.

USFWS provided a data file summarizing moose and caribou harvest effort and success in GMU 13 by subunit for the years 1994–2011, totaling 6,480 caribou harvest records and 898 moose harvest records from hunts on federal lands (Table 1). Because of the pattern of land ownership in GMU 13, however, most of the federal subsistence harvests reported for that unit were taken in Subunit 13B, east of the Project area (T. Evans, USFWS, personal communication).

Many of the caribou, lynx, wolf, and wolverine harvests reported for GMUs 13, 14, and 16 came from GMU 13, but that unit has a low reported marten harvest (Table 1) because marten are no longer required to be sealed in GMU 13E. Hence, because the reported harvest of marten was a very low proportion of the actual harvest, marten were not analyzed further.

5.2.1. Game Management Unit 13E

Between 2003 and 2011, harvests of 3,528 caribou and 1,314 moose were reported from GMU 13E. Between 2003 and 2010, harvests of 540 black bears and 461 brown bears were reported from GMU 13E (Table 2). The mean annual harvests over those time periods were 392 caribou, 146 moose, 60 black bears, and 58 brown bears. No linear trend in caribou harvest was detected among years (linear regression; $P = 0.916$), but moose harvest increased significantly with year (linear regression; $P = 0.001$), by a mean of 8.5 moose/year (95% C.I. = 4.5 to 12.4 moose/year). Because of changes in reporting requirements for bears, changes in harvest among years were not analyzed.

Reported harvests totaled 319 beavers, 74 lynx, 56 river otters, 110 Dall's sheep, 296 wolves, and 80 wolverines in GMU 13E during 2003–2010 (2003–2011 for sheep), resulting in mean annual harvests of 39.9 beaver, 9.3 lynx, 7.0 river otters, 22.0 sheep, 37.0 wolves, and 10.0 wolverines (Table 3). Lynx showed the greatest proportional annual fluctuation in annual reported harvest, ranging from zero in 2005 to 20 in 2009. Annual variability in lynx harvest is likely due to a combination of different levels of trapping and hunter effort in different years and fluctuations in animal densities. Lynx, in particular, display large natural population fluctuations over periods of years, which should be reflected in reported harvest (Mowat et al. 1999), provided that trapping effort remains generally similar among years.

Strong patterns were found in the percentage of reported harvest by month (Table 4; excluding federal subsistence harvest, which did not differentiate by month), as would be expected from the timing of open seasons. A total of 81% of caribou harvest occurred in August–September and 90% of moose harvest occurred in September. Most sheep harvest (78%) occurred in August and the remaining 22% occurred in September. The highest black bear harvests occurred during May–June and August–September. Most brown bear harvest occurred during August–September, with a lower percentage occurring in spring. Most furbearers were harvested during the winter trapping season.

Eight different types of transportation used for moose hunting in GMU 13E were identified in the ADF&G harvest database, plus an additional other or unknown category. The majority of hunters (63.4%) used 3- or 4-wheelers or other off-road vehicles (Table 5) to access hunting areas. A total of 21.1% used highway vehicles or traveled by foot. Airplanes were used by 7.1% of hunters and boats or airboats were used by 8.6% of hunters. These patterns were largely consistent over the time period for which data were available, but most of the increase in harvest was taken by hunters using 3- or 4-wheelers (Table 5).

Over all years, the majority of moose harvest (72.5%) was also reported by hunters using 3- or 4-wheelers or other off-road vehicles (Table 5). Highway vehicles were used for 10.9% of moose harvest and airplanes were used for 7.2%. A total of 8.2% of the moose harvest was taken using a boat or an airboat (Table 5).

The overall hunter success rate for moose hunters in GMU 13E was 20.4% (Table 5). The highest success rate was for hunters using off-road vehicles (30.7%) followed by horse or dog teams (28.0%) and airboats (27.5%). The lowest success rates were for hunters on foot (11.8%) or using highway vehicles (11.2%). The success rate for hunters using 3- or 4-wheelers was slightly higher (22.0%) than the overall mean.

Nine different types of transportation used for caribou hunting in GMU 13E were identified in the ADF&G harvest database, plus an additional other or unknown category. The majority of caribou hunters used 3- or 4-wheelers (53.1%) or off-road vehicles (11.3%; Table 6) to access hunting areas. A total of 21.3% used highway vehicles or traveled by foot. Airplanes were used by 4.9% of hunters, boats or airboats were used by 2.4% of hunters, and snowmachines were used by 6.3% of caribou hunters.

Over all years, the majority of caribou harvest (67.9%) was taken by hunters using 3- or 4-wheelers (56.7%) or other off-road vehicles (Table 6). Access by highway vehicles or foot accounted for 17.1% of caribou harvest and airplanes were used for 4.7%. A total of 2.3% of caribou harvest was taken using a boat or airboat and snowmachine access was used for 7.2% of the harvest (Table 6).

The overall mean hunter success rate for caribou hunters in GMU 13E was 72.5% (Table 6). The highest success rate was for caribou hunters using a horse or dog team (89.5%), snowmachines (83.2%), and airboats (82.9%). Success rates were lower for access by highway vehicles (58.3%), foot (61.3%), boat (62.2%), and other/unknown (47.1%). The mean success rate for caribou hunters using 3- or 4-wheelers was slightly higher (77.5%) than the overall mean and the mean success rate for airplane hunters was slightly lower (69.2%) than the overall mean.

The largest proportions of the brown bear harvest in GMU 13E were taken by hunters using 3- or 4-wheelers (27.4%) or airplanes (26.0%) (Table 7). Substantial proportions of the harvest also were taken using boat or airboat (18.2%), highway vehicles (10.1%), or snowmachines (9.6%) for access. The methods of transportation used to harvest brown bears in GMU 13E changed little during 2003–2010 (Table 7).

The majority of Dall's sheep hunters used 3- or 4-wheelers (53.4%) or off-road vehicles (7.6%) for access to hunting areas (Table 8). Other important modes of access were airplanes (20.8%) or highway vehicles (15.1%). The majority of the sheep harvest, however, was taken by hunters using airplanes (55.1%), whereas hunters using 3- or 4-wheelers harvested only 32.7% of sheep. Overall, the success rate for sheep hunters was only 13.8%, with hunters using airplanes having a higher success rate (36.6%) and hunters using 3- or 4-wheelers a lower success rate (8.5%) (Table 8).

5.2.2. Aggregated Major Units

The second level of analysis was the aggregation of ADF&G major units, which resulted in some loss of data when moving from GMU subunits to major units. For GMU 13E, 96.1% of overall harvest was attributed to a major unit (Table 9). There were large differences in the percentage of harvest data attributed to a major unit by species. All river otters and wolves were assigned to a major unit, but only 93.7% of beavers, 94.8% of black bear, 95.4% of caribou, and 95.5% of Dall's sheep could be assigned to a major unit (Table 9).

Between 2003 and 2011, a total of 1,670 caribou, 898 moose, 447 black bears, 344 brown bears, and 135 Dall's sheep were harvested from the four ADF&G major units (or portions of major units; Figure 2) according to the ADF&G data (Table 10). Additional harvest may have occurred that was not identified to major unit, however (Table 9).

Again, strong patterns were evident in the reported harvest by month (Table 11), corresponding largely with seasonal harvest restrictions. The highest black bear harvests occurred in May–June

and August–September. Most brown bear harvest occurred during August–September, with a lower percentage occurring in spring and summer. A total of 96.9% of caribou harvest occurred in August–September and 94.2% of moose harvest occurred in September. Most sheep harvest (77.8%) occurred in August and the remaining 22.2% occurred in September. Most furbearers were harvested during winter (Table 11). These temporal patterns were very similar to those found for the GMU 13E area (Table 4).

Nine different types of transportation used for moose hunting in the aggregated major units were identified in the ADF&G harvest database, plus an additional other or unknown category. The majority of hunters (68.5%) used 3- or 4-wheelers or other off-road vehicles (Table 12) for access to hunting areas. Airplanes were used by 15.2% of hunters and boats or airboats were used by 7.9% of hunters. A total of 7.1% used highway vehicles or traveled by foot. These patterns were largely consistent over the time period for which data are available, but most of the increase in moose harvest over time was a result of increasing harvest by hunters with 3- and 4-wheelers and other off-road vehicles (Table 12).

Over all years, the majority of moose harvest (76%) was also taken by hunters with 3- or 4-wheelers or other off-road vehicles (Table 12). Highway vehicles were used for 4.6% of the moose harvest and airplanes were used for 13.0%. A total of 4.9% of moose harvest occurred using a boat or an airboat (Table 12).

The overall hunter success rate for moose hunters in the aggregated major units was 23.6% (Table 12). The highest success rate was for hunters using off-road vehicles (35.8%) followed by horse or dog teams (25.0%), 3- or 4-wheelers (22.6%), and airboats (22.2%). The lowest success rate was for highway vehicles (15.8%), boat (14.4%), and foot (0%; Table 12).

