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CHAPTER 31: MOOSE MANAGEMENT REPORT

From: 1 July 2011
To: 30 June 2013

LOCATION

GAME MANAGEMENT UNIT: 22 (25,230 mi^2)

GEOGRAPHIC DESCRIPTION: Seward Peninsula and the adjacent mainland drained by all streams flowing into Norton Sound

BACKGROUND

Before 1930 very few moose were observed on the Seward Peninsula. However, by the late 1960s much of the suitable habitat in Unit 22 contained moose. Moose populations grew rapidly in the 1960s through the early 1980s and peaked in the mid-1980s in most parts of the unit. Severe winters in 1989, 1990, and 1992 caused declines in moose densities because winter browse was insufficient to maintain such large populations in Units 22B and 22D (Nelson 1995). Populations in these areas never recovered and have now stabilized at lower densities. Habitat is no longer believed to be a major limiting factor at current population levels; rather, brown bear predation on calves is thought to be a significant factor suppressing Unit 22 moose populations.

Although moose have been present in Unit 22 for a relatively short time, they rapidly became an extremely important food source for many Seward Peninsula residents, and demand for moose by subsistence and sport hunters is high throughout the unit. Gravel roads, trails, navigable rivers and snowmachines provide hunters with easy access to suitable moose habitat (Machida 1997). Annual harvests reported from 1969 through 2004 ranged from a low of 44 moose in 1972 to a high of 408 moose in 1986 (Table 1). Beginning in 2001, declining moose populations prompted the Board of Game to implement restrictions intended to reduce harvest in many parts of Unit 22, and the most accessible portions of Unit 22 now have 14-day fall hunting seasons with harvest quotas, adjusted based on current population survey data to prevent overharvest of bull moose. Unit residents account for most of the annual reported harvest.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

The following population objectives and bull:cow ratios are the current management goals for Unit 22:

- Unit 22 unitwide: maintain a combined population of 5,100–6,800 moose.
  - Unit 22A: maintain a population of 600–800 moose.

- Unit 22B West: increase and stabilize the population at 1,000–1,200 moose.
- Unit 22B East: insufficient data exists to develop a specific management goal; however, increased recruitment rates and population growth are desired.
- Unit 22C: maintain a population of 450–525 moose.
- Unit 22D: maintain a population of 2,000–2,500 moose.
- Unit 22E: increase and stabilize the population at 200–250 moose.

➢ Maintain a minimum bull:cow ratio of 30:100 in Units 22A, 22B, 22D, and 22E.

➢ Maintain a minimum bull:cow ratio of 20:100 in Unit 22C.

The Unit 22 population objective (5,100–6,800 moose) recommended by the Alaska Department of Fish and Game (ADF&G, the department) was adopted by the Board of Game in November 2001. This objective was revised downward slightly from our previous management goal of 5,700–7,300 moose, which may be slightly larger than habitat can support. In Units 22A, 22B, and 22D, our goal is to increase and stabilize the population from a period of steady decline in moose numbers. In Unit 22C, the goal was revised slightly upward (from reduce and maintain a population of 450–475 moose) based on results of a 2004 habitat survey, with the revised goal intended to maintain a population within winter browse carrying capacity. In Unit 22E our goal is to reduce the population to the upper threshold of our management goal of 250 moose. However, understanding precise population potential in Unit 22 is difficult due to the lack of data related to both habitat quantity and quality. We attempt to maintain a minimum bull:cow ratio of 30:100 in all units except Unit 22C, where a minimum bull:cow ratio of 20:100 appears acceptable.

MANAGEMENT OBJECTIVES

The management objectives for survey and inventory activities in Unit 22 are as follows:

➢ In selected areas of the unit, make annual estimates of moose abundance, sex and age composition, and yearling recruitment, and determine trends in population size and composition.

- Complete censuses in the 5 subunits of Unit 22 on a 3-year rotational basis to estimate moose abundance.
- Complete late fall and/or early spring aerial surveys in selected portions of the unit to provide an index of moose population status and trends, sex and age composition, and yearling recruitment.

➢ Monitor human and natural mortality factors affecting the population.

- Evaluate hunting mortality by analyzing all moose harvest data.

  - Improve harvest reporting through public education, vendor support, and improved communication, and by conducting community-based harvest assessment surveys in selected villages.

- Evaluate hunting regulations and recommend changes if necessary for conservation purposes.

- Improve public understanding of hunting regulations and the reasons they are necessary.