Nine different types of transportation used for caribou hunting in the aggregated major units were identified in the ADF&G harvest database, plus an additional other or unknown category. The majority of caribou hunters used 3- or 4-wheelers (54.2%) or other off-road vehicles (14.9%; Table 13) to access hunting areas. A total of 6.1% used highway vehicles or traveled by foot. Airplanes were used by 20.5% of hunters, boats or airboats were used by 2.6% of hunters, and snowmachines were used by 0.8% of caribou hunters.

Over all years, the majority of caribou harvest also occurred by hunters with 3- or 4-wheelers (57.3%) and an additional 14.3% occurred with off-road vehicles (Table 13). Highway vehicles or foot were used for 4.6% of caribou harvest and airplanes were used for 19.8%. A total of 2.2% of caribou harvest occurred using a boat or an airboat and 0.8% occurred using snowmachines (Table 13). The overall mean hunter success rate for caribou hunters in the aggregated major units was 72.5% (Table 13). The highest success rate was for caribou hunters using other/unknown types (81.3%), 3- or 4-wheelers (76.7%) and snowmachines (72.2%), and airplanes (70.0%). The lowest success rate was for airboats (44.4%), highway vehicles (54.9%), and boats (64.0%). The mean success rate for caribou hunters using 3- or 4-wheelers was slightly higher (76.7%) than the overall mean and the mean success rate for airplane hunters was slightly lower than the overall mean (70.0%; Table 13).

Most brown bears harvested in the aggregated major units were taken by hunters using airplanes (40.2%), but 21.6% used boats, 17.5% used 3- or 4-wheelers, and 8.5% used snowmachines (Table 14). Nearly all sheep hunters used airplanes (50.6%) or 3- or 4-wheelers or other off-road vehicles (44.4%) (Table 15). The transportation used by successful sheep hunters was much

different than the effort, however, in that 88.7% of the total harvest was taken by hunters using airplanes. This pattern was reflected in the success rates: the overall success rate was 20.8%, but airplane hunters had a 36.4% success rate, hunters using horse/dog teams had a 30.0% success rate, and hunters using all other transportation types had success rates under 10% (Table 15). Some of the large discrepancy in success rates may have resulted from airplane hunters specifically targeting sheep, whereas other hunters may have been targeting other species but decided to get a sheep harvest ticket.

5.2.3. Aggregated Uniform Coding Units

The third level of analysis was the aggregation of 13 adjacent UCUs (Figure 2), which again resulted in some loss of data from those analyzed for the aggregated major units. For GMU 13E, 96.1% of the overall harvest was attributed to a major unit, whereas 90.0% was attributed to specific UCUs (Table 9). In some cases, harvest was not attributed to a single UCU but was attributed only to one of several different UCUs. Where all of those UCUs were located within the analytical zone, then that harvest was included in the dataset for the UCU zone.

Between 2003 and 2011, 398 caribou, 277 moose, 37 black bears, 55 brown bears, and 13 Dall's sheep were harvested from the aggregated UCU zone (Table 16), although some additional harvest occurred that could not be attributed correctly to specific UCUs (Table 9). Large differences among species were noted in the percentage of harvest data attributed to a UCU. Over 90% of the harvests of brown bear, caribou, lynx, moose, and wolf were assigned to a specific UCU, in contrast to only 56.1% of those of beavers, 69.6% of river otters, and 80.4% of black bears (Table 9).

Strong patterns were evident in the proportions of reported harvest among months (Table 17). The highest proportion of black bear harvest occurred during August–September (86.4%) and an additional 13.5% occurred during May–June. Most brown bear harvest was taken during April–May and August–September, with some additional harvest in June and October. A total of 99.5% of caribou harvest occurred in August–September and 96.7% of moose harvest occurred in September. Most sheep harvest (61.5%) occurred in August and the remaining 38.5% occurred in September. Most furbearers were harvested during winter (Table 17). These temporal patterns were very similar to those found for GMU 13E (Table 4) and the aggregated major units (Table 11).

Seven different types of transportation used for moose hunting in the UCU zone were identified in the ADF&G harvest database, plus an additional category for other or unknown. The majority of hunters (72.5%) used 3- or 4-wheelers or other off-road vehicles for primary access to hunting areas (Table 18). Airplanes were used by 19.2% of hunters, boats or airboats were used by 6.0%, and highway vehicles were used by 1.9%. These patterns were largely consistent over the time period for which data are available, although the total numbers fluctuated substantially among years (Table 18).

Over all years, the bulk of the moose harvest (85.8%) was taken by hunters using 3- or 4-wheelers or other off-road vehicles (Table 18). Other proportions included 10.2% by hunters using airplanes, 2.2% by hunters using boats or airboats, and 1.5% by hunters using highway vehicles (Table 18).

The overall success rate for moose hunters in the UCU zone was 29.5% (Table 18). Airboats and horse/dog team each were used by a single hunter, both of whom harvested a moose. Of the remaining categories, the highest success rates were for hunters using off-road vehicles (37.9%), 3- or 4-wheelers (34.0%), and highway vehicles (22.2%). The lowest success rates were for hunters using airplanes (15.6%) or boats (9.1%) (Table 18).

Seven different types of transportation used for caribou hunting in the UCU zone were identified in the ADF&G harvest database, plus an additional other or unknown category. The largest proportion of caribou hunters (57.4%) used 3- or 4-wheelers or other off-road vehicles for access to hunting areas (Table 19). Airplanes were used by 33.7% of hunters, boats or airboats were used by 6.5% of hunters, highway vehicles by 1.7% of hunters, and snowmachines were used by 0.2% (Table 19).

Over all years, the largest proportion of caribou harvest occurred by hunters with 3- or 4-wheelers (44.5%) and an additional 13.7% occurred with off-road vehicles (Table 19). Airplanes were used for an additional 33.8% of harvested caribou. Just 6.4% of caribou harvest occurred with boats or airboats, 1.0% occurred with highway vehicles, and 0.3% with snowmachines. The overall average hunter success rate for caribou hunters in the UCU zone was 75.1% (Table 19). The highest success rate was for snowmachines and airboats, but these transportation methods only had a single hunter using each type. Caribou hunters using off-road vehicles (79.4%), airplanes (75.6%), or 3- or 4-wheelers (75.4%) had success rates slightly higher than the overall average and hunters using boats (72.7%) and highway vehicles (44.4%) had lower success rates than the overall average (Table 19).

Most of the brown bear harvest in the UCU zone was taken by hunters using 3- or 4-wheelers (37.0%) or airplanes (29.6%), with lesser proportions being taken by hunters using snowmachines (16.7%), boats or airboats (13.0%), or other off-road vehicles (1.9%) (Table 20).

Almost all Dall's sheep hunters used 3- or 4-wheelers or other off-road vehicles (72.2%) or airplanes (25.0%) (Table 21). The transportation modes used for successful harvest of Dall's sheep were much different than the effort; 76.9% of the harvest was taken by hunters using airplanes for access and the other 23.1% was taken by hunters using 3- or 4-wheelers. This pattern was reflected in success rates also; although the overall success rate was just 9.0%, hunters using airplanes had a 27.8% success rate, those using 3- or 4- wheelers had a success rate of 3.5%, and no sheep were harvested by hunters using other forms of transportation (Table 21). Some of the large discrepancies in success rates may have been the result of hunters using airplanes to target sheep, whereas other hunters may have been targeting other species while still carrying a sheep harvest ticket.

5.2.4. Comparison Among Zones

The mean annual reported harvest of each species was calculated for each of the three analytical zones: GMU 13E, aggregated major units, and aggregated UCUs. To facilitate comparisons among these differently sized zones, the mean harvests were divided by the area of the zones to calculate a mean annual harvest rate per 1,000 square kilometers. Because not all of the harvests could be assigned to a specific major unit or UCU, we adjusted the harvest rates by dividing them by the species-specific proportion of the GMU 13E harvest that was assigned to major units or UCUs (Table 9). These adjusted harvest rates allow general comparisons of harvest rates to be

made among the three analytical zones (Table 22). The aggregated UCUs zone reflects harvests nearest to the dam, associated infrastructure, and reservoir inundation zone, whereas the other two areas provide a larger, regional perspective.

The mean annual harvest rate for all species except wolves was lower in the UCU zone than in GMU 13E (Table 22). The harvest rate for wolves was 2.96 wolves/1,000 square kilometers in the UCU zone and just under 2 wolves/1,000 square kilometers in the two larger zones. The harvest rate of caribou was 20.78 caribou/1,000 square kilometers in GMU 13E, 13.28 caribou/1,000 square kilometers in the major unit zone, and 10.51 caribou/1,000 square kilometers in the UCU zone. The harvest rate for moose was more uniform among areas, however, averaging 7.62 moose/1,000 square kilometers in GMU 13E, 7.01 moose/1,000 square kilometers in the major units zone, and 7.53 moose/1,000 square kilometers in the UCU zone. The harvest of Dall's sheep was 0.65 sheep/1,000 square kilometers in GMU 13E, 1.07 sheep/1,000 square kilometers in the major units zone, and 0.37 sheep/1,000 square kilometers in the UCU zone (Table 22). The lower harvest rates in the UCU zone are most likely due to the fact that access into the Project area currently is relatively difficult.

5.3. Species Abundance

Species abundance is an important factor affecting hunting effort and harvest levels for each targeted species. Unfortunately, adequate data on species abundance are often lacking at the spatial and temporal resolution necessary to identify density and trends in the Project area. Some general patterns have been identified based on the available population data, however.

5.3.1. Moose

Moose densities in GMU 13 were low in the early 1900s, increased in the 1940s, and peaked in the mid-1960s (Tobey and Schwanke 2010). Numbers then declined over the next 10 years, reaching a low in 1975 due to severe winters, increased predation, and large human harvests of both bulls and cows. The population increased during 1978–1987, then declined 47% in the early 1990s and reached a low in 2001. After wolf control resumed in GMU 13 in 2003, moose numbers started to rebound (Tobey and Schwanke 2010). Observed density in moose trend-count areas in GMU 13 increased steadily from 0.39 moose/square kilometers in 2001 to 0.66 moose/square kilometers in 2009. GMU 13E had intermediate densities relative to the other four GMU subunits in GMU 13 (Tobey and Schwanke 2010).

5.3.2. Caribou

The NCH was estimated at 18,713 in 1980 (Pitcher 1982) and 27,528 by 1985 (Pitcher 1987). It grew steadily to approximately 50,000 animals by 1995, then declined and remained fairly stable in the range of 30,000–35,000 caribou from the mid-1990s to 2007, when the population was estimated at 33,744 (Tobey and Schwanke 2009a). In June 2012, the herd size was estimated at approximately 46,500 animals (ADF&G press release, 31 July 2012), which resulted in ADF&G issuing an additional 2,425 drawing permits for the herd that year.

The DCH traditionally ranged north of the Alaska Range in GMU 20A. In recent years animals from that herd have been found in the Cantwell area, along the western portion of the Denali Highway, and in the upper Susitna River basin (Seaton 2009). The DCH was estimated at 1,500–

2,500 caribou in 1975, but subsequently grew to nearly 11,000 by 1989. Herd size dropped again to about 3,000 animals by the late 1990s, however, and has remained low. The most recent herd estimate was approximately 3,000 animals in 2007 (Seaton 2009).

5.3.3. Brown Bear

Estimates of brown bear density in various parts of GMU 13 since 1979 have ranged from 16 to 41 bears/1,000 km² (386 mi²) (Tobey and Kelleyhouse 2007). Comparisons among years are complicated by the fact, however, that different survey methods were used at various times. Subunits 13A and 13E appear to have some of the highest brown bear densities in interior and northern Alaska (Tobey and Kelleyhouse 2007). Density was estimated in 1985 (27.1 bears/1,000 km²) and 1995 (40.8 bears/1,000 km²), suggesting that the population was increasing during that period (Tobey and Schwanke 2009b). In 2000, 2001, and 2003, line-transect surveys were completed in portions of Subunit 13E, producing a density estimate of 32.2 bears/1,000 km² (Tobey and Schwanke 2009b).

GMU 13 has been designated by ADF&G for intensive management, so reducing the bear population is a management priority to boost survival rates of moose and caribou for human consumption. Population reduction was sought mainly through liberalized bear hunting regulations, involving longer seasons and higher bag limits (one bear per hunter per year instead of one bear every four years previously). Preliminary results of a recent population estimate conducted in western Subunit 13A suggest that the brown bear population in that area is similar to the level observed in 1998 (Tobey and Schwanke 2009b).

5.3.4. Black Bear

Very few data exist regarding black bear abundance in GMU 13 and trends in black bear abundance have not been documented (Robbins 2011). The only density estimate available (89.7 bears/1,000 km²) came from the bear study conducted for the original Alaska Power Authority (APA) Project in 1985 (Miller 1987). That density estimate should be interpreted cautiously, however, due to the difficulty of observing black bears in the dense vegetation they favor. Miller (1987) considered the black bear habitat in his study area to be marginal and not representative of more forested, higher quality habitats in other areas of GMU 13. Based on field observations and harvest data, Robbins (2011) concluded that black bears were more abundant in large portions of Subunits 13D and 13E than in Subunit 13C.

5.3.5. Dall's Sheep

ADF&G conducts periodic aerial surveys for Dall's sheep in Subunits 13A, 13E, 14A, and 14B (Talkeetna Mountains and Chulitna–Watana Hills). The first large-scale survey of sheep in the area was conducted in 1974 and produced an estimate of 2,500 to 3,000 individuals, assuming that 80% of the population was counted (Peltier 2011). More recent surveys in the Watana Hills, conducted in 1999 and 2003, provided counts of 97 sheep (18% lambs) and 50 sheep (14% lambs), respectively (Peltier 2008). The total sheep counts across the entire reporting area have varied somewhat through time: approximately 2,500 in the late 1980s, 2,000–2,500 in 1994, and 2,500–3,000 in 1999. Those years of fairly stable counts were followed by a severe winter (1999–2000) and the sheep population declined to approximately 1,750 animals (Peltier 2008). Subsequent surveys conducted between 2000 and 2003 suggested the population was beginning

to recover, but the most recent estimate indicated that the population size remains low (approximately 1,500 individuals; Peltier 2011).

5.3.6. Furbearers

Beavers are considered to be relatively abundant in GMU 13, judging from incidental observations of beaver lodges and caches (Schwanke 2010). Lynx numbers peaked in 2000 and were low in 2002–2003 but rose substantially in subsequent years (Schwanke 2010). Wolverines were thought to be scarce in GMUs 13 and 11 from 1996 to 2003, but the density is now thought to be increasing in those units, at least at moderate and high elevations (Schwanke 2010). Marten numbers in GMUs 13 and 11 are thought to have increased in the 1980s and 1990s, peaking in about 1998, and to have been variable since then. Marten tracks were common during 2006–2007 (Schwanke 2010).

ADF&G also conducts surveys of trappers across Alaska by circulating questionnaires. Each trapper is asked to rank the abundance of different furbearers and prey species in their individual trapping area and to assess trends in abundance. For the years 2003–2009, these assessments were summarized for all of GMUs 13 and 11 combined (Peltier 2005; Blejwas 2006, 2007, 2010; Schumacher 2010a, 2010b) (Table 23). The results indicate trappers' impressions of the relative abundance of most furbearers and their major prey species over a broad geographic area. The trapper questionnaires indicate that, in most years, most species were considered to be common or abundant (Table 23). Snowshoe hares were thought to be common during 2003–2006 and abundant after that. That pattern was reflected in the abundance of lynx, which were scarce from 2003 to 2005 and became common after that. This impression is consistent with the increased lynx harvest in GMU 13E from 2007 to 2009 (Table 3). In general, lynx harvest is relatively low in GMU 13E and is mainly limited to the eastern portion of the subunit where suitable habitat is more easily accessible (Schwanke 2010). River otters were considered to be common during 2003–2007 and generally scarce after that. Wolves were common during 2003–2007, abundant in 2007–2008, but then became scarcer in 2008–2009. Beavers were common in all years except 2007–2008, when they were considered abundant. Marten were considered to be common in all years (Table 23).

6. DISCUSSION

The region encompassing the Project area is important for sport and subsistence hunting and trapping, but much of the Project area itself is currently remote, with difficult access. The greatest use for hunting occurs in August and September, with most trapping occurring in the winter months. The mean annual harvests for all of GMU 13E since 2003 were 392 caribou, 146 moose , 68 black bears, 58 brown bears, and 22 Dall's sheep, with lesser numbers of beaver, lynx, river otter, wolf, and wolverine being taken. Within the smaller zone of aggregated UCUs that was analyzed for this study, harvests generally were much lower than in the larger regional areas. The annual harvests in the UCU zone since 2003 averaged just 44 caribou, 31 moose, 7 brown bears, 5 black bears, and 13 wolves, with only occasional harvest of beaver, lynx, river otter, wolverine, and Dall's sheep (Table 16). After adjusting for differences among the analytical areas and reporting rates, however, the mean harvest rates of moose were quite similar among the UCU zone, the major units zone, and GMU 13E (Table 22). The lower harvests of

most species in the UCU zone reflect the difficulty of access into that area away from major roads.

Big game hunters currently use a variety of transportation methods for access, including 3- or 4-wheelers, other off-road vehicles, boats, airboats, airplanes, and highway vehicles, but 3- or 4-wheelers and other off-road vehicles were the predominant transportation method used in the zones analyzed. Despite the large size and navigability of the upper Susitna River and other rivers nearby, few hunters currently use boats in the area, presumably due to the fact that travel downstream from the upper river is restricted by Vee Canyon and Devils Canyon.