METHODS

During the reporting period, we conducted aerial surveys in the spring and fall to estimate sex and age composition and short yearling recruitment in portions of Unit 22. Aerial composition and population surveys were completed using fixed-wing Super Cub type aircraft (Piper PA-12, PA-18, Scout). Geospatial population estimation (GSPE) techniques were used in February and March 2012 and 2013 to estimate moose abundance in Unit 22A, Unit 22B, west of the Darby Mountains, and Unit 22C (J. VerHoef, ADF&G, personal communication). Population estimates from this reporting period are comparable to previous geospatial census efforts completed in the same areas of Unit 22A (February and March 2003, 2005, and 2008) and Unit 22C and 22B (February and March 2001, 2004, 2007, and 2010). The department administered registration moose hunts in the most heavily hunted areas along the Nome road system in Units 22B, 22C, and 22D. A registration hunt was also administered in the central portion of Unit 22A where the moose population is recovering and in season management of harvest is required.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Summary results for population censuses completed in Units 22A, 22B, and 22C are discussed below, and are presented in Figures 1–3, Appendix 1, and Table 2.

Population Size

Both of the GSPE moose population surveys (Unit 22A and Unit 22C) completed during the reporting period found observable moose point estimates outside of previous population survey confidence intervals (Fig. 1–3, Table 2). We used a C-185 with 4 occupants (pilot and three observers) to stratify survey areas into “high” and “low” boxes. Super Cub type aircraft were used to intensively search boxes for moose.

In Unit 22A, the 2012 GSPE survey estimated 545 observable moose (90% CI: 452–638), 0.23 moose/mi^2, 24 calves:100 adults, and a 19% recruitment rate. Low level intensive searches were conducted in 154 of 406 (38%) sample units to locate and count moose (Fig. 1, Table 2).

In Unit 22B, west of the Darby Mountains, and Unit 22C, the 2013 GSPE survey estimated 1,047 observable moose (90% CI: 900–1,194) in the total survey area.

The GSPE technique estimated 618 observable moose, 0.25 moose/mi^2, 10 calves:100 adults, and 9% recruitment in the Unit 22B survey area. A Sightability Correction Factor (SCF) of 1.26 (SE = 0.180) was estimated for Unit 22B, west of the Darby Mountains, by resurveying a random sample of surveyed SUs at a greater search intensity. Applying this SCF to the estimate of observable moose yields an estimate of total moose abundance in Unit 22B. The estimate of total moose abundance was 767 (90% CI: 545–989) as compared to the observable moose estimate of 618 observable moose (90% CI: 500–735). The decrease in the relative precision of the total moose abundance estimate is due to the additional variance associated with the SCF estimate, which was greater than expected partly because of a sample size less than planned and partly because of low moose counts in the high stratum SUs surveyed (Fig. 2, Appendix 1).

The GSPE technique estimated 429 observable moose (90% CI: 356–502), 0.27 moose/mi², 15 calves:100 adults, and 13% recruitment in the Unit 22C survey area (Fig. 3). Please see Appendix 1 for additional information related to 2013 moose population survey methodology and results.

Population Composition

Fall. We completed fall composition surveys using Piper PA-12 aircraft in several areas during the reporting period (Table 3). During October and November 2011 and 2012 we completed composition surveys in Unit 22C. In 2013 composition surveys were completed in the Unit 22D Kuzitrin River drainage.

Unit 22C. The 2011 moose composition survey classified 194 moose and found 13 bulls:100 cows, 15 calves:100 cows, and 12% calves. The 2012 composition survey classified 237 moose and found 17 bulls:100 cows, 17 calves:100 cows, and 13% calves (Table 3). Annual composition surveys completed in Unit 22C since 2006 have found bull:cow ratios below 20 bulls:100 cows, suggesting hunt management should continue to protect bulls in the population.

Unit 22D. In 2012, we completed a composition survey in the Kuzitrin drainage, classified 295 moose and found 23 bulls:100 cows, 16 calves:100 cows, and 12% calves (Table 3).

Spring. We did not complete spring recruitment surveys during the reporting period. We attempted to classify moose during March 2013 in the southern portion of Unit 22A, but weather allowed for only one short day of flying, and did not produce reportable data. Results from spring surveys completed prior to the reporting period can be found in Table 4.

Distribution and Movements

No studies were undertaken during this reporting period to evaluate distribution or movements of moose in Unit 22; however, a 10-month old moose captured and weighed in 2009 was harvested by a hunter in the Crater Creek drainage, located approximately 30 miles to the northeast of the original capture location.

MORTALITY

Harvest

Seasons and Bag Limits. A regulatory year (RY) begins on 1 July and ends on 30 June (e g., RY11 = 1 July 2011–30 June 2012). No changes were implemented in Unit 22 during the reporting period.