Given the relative remoteness of most of the Project area and the currently low harvest rates for most species, increased access due to Project construction is likely to result in substantial changes in hunting effort and harvest. Such changes will depend on the nature of regulations and policies regarding public access to the proposed new roads, reservoir, and transmission corridors. Hunting regulations may need to be reviewed by ADF&G and adapted to accommodate increased access and harvest. Boat traffic may increase due to hunters accessing the reservoir from the proposed access road or along the Susitna River from the Denali Highway or via the interconnected lake system from Lake Louise through Susitna and Tyone lakes. New road access is likely to lead to the development of additional 4-wheeler trails. New access by 4-wheelers, other off-road vehicles, and boats may render some destinations, which currently are accessible only by aircraft, less desirable to some hunters.

Additional changes in harvest may result from changes in wildlife distribution as a result of direct or indirect effects of the Project on habitats or from disturbance associated with the Project. Such changes and any associated effects on hunting or trapping are difficult to predict with the information currently available, but the wildlife studies being initiated for the Project in the 2013–2014 study plans are intended to provide more background information to help assess such changes.

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8. TABLES

Table 1. Total number of harvest records (including unsuccessful hunts) by species, GMU, and data source.

Source	Species	Game Management Unit			Total
		13	14	16	
ADF&G[1]	Beaver	1,609	1,240	1,715	4,564
	Bison	8	0	0	8
	Black Bear	1,456	1,732	3,453	6,641
	Brown Bear	1,115	218	964	2,297
	Caribou	12,692	175	44	12,911
	Lynx	4,815	54	19	4,888
	Marten	130	1,753	7,062	8,945
	Moose	6,099	6,922	2,774	15,795
	Mountain Goat	76	324	0	400
	River Otter	309	238	331	878
	Dall's Sheep	784	715	66	1,565
	Wolf	1,070	159	406	1,635
	Wolverine	343	90	273	706
USFWS[2]	Caribou	6,480	–	–	6,480
	Moose	898	–	–	898

Notes:

1 ADF&G harvest database, 2003–2011.

2 USFWS Office of Subsistence Management, 1994–2011.

Table 2. Total harvests of caribou, moose, black bear, and brown bear in GMU 13E.

Caribou and moose records are from 2003–2011 and black bear and brown bear records are from 2003–2010; some overlap may occur for 2009–2010 between the harvest database and the bear sealing database.

Regulatory Year	Caribou		Moose		Black Bear		Brown Bear	
	ADF&G Harvest[1]	USFWS[2]	ADF&G Harvest[1]	USFWS[2]	ADF&G Harvest[1]	ADF&G Sealing[3]	ADF&G Harvest[1]	ADF&G Sealing[3]
2003	256	5	110	6	–	43	–	51
2004	294	5	115	3	–	48	–	65
2005	644	2	105	4	–	53	–	54
2006	664	4	152	5	–	46	–	50
2007	350	4	134	3	–	58	–	68
2008	269	4	166	3	–	67	–	66
2009	119	4	161	4	47	59	–	51
2010	397	2	169	2	49	70	–	56
2011	504	1	170	2	–	–	–	–
Total	3,497	31	1,282	32	96	444	–	461
Mean	388.6	3.4	142.4	3.6	48	55.5		57.6

Notes:

1 Alaska Department of Fish & Game harvest database.
2 U.S. Fish & Wildlife Service Office of Subsistence Management.
3 Alaska Department of Fish & Game bear sealing records.

Table 3. Total harvests of beaver, lynx, river otter, Dall's sheep, wolf, and wolverine in GMU 13E, 2003–2011.

(Data from ADF&G furbearer database and, for sheep, from harvest database)

Regulatory Year	Beaver	Lynx	River Otter	Dall's Sheep	Wolf	Wolverine
2003	27	6	19	15	70	11
2004	45	3	12	8	49	8
2005	27	0	7	12	22	10
2006	35	8	5	13	18	9
2007	41	15	1	9	20	9
2008	27	15	7	10	48	10
2009	38	20	1	16	24	11
2010	79	7	4	12	45	12
2011	–	–	–	15	–	––
Total	319	74	56	110	296	80
Mean	39.9	9.3	7.0	22.0	37.0	10.0

Table 4. Percentage of total harvests in GMU 13E with known date, by species and month, 2003–2011.

(Data from ADF&G)

Species	*n*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beaver[1]	319	3.4	8	6.3	7.2	5	0	0	0	7.5	39	12.2	11.6
Black Bear[1]	536	0	0	0	0.6	26.3	29.7	2.4	17	21.5	2.6	0	0
Brown Bear[1]	461	0	0	0	8.7	13	8.7	10.4	23	32	4.1	0	0
Caribou	3,460	2.1	1	1.9	0	0	0	0.1	27	54	7.2	4.7	1.9
Lynx[1]	74	31	15	0	0	0	0	0	0	0	0	14.9	39.2
Moose	1,271	0	0	0	0	0	0.1	0.1	8.9	90	0.4	0.2	0
River Otter[1]	56	16	27	11	0	0	0	0	0	0	0	25	21.4
Dall's Sheep	109	0	0	0	0	0	0	0	78	22	0	0	0
Wolf[1]	296	21	35	17	6.8	0	0	0	0.3	6.8	3	2.7	8.8
Wolverine[1]	80	53	0	0	0	0	0	0	0	7.5	0	7.5	32.5

Notes:

1 Data from 2003–2010.

Table 5. Moose hunter effort, harvest, and success by transportation type and year in GMU 13E, 2003–2011.

(Data from ADF&G harvest database)

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Off-road Vehicle	Highway Vehicle	Foot	Other/ Unknown	Airboat	Total
Effort	2003	31	4	47	244	48	133	0	1	4	512
	2004	47	5	43	296	70	114	0	0	2	577
	2005	46	4	43	330	68	131	0	0	12	634
	2006	57	2	48	391	82	139	1	6	14	740
	2007	45	2	55	405	59	139	1	1	14	721
	2008	55	5	64	396	69	154	1	2	10	756
	2009	56	3	45	386	70	130	3	6	10	709
	2010	56	0	49	459	90	154	6	9	14	837
	2011	47	0	46	393	69	137	5	3	11	711
	Total	440	25	440	3,300	625	1,231	17	28	91	6,197
Harvest	2003	8	2	7	53	21	15	0	0	1	107
	2004	7	2	5	64	21	13	0	0	1	113
	2005	6	0	7	57	22	10	0	0	2	104
	2006	11	0	10	77	29	17	0	3	3	150
	2007	6	1	14	80	14	14	0	0	4	133
	2008	10	1	9	97	18	24	0	0	4	163
	2009	15	1	11	96	13	19	1	0	5	161
	2010	12	0	7	103	26	12	0	2	4	166
	2011	16	0	9	99	28	14	1	1	1	169
	Total	91	7	79	726	192	138	2	6	25	1,266
Success	2003	25.8	50.0	14.9	21.7	43.8	11.3	–	0	25.0	20.9
	2004	14.9	40.0	11.6	21.6	30.0	11.4	–	–	50.0	19.6
	2005	13.0	0	16.3	17.3	32.4	7.6	–	–	16.7	16.4
	2006	19.3	0	20.8	19.7	35.4	12.2	0	50.0	21.4	20.3

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Off-road Vehicle	Highway Vehicle	Foot	Other/ Unknown	Airboat	Total
	2007	13.3	50.0	25.5	19.8	23.7	10.1	0	0	28.6	18.4
	2008	18.2	20.0	14.1	24.5	26.1	15.6	0	0	40.0	21.6
	2009	26.8	33.3	24.4	24.9	18.6	14.6	33.3	0	50.0	22.7
	2010	21.4	–	14.3	22.4	28.9	7.8	0	22.2	28.6	19.8
	2011	34.0	–	19.6	25.2	40.6	10.2	20.0	33.3	9.1	23.8
	Total	20.7	28.0	18.0	22.0	30.7	11.2	11.8	21.4	27.5	20.4

Table 6. Caribou hunter effort, harvest, and success by transportation type and year in GMU 13E, 2003–2011.

(Data from ADF&G harvest database)

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Highway Vehicle	Foot	Other/ Unknown	Airboat	Total
Effort	2003	28	2	5	194	1	50	79	0	1	4	364
	2004	25	3	3	201	30	54	55	0	1	1	373
	2005	51	4	19	385	120	99	118	10	0	5	811
	2006	59	3	14	456	94	110	184	8	1	9	938
	2007	0	1	7	351	1	49	104	2	3	9	527
	2008	22	4	6	245	0	58	62	0	2	4	403
	2009	7	1	3	79	18	18	35	3	0	2	166
	2010	14	1	9	249	29	44	180	5	1	4	536
	2011	28	0	8	389	10	62	173	3	8	3	684
	Total	234	19	74	2,549	303	544	990	31	17	41	4,802
Harvest	2003	16	2	1	158	0	31	45	0	0	3	256
	2004	19	3	3	166	27	42	33	0	1	0	294
	2005	39	3	13	320	101	77	74	8	0	5	640
	2006	35	3	7	327	80	77	116	4	0	8	657
	2007	0	1	3	258	0	33	45	1	0	8	349
	2008	16	4	2	179	0	36	28	0	1	2	268
	2009	7	0	3	61	12	11	23	1	0	1	119
	2010	10	1	8	204	25	38	104	2	0	4	396
	2011	20		6	302	7	46	109	3	6	3	502
	Total	162	17	46	1,975	252	391	577	19	8	34	3,481
Success	2003	57.1	100.0	20.0	81.4	0	62.0	57.0	–	0	75.0	70.3
	2004	76.0	100.0	100.0	82.6	90.0	77.8	60.0	–	100.0	0	78.8
	2005	76.5	75.0	68.4	83.1	84.2	77.8	62.7	80.0	–	100.0	78.9

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Highway Vehicle	Foot	Other/ Unknown	Airboat	Total
	2006	59.3	100.0	50.0	71.7	85.1	70.0	63.0	50.0	0	88.9	70.0
	2007	–	100.0	42.9	73.5	0	67.3	43.3	50.0	0	88.9	66.2
	2008	72.7	100.0	33.3	73.1	–	62.1	45.2	–	50.0	50.0	66.5
	2009	100.0	0	100.0	77.2	66.7	61.1	65.7	33.3	–	50.0	71.7
	2010	71.4	100.0	88.9	81.9	86.2	86.4	57.8	40.0	0	100.0	73.9
	2011	71.4	–	75.0	77.6	70.0	74.2	63.0	100.0	75.0	100.0	73.4
	Total	69.2	89.5	62.2	77.5	83.2	71.9	58.3	61.3	47.1	82.9	72.5

Table 7. Total brown bear harvest by transportation type and year in GMU 13E, 2003–2010.

(Data from ADF&G sealing records)

Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Snow-machine	Off-road Vehicle	Highway Vehicle	Foot	Other/ Unknown	Airboat	Total
2003	12	0	10	14	5	3	6	1	0	0	51
2004	17	1	10	18	9	1	5	3	1	0	65
2005	16	1	2	18	7	0	7	2	1	0	54
2006	12	0	13	11	3	0	6	4	1	0	50
2007	11	0	15	18	7	1	11	5	0	0	68
2008	21	0	13	17	0	0	5	4	1	0	65
2009	15	0	6	13	4	0	4	5	2	1	50
2010	15	0	13	16	5	1	2	2	0	0	54
Total	119	2	82	125	44	6	46	26	6	1	457

Table 8. Dall's sheep hunter effort, harvest, and success by transportation type and year in GMU 13E, 2003–2011.

(Data from ADF&G harvest database)

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Off-road Vehicle	Highway Vehicle	Foot	Other/ Unknown	Total
Effort	2003	13	4	2	38	4	17	0	0	78
	2004	11	4	0	35	4	6	0	0	60
	2005	19	0	1	36	8	8	0	0	72
	2006	12	1	0	41	10	14	1	1	80
	2007	13	1	0	58	10	16	1	0	99
	2008	22	2	0	46	2	15	1	1	89
	2009	30	1	0	49	6	12	0	0	98
	2010	21	0	0	58	10	16	0	1	106
	2011	20	0	1	52	5	13	0	0	91
	Total	161	13	4	413	59	117	3	3	773
Harvest	2003	8	3	0	4	0	0	0	0	15
	2004	3	0	0	4	0	0	0	0	7
	2005	7	0	0	2	1	1	0	0	11
	2006	4	0	0	5	1	3	0	0	13
	2007	4	1	0	4	0	0	0	0	9
	2008	5	0	0	3	0	1	0	0	9
	2009	14	0	0	2	0	0	0	0	16
	2010	9	0	0	2	0	1	0	0	12
	2011	5	0	0	9	0	1	0	0	15
	Total	59	4	0	35	2	7	0	0	107
Success	2003	61.5	75.0	0	10.5	0	0	–	–	19.2
	2004	27.3	0	–	11.4	0	0	–	–	11.7
	2005	36.8	–	0	5.6	12.5	12.5	–	–	15.3

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Off-road Vehicle	Highway Vehicle	Foot	Other/ Unknown	Total
	2006	33.3	0	–	12.2	10.0	21.4	0	0	16.3
	2007	30.8	100.0	–	6.9	0	0	0	–	9.1
	2008	22.7	0	–	6.5	0	6.7	0	0	10.1
	2009	46.7	0	–	4.1	0	0	–	–	16.3
	2010	42.9	–	–	3.4	0	6.3	–	0	11.3
	2011	25.0	–	0	17.3	0	7.7	–	–	16.5
	Total	36.6	30.8	0	8.5	3.4	6.0	0	0	13.8

Table 9. Total reported harvests in GMU 13E by species, and reported harvests and percentages within aggregated major units and UCUs, 2003–2011.

	GMU 13E	Aggregated Major Units		Aggregated UCUs	
Species	***n***	***n***	**%**	***n***	**%**
Beaver[1]	319	299	93.7	179	56.1
Black Bear[1]	540	512	94.8	434	80.4
Brown Bear[1]	461	452	98.0	425	92.2
Caribou	3,497	3,337	95.4	3,279	93.8
Lynx[1]	74	73	98.6	70	94.6
Moose	1,282	1,247	97.3	1,171	91.3
River Otter[1]	56	56	100.0	39	69.6
Dall's Sheep	110	105	95.5	96	87.3
Wolf[1]	296	296	100.0	282	95.3
Wolverine[1]	80	79	98.8	67	83.8
Total	6,715	6,456	96.1	6,042	90.0

Notes:

1 Data from 2003–2010.

Table 10. Total reported harvest by species in aggregated major units, 2003–2011.

(Data from ADF&G harvest database)

	Species									
Year	Beaver	Black Bear	Brown Bear	Caribou	Lynx	Moose	River Otter	Dall's Sheep	Wolf	Wolverine
2003	15	34	36	141	3	61	9	15	64	9
2004	23	47	40	130	0	89	7	17	43	4
2005	13	41	31	333	0	79	2	21	14	8
2006	11	41	47	301	1	108	6	8	14	10
2007	21	43	57	190	1	86	1	18	7	9
2008	15	55	51	158	2	106	4	13	48	11
2009	32	76	37	70	5	114	0	20	13	11
2010	55	110	45	131	9	129	5	9	25	3
2011	–	–	–	216	–	126	–	14	–	–
Total	185	447	344	1,670	21	898	34	135	228	65
Mean	23.1	55.9	43.0	185.6	2.6	99.8	4.3	15.0	28.5	8.1

Table 11. Percentage of total harvests in aggregated major units with known date, by month and species, 2003–2011.

(Data from ADF&G)

Species	*n*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beaver[1]	185	7	14.1	11.9	9.2	5.4	0	0	0	8.1	18.9	9.7	15.7
Black Bear[1]	446	0	0	0	0.2	28.9	30.9	2.5	15	21.3	1.1	0	0
Brown Bear[1]	344	0	0.3	0	9	7.8	9.6	13.1	19.8	36.9	3.5	0	0
Caribou	1,655	0.1	0.1	0.4	0	0	0	0.1	26.2	70.7	1.1	1.1	0.2
Lynx[1]	21	47.6	38.1	0	0	0	0	0	0	0	0	0	14.3
Moose	893	0	0	0	0.1	0	0	0.1	4.5	94.2	0.4	0.2	0.4
River Otter[1]	34	17.6	26.5	20.6	0	0	0	0	0	0	0	14.7	20.6
Dall's Sheep	135	0	0	0	0	0	0	0	77.8	22.2	0	0	0
Wolf[1]	228	20.2	41.2	16.7	5.3	0	0	0	0.4	4.4	1.3	0.4	10.1
Wolverine[1]	65	60	1.5	3.1	0	0	0	0	0	10.8	0	3.1	21.5

Notes:

1 Data from 2003–2010.

Table 12. Moose hunter effort, harvest, and success by transportation type and year in aggregated major units, 2003–2011.

(Data from ADF&G harvest database)

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Highway Vehicle	Foot	Airboat	Other/ Unknown	Total
Effort	2003	45	5	31	146	0	46	31	0	0	0	304
	2004	62	4	28	189	0	61	27	0	1	0	372
	2005	57	0	39	195	0	63	40	0	0	2	396
	2006	70	0	31	221	0	96	21	0	2	5	446
	2007	56	2	24	207	0	65	25	0	1	6	386
	2008	64	1	46	215	0	77	18	0	1	8	430
	2009	63	0	35	227	0	94	29	1	6	3	458
	2010	80	0	21	251	0	95	44	3	6	6	506
	2011	70	0	22	212	1	101	24	3	1	7	441
	Total	567	12	277	1,863	1	698	259	7	18	37	3,739
Harvest	2003	7	1	3	29	0	15	5	0	0	0	60
	2004	9	1	1	49	0	22	4	0	0	0	86
	2005	8	0	5	35	0	22	6	0	0	0	76
	2006	13	0	3	41	0	40	4	0	1	4	106
	2007	11	0	4	45	0	23	2	0	0	0	85
	2008	12	1	7	49	0	31	2	0	0	3	105
	2009	17	0	7	58	0	21	9	0	1	1	114
	2010	22	0	4	59	0	35	5	0	2	0	127
	2011	16	0	6	56	0	41	4	0	0	1	124
	Total	115	3	40	421	0	250	41	0	4	9	883
Success	2003	15.6	20.0	9.7	19.9	–	32.6	16.1	–	–	–	19.7
	2004	14.5	25.0	3.6	25.9	–	36.1	14.8	–	0	–	23.1
	2005	14.0	–	12.8	17.9	–	34.9	15.0	–	–	0	19.2
	2006	18.6	–	9.7	18.6	–	41.7	19.0	–	50.0	80.0	23.8

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Highway Vehicle	Foot	Airboat	Other/ Unknown	Total
	2007	19.6	0	16.7	21.7	–	35.4	8.0	–	0	0	22.0
	2008	18.8	100.0	15.2	22.8	–	40.3	11.1	–	0	37.5	24.4
	2009	27.0	–	20.0	25.6	–	22.3	31.0	0	16.7	33.3	24.9
	2010	27.5	–	19.0	23.5	–	36.8	11.4	0	33.3	0	25.1
	2011	22.9	–	27.3	26.4	0	40.6	16.7	0	0	14.3	28.1
	Total	20.3	25.0	14.4	22.6	0	35.8	15.8	0	22.2	24.3	23.6

Table 13. Caribou hunter effort, harvest, and success by transportation type and year in aggregated major units, 2003–2011.

(Data from ADF&G harvest database)

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Highway Vehicle	Foot	Airboat	Other/ Unknown	Total
Effort	2003	43	1	4	111	0	21	11	0	0	0	191
	2004	40	1	4	87	3	23	9	0	0	0	167
	2005	85	1	13	213	5	69	23	3	0	1	413
	2006	100	2	8	235	5	66	17	0	1	3	437
	2007	24	0	5	187	0	35	18	0	1	4	274
	2008	55	1	3	137	0	39	14	0	2	3	254
	2009	42	0	3	28	2	9	10	1	0	2	97
	2010	39	0	5	69	1	21	24	0	1	2	162
	2011	42	0	5	173	2	58	7	2	4	1	294
	Total	470	6	50	1,240	18	341	133	6	9	16	2,289
Harvest	2003	24	1	1	90	0	15	9	0	0	0	140
	2004	30	0	2	72	2	17	7	0	0	0	130
	2005	59	0	10	182	5	58	15	2	0	1	332
	2006	69	2	3	162	4	42	11	0	0	3	296
	2007	16	0	2	138	0	24	5	0	0	4	189
	2008	34	1	2	96	0	16	7	0	1	1	158
	2009	33	0	2	20	0	8	6	0	0	1	70
	2010	32	0	5	60	1	18	12	0	0	2	130
	2011	32	0	5	131	1	39	1	2	3	1	215
	Total	329	4	32	951	13	237	73	4	4	13	1,660
Success	2003	55.8	100.0	25.0	81.1	–	71.4	81.8	–	–	–	73.3
	2004	75.0	0	50.0	82.8	66.7	73.9	77.8	–	–	–	77.8
	2005	69.4	0	76.9	85.4	100.0	84.1	65.2	66.7	–	100.0	80.4

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Highway Vehicle	Foot	Airboat	Other/ Unknown	Total
	2006	69.0	100.0	37.5	68.9	80.0	63.6	64.7	–	0	100.0	67.7
	2007	66.7	–	40.0	73.8	–	68.6	27.8	–	0	100.0	69.0
	2008	61.8	100.0	66.7	70.1	–	41.0	50.0	–	50.0	33.3	62.2
	2009	78.6	–	66.7	71.4	0	88.9	60.0	0	–	50.0	72.2
	2010	82.1	–	100.0	87.0	100.0	85.7	50.0	–	0	100.0	80.2
	2011	76.2	–	100.0	75.7	50.0	67.2	14.3	100.0	75.0	100.0	73.1
	Total	70.0	66.7	64.0	76.7	72.2	69.5	54.9	66.7	44.4	81.3	72.5

Table 14. Total brown bear harvest by transportation type and year in aggregated major units, 2003–2010.

(Data from ADF&G bear sealing records)

Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Highway Vehicle	Foot	Airboat	Other/ Unknown	Total
2003	13	0	11	6	2	2	1	1	0	0	36
2004	17	1	9	2	8	1	1	1	0	0	40
2005	18	0	3	5	3	0	0	1	1	0	31
2006	16	0	10	6	7	1	2	2	3	0	47
2007	18	0	13	17	3	2	2	2	0	0	57
2008	23	0	12	9	2	2	0	3	0	0	51
2009	15	0	4	7	1	0	0	7	2	1	37
2010	18	0	12	8	3	2	0	1	0	0	44
Total	138	1	74	60	29	10	6	18	6	1	343

Table 15. Dall's sheep hunter effort, harvest, and success by transportation type and year in aggregated major units, 2003–2011.

(Data from ADF&G harvest database)

Variable	Year	Airplane	Horse/Dog Team	Boat	3- or 4-Wheeler	Off-road Vehicle	Highway Vehicle	Foot	Other/ Unknown	Total
Effort	2003	28	6	2	24	5	1	0	0	66
	2004	31	3	0	29	7	1	0	0	71
	2005	43	0	0	24	7	4	0	0	78
	2006	32	0	0	14	4	1	1	1	53
	2007	30	0	0	44	8	3	0	0	85
	2008	47	0	1	24	2	1	1	2	78
	2009	47	0	0	21	5	0	0	0	73
	2010	33	1	1	32	5	1	0	0	73
	2011	33	0	0	24	5	1	0	0	63
	Total	324	10	4	236	48	13	2	3	640
Harvest	2003	14	1	0	0	0	0	0	0	15
	2004	13	2	0	1	0	0	0	0	16
	2005	19	0	0	1	0	1	0	0	21
	2006	7	0	0	1	0	0	0	0	8
	2007	14	0	0	3	1	0	0	0	18
	2008	13	0	0	0	0	0	0	0	13
	2009	18	0	0	1	0	0	0	0	19
	2010	9	0	0	0	0	0	0	0	9
	2011	11	0	0	3	0	0	0	0	14
	Total	118	3	0	10	1	1	0	0	133
Success	2003	50.0	16.7	0	0	0	0	–	–	22.7
	2004	41.9	66.7	–	3.4	0	0	–	–	22.5
	2005	44.2	–	–	4.2	0	25.0	–	–	26.9

Variable	Year	Airplane	Horse/Dog Team	Boat	3- or 4-Wheeler	Off-road Vehicle	Highway Vehicle	Foot	Other/ Unknown	Total
	2006	21.9	–	–	7.1	0	0	0	0	15.1
	2007	46.7	–	–	6.8	12.5	0	–	–	21.2
	2008	27.7	–	0	0	0	0	0	0	16.7
	2009	38.3	–	–	4.8	0	–	–	–	26.0
	2010	27.3	0	0	0	0	0	–	–	12.3
	2011	33.3	–	–	12.5	0	0	–	–	22.2
	Total	36.4	30.0	0	4.2	2.1	7.7	0	0	20.8

Table 16. Total harvest by species in aggregated UCUs, 2003–2011.

(Data from ADF&G harvest database)

Year	Beaver	Black Bear	Brown Bear	Caribou	Lynx	Moose	River Otter	Dall's Sheep	Wolf	Wolverine
2003	8	4	6	36	2	17	1	2	32	3
2004	0	3	4	44	0	28	0	1	24	0
2005	0	1	6	98	0	29	0	0	4	1
2006	0	1	7	78	0	37	0	1	8	1
2007	0	2	10	30	1	25	0	0	2	1
2008	0	4	6	35	0	38	0	1	20	3
2009	0	6	7	10	0	33	0	3	7	0
2010	0	16	9	22	0	33	0	2	8	0
2011	–	–	–	45	–	37	–	3	–	–
Total	8	37	55	398	3	277	1	13	105	9
Average	1.0	4.6	6.9	44.2	0.4	30.8	0.1	1.4	13.1	1.1

Table 17. Percentage of total harvests in aggregated UCUs with known date, by month and species, 2003–2011.

(Data from ADF&G)

Species	*n*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beaver[1]	8	0	0	0	0	12.5	0	0	0	25	62.5	0	0
Black Bear[1]	37	0	0	0	0	2.7	10.8	0	40.5	45.9	0	0	0
Brown Bear[1]	55	0	0	0	12.7	10.9	3.6	0	21.8	49.1	1.8	0	0
Caribou	394	0	0	0	0	0	0	0	20.1	79.4	0.3	0.3	0
Lynx[1]	3	33.3	0	0	0	0	0	0	0	0	0	0	66.7
Moose	275	0	0	0	0	0	0	0	3.3	96.7	0	0	0
River Otter[1]	1	0	0	100	0	0	0	0	0	0	0	0	0
Dall's Sheep	13	0	0	0	0	0	0	0	61.5	38.5	0	0	0
Wolf[1]	105	17.1	43.8	13.3	5.7	0	0	0	0	5.7	1.0	0	13.3
Wolverine[1]	9	66.7	0	0	0	0	0	0	0	22.2	0	0	11.1

Notes:

1 Data from 2003–2010.

Table 18. Moose hunter effort, harvest, and success by transportation type and year in aggregated UCUs, 2003–2011.

(Data from ADF&G harvest database)

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Off-road Vehicle	Highway Vehicle	Airboat	Other/ Unknown	Total
Effort	2003	14	0	8	45	8	4	0	0	79
	2004	23	1	3	60	21	2	0	0	110
	2005	22	0	8	48	17	3	0	0	98
	2006	26	0	6	59	28	3	0	0	122
	2007	17	0	3	60	11	2	0	2	95
	2008	21	0	15	64	23	0	0	0	123
	2009	19	0	4	63	13	2	0	1	102
	2010	25	0	2	68	16	1	1	0	113
	2011	12	0	6	56	16	1	0	0	91
	Total	179	1	55	523	153	18	1	3	933
Harvest	2003	2	0	1	10	4	0	0	0	17
	2004	3	1	0	17	6	0	0	0	27
	2005	2	0	2	16	8	1	0	0	29
	2006	5	0	0	16	14	1	0	0	36
	2007	1	0	0	21	3	0	0	0	25
	2008	2	0	2	26	8	0	0	0	38
	2009	4	0	0	26	2	1	0	0	33
	2010	6	0	0	22	4	0	1	0	33
	2011	3	0	0	24	9	1	0	0	37
	Total	28	1	5	178	58	4	1	0	275
Success	2003	14.3	–	12.5	22.2	50.0	0	–	–	21.5
	2004	13.0	100.0	0	28.3	28.6	0	–	–	24.5
	2005	9.1	–	25.0	33.3	47.1	33.3	–	–	29.6
	2006	19.2	–	0	27.1	50.0	33.3	–	–	29.5

Variable	Year	Airplane	Horse/ Dog Team	Boat	3- or 4-Wheeler	Off-road Vehicle	Highway Vehicle	Airboat	Other/ Unknown	Total
	2007	5.9	–	0	35.0	27.3	0	–	0	26.3
	2008	9.5	–	13.3	40.6	34.8	–	–	–	30.9
	2009	21.1	–	0	41.3	15.4	50.0	–	0	32.4
	2010	24.0	–	0	32.4	25.0	0	100.0	–	29.2
	2011	25.0	–	0	42.9	56.3	100.0	–	–	40.7
	Total	15.6	100.0	9.1	34.0	37.9	22.2	100.0	0	29.5

Table 19. Caribou hunter effort, harvest, and success by transportation type and year in aggregated UCUs, 2003–2011.

(Data from ADF&G harvest database)

Variable	Year	Airplane	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Highway Vehicle	Airboat	Other/ Unknown	Total
Effort	2003	20	3	24	0	0	2	0	0	49
	2004	19	2	21	1	7	0	0	0	50
	2005	41	11	40	0	20	2	0	0	114
	2006	45	5	48	0	17	2	0	0	117
	2007	0	2	40	0	6	2	0	1	51
	2008	17	2	23	0	7	0	1	2	52
	2009	6	1	3	0	1	0	0	0	11
	2010	9	4	9	0	4	1	0	0	27
	2011	19	3	24	0	6	0	0	0	52
	Total	176	33	232	1	68	9	1	3	523
Harvest	2003	14	1	19	0	0	2	0	0	36
	2004	15	2	20	1	6	0	0	0	44
	2005	34	9	35	0	18	2	0	0	98
	2006	27	2	30	0	15	0	0	0	74
	2007	0	0	24	0	4	0	0	1	29
	2008	14	2	16	0	2	0	1	0	35
	2009	6	1	2	0	1	0	0	0	10
	2010	8	4	7	0	3	0	0	0	22
	2011	15	3	22	0	5	0	0	0	45
	Total	133	24	175	1	54	4	1	1	393
Success	2003	70.0	33.3	79.2	–	–	100.0	–	–	73.5
	2004	78.9	100.0	95.2	100.0	85.7	–	–	–	88.0
	2005	82.9	81.8	87.5	–	90.0	100.0	–	–	86.0

Variable	Year	Airplane	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Highway Vehicle	Airboat	Other/ Unknown	Total
	2006	60.0	40.0	62.5	–	88.2	0	–	–	63.2
	2007	–	0	60.0	–	66.7	0	–	100.0	56.9
	2008	82.4	100.0	69.6	–	28.6	–	100.0	0	67.3
	2009	100.0	100.0	66.7	–	100.0	–	–	–	90.9
	2010	88.9	100.0	77.8	–	75.0	0.0	–	–	81.5
	2011	78.9	100.0	91.7	–	83.3	–	–	–	86.5
	Total	75.6	72.7	75.4	100.0	79.4	44.4	100.0	33.3	75.1

Table 20. Total brown bear harvest by transportation type and year in aggregated UCUs, 2003–2010.

(Data from ADF&G sealing records)

Year	Airplane	Boat	3- or 4-Wheeler	Snow machine	Off-road Vehicle	Airboat	Other/ Unknown	Total
2003	0	1	4	1	0	0	0	6
2004	1	0	0	3	0	0	0	4
2005	4	0	2	0	0	0	0	6
2006	0	2	3	1	0	1	0	7
2007	1	2	6	0	1	0	0	10
2008	3	1	1	1	0	0	0	6
2009	3	0	2	1	0	0	1	7
2010	4	0	2	2	0	0	0	8
Total	16	6	20	9	1	1	1	54

Table 21. Dall's sheep hunter effort, harvest, and success by transportation type and year in aggregated UCUs, 2003–2011.

(Data from ADF&G harvest database)

Variable	Year	Airplane	Boat	3- or 4-Wheeler	Off-road Vehicle	Highway Vehicle	Foot	Total
Effort	2003	3	1	7	1	1	0	13
	2004	4	0	11	2	0	0	17
	2005	6	0	8	3	0	0	17
	2006	3	0	5	1	0	0	9
	2007	2	0	13	4	1	0	20
	2008	2	0	12	0	0	1	15
	2009	8	0	8	2	0	0	18
	2010	4	0	14	3	0	0	21
	2011	4	0	8	2	0	0	14
	Total	36	1	86	18	2	1	144
Harvest	2003	2	0	0	0	0	0	2
	2004	1	0	0	0	0	0	1
	2005	0	0	0	0	0	0	0
	2006	0	0	1	0	0	0	1
	2007	0	0	0	0	0	0	0
	2008	1	0	0	0	0	0	1
	2009	3	0	0	0	0	0	3
	2010	2	0	0	0	0	0	2
	2011	1	0	2	0	0	0	3
	Total	10	0	3	0	0	0	13
Success	2003	66.7	0	0	0	0	–	15.4
	2004	25.0	–	0	0	–	–	5.9
	2005	0	–	0	0	–	–	0
	2006	0	–	20.0	0	–	–	11.1
	2007	0	–	0	0	0	–	0
	2008	50.0	–	0	–	–	0	6.7
	2009	37.5	–	0	0	–	–	16.7
	2010	50.0	–	0	0	–	–	9.5
	2011	25.0	–	25.0	0	–	–	21.4
	Total	27.8	0	3.5	0	0	0	9.0

Table 22. Mean annual harvest rate per 1,000 km² for each species in three analytical zones (GMU 13E, aggregated major units, aggregated UCUs).

To correct for under-reporting in smaller unit designations, harvest rates for the major units and UCUs were adjusted by dividing by the proportion of the harvest in GMU 13E that was also assigned to a specific major unit or UCU for each species (see Table 9).

		Analytical Zone					
		Aggregated Major Units			Aggregated UCUs		
Species	GMU 13E	Unadjusted	% of GMU 13E	Adjusted	Unadjusted	% of GMU 13E	Adjusted
Beaver	2.13	1.58	93.7	1.68	0.22	56.1	0.40
Black Bear	3.61	3.82	94.8	4.02	1.03	80.4	1.29
Brown bear	3.08	2.94	98.0	3.00	1.54	92.2	1.67
Caribou	20.78	12.67	95.4	13.28	9.85	93.8	10.51
Lynx	0.49	0.18	98.6	0.18	0.08	94.6	0.09
Moose	7.62	6.81	97.3	7.01	6.87	91.3	7.53
River Otter	0.37	0.29	100.0	0.29	0.03	69.6	0.04
Dall's Sheep	0.65	1.02	95.5	1.07	0.32	87.3	0.37
Wolf	1.98	1.95	100.0	1.95	2.82	95.3	2.96
Wolverine	0.53	0.55	98.8	0.56	0.25	83.8	0.30

Table 23. Relative abundance and population trends of furbearers and their prey, based on trapper questionnaires for GMUs 11 and 13.

(Sources: Peltier 2005; Blejwas 2006, 2007, 2010; Schumacher 2010a, 2010b). A plus sign indicates an increasing trend and a minus sign indicates a decreasing trend.

		Regulatory Year					
Group	**Species**	**2003–2004**	**2004–2005**	**2005–2006**	**2006–2007**	**2007–2008**	**2008–2009**
Furbearers	Beaver	common	common	common	common	abundant	common
	Coyote	common	common	common	common	scarce	common
	Ermine	abundant	common	abundant	abundant	common	common
	Lynx	scarce	scarce	common	common (+)	common	common (+)
	Marten	common (+)	common	common	common	common	common
	Mink	common (+)	common	common	common	common	scarce
	Muskrat	abundant (+)	common	common	scarce	scarce	common
	Red Fox	scarce	common	common	common	common	common
	Red Squirrel	abundant (+)	abundant	abundant	abundant	abundant	abundant
	River Otter	common (+)	common	common	common	scarce (–)	scarce
	Wolf	common	common	common (–)	common	abundant	scarce (–)
	Wolverine	scarce (+)	common	common	common	common	Scarce
Prey	Grouse	common (+)	common (+)	common (+)	common	common (–)	common
	Snowshoe Hare	common (+)	common	common	abundant (+)	abundant	abundant (+)
	Mice/Rodents	common (+)	common	common	abundant	common	common
	Ptarmigan	abundant (+)	abundant	abundant	common	common	abundant

9. FIGURES

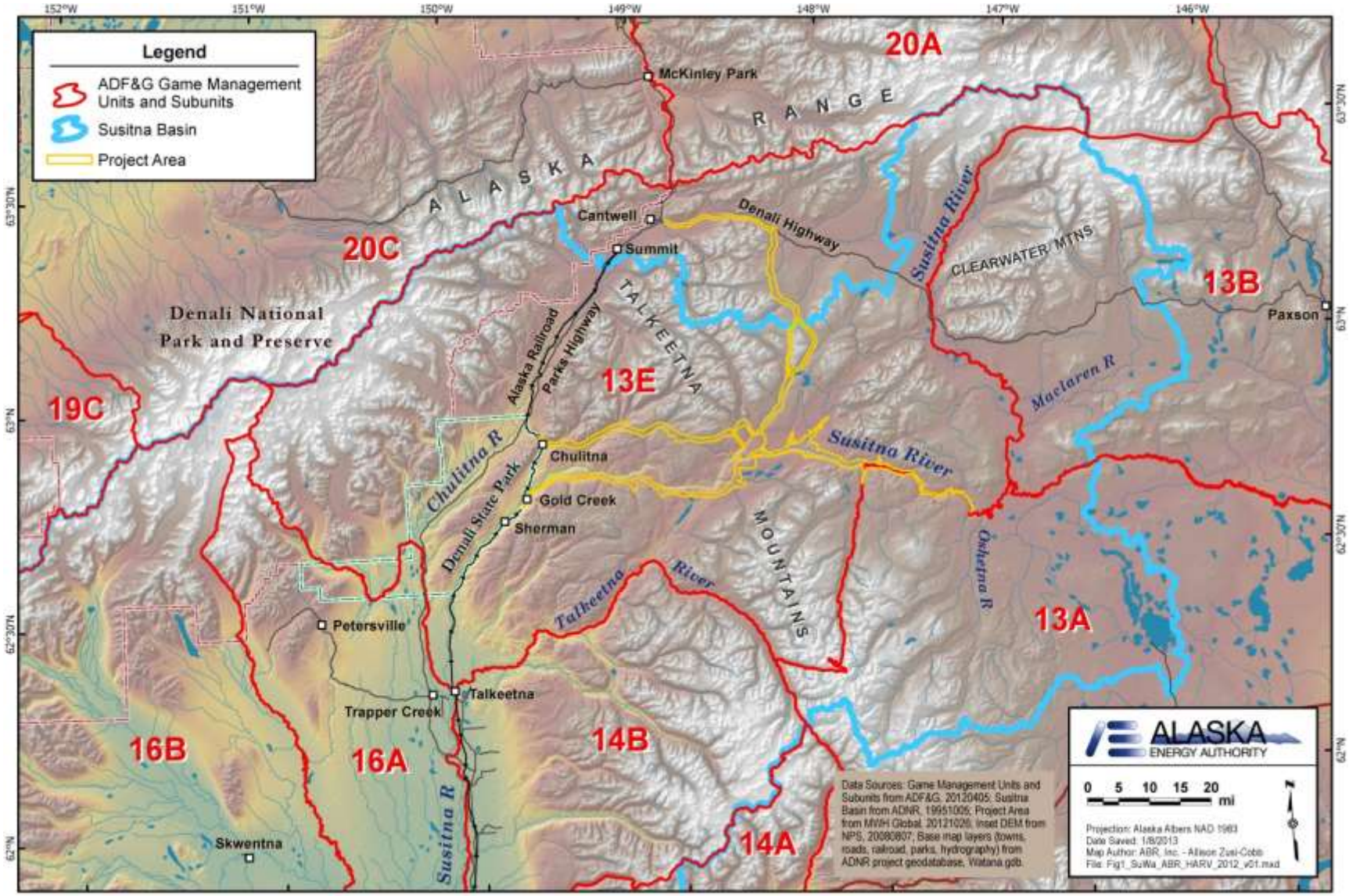

Figure 1. Game Management Units and subunits in and near the Susitna River basin.

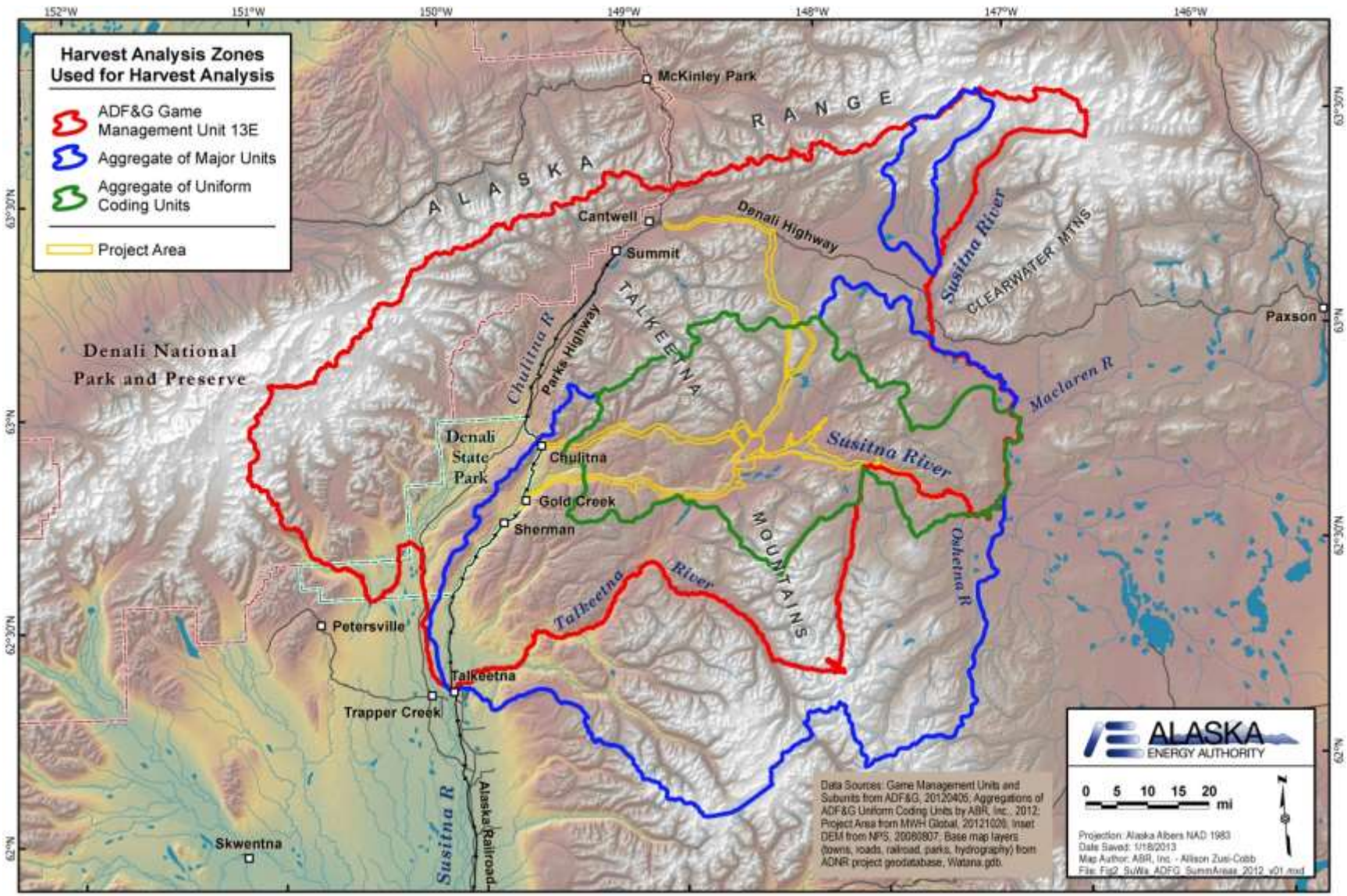

Figure 2. Analytical zones used for wildlife harvest analysis in 2012.