Regulatory years RY11 and RY12 Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 22A, that portion north of and including the Tagoomenik and Shaktoolik river drainages.		
Residents: 1 bull.	1 Aug–30 Sep	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.		1 Sep–14 Sep
Unit 22A, that portion in the Unalakleet River drainage and all drainages flowing into Norton Sound, north of the Golsovia River drainage and south of the Tagoomenik and Shaktoolik river drainages.		
Residents: 1 bull.	1 Sep–14 Sep	
Nonresidents:		No open season
Remainder of Unit 22A		
Residents: 1 bull; or 1 antlered bull.	1 Aug–30 Sep 1 Jan–31 Jan	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.		1 Sep–30 Sep

Regulatory years RY11 and RY12 Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 22B, that portion east of the Darby Mountains, including the drainages of the Kwiniuk, Tubutulik, Koyuk and Inglutalik rivers.		
Residents: 1 bull.	1 Aug–30 Sep 1 Nov–31 Dec	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.		1 Nov–31 Dec
Remainder of Unit 22B,		
Residents: 1 bull by registration permit only; or	1 Sep–14 Sep	
1 antlered bull by registration permit only.	1 Jan–31 Jan	
Nonresidents:		No open season
Unit 22C		
Residents: 1 bull by registration permit only; or	1 Sep–14 Sep	
1 antlerless moose by registration permit.	15 Sep–30 Sep	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.		1 Sep–14 Sep
Unit 22D, that portion within the Kougarok, Kuzitrin and Pilgrim river drainages		
Residents: 1 antlered bull by registration permit only; or	1 Sep–14 Sep	
1 antlered bull by registration permit only.	1 Jan–31 Jan (Season may be announced by emergency order)	

Regulatory years RY11 and RY12 Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Nonresidents:		No open season
Unit 22D Kuzitrin River drainage (includes Kougarok and Pilgrim rivers),and Southwest area located west of Tisuk River drainage, west of the west bank of Canyon Creek beginning at McAdam's Creek continuing to Tuksuk Channel.		
Residents: 1 bull by registration permit only; or	1 Sep–14 Sep	
1 bull by registration permit only.	1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
Remainder of Unit 22D		
Residents: 1 antlered bull or	10 Aug–14 Sep	
1 moose; however antlerless moose may be taken only from 1 Dec through 31 Dec; a person may not take a cow accompanied by a calf.	1 Oct–31 Jan	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side, by registration permit only.		1 Sep–14 Sep
Unit 22E		
Residents: 1 bull; or	1 Aug–31 Dec	
1 antlered bull.	1 Jan– 31 Jan	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side, by registration permit only.		1 Sep–14 Sep

Alaska Board of Game Actions and Emergency Orders (EO). The Board of Game made no changes to the Unit 22 moose seasons or bag limits at their meetings in 2011. Several emergency orders were issued by the department, as follows:

In September 2011, the department issued an EO that closed fall registration permit hunt RM840 in Unit 22B, west of the Darby Mountains, and Unit 22C. The Unit 22B registration hunt area had a harvest quota of 15 bull moose, and the Unit 22C hunt area had a harvest quota of 13 bull moose that was anticipated to be met by 6 September. The EO was issued to prevent overharvest.

In September 2011, the department issued an EO that extended fall registration permit hunt RM841 in the central portion of Unit 22A. The harvest quota of 14 antlered bulls in the hunt area was unmet on 14 September, and the EO was issued to provide additional opportunity.

In September 2011, the department issued an EO that closed fall registration permit hunt RM841 in the central portion of Unit 22A. The harvest quota of 14 antlered bulls was anticipated to be met by 17 September, and the EO was issued to prevent overharvest.

In December 2011, the department issued an EO that opened winter registration permit hunt RM849 in Unit 22D Southwest and Unit 22D Kuzitrin River Drainage. The fall harvest quota of 54 bulls during fall registration hunt RM840 was not met which left a surplus of 10 antlered bulls available for harvest during the winter hunt.

In November 2012, the department issued an EO that opened winter registration permit hunt RM844 in the central portion of Unit 22A. The fall harvest quota of 22 bulls during fall registration hunt RM841 was not met which left a surplus of 6 antlered bulls available for harvest during the winter hunt.

In February 2012, the department issued an EO that opened a winter moose hunt in the remainder of Unit 22A with the bag limit of one antlered bull. The EO was issued to provide additional opportunity based on low fall harvest and inclement weather during the regular winter 1 January – 31 January season.

Hunter Harvest. During RY11, harvest report data show that 607 hunters harvested 196 moose (168 males, 26 females, and 2 unknown). A harvest of 178 moose (153 males and 25 females) was reported taken by 651 hunters during the RY12 season (Table 1).

Moose harvest remained well below harvest levels seen in the 1980s. Hunters reported an annual average harvest of 343 moose 1980–1989 when moose populations were at their highest densities. Declining numbers of moose have resulted in shortened seasons with harvest quotas in many parts of the unit, which have reduced harvest in recent years.

Compliance with license and harvest reporting requirements by Nome residents is believed to be high, but harvest reporting by some village residents has always been incomplete.

Resident Permit Hunts. Two registration permit hunts for antlerless moose are administered in Unit 22C. Hunt RM850 occurs in the Nome and Snake river drainages, and RM852 occurs in the remainder of Unit 22C. In RY11, 13 cows were harvested in RM850, and 11 cows were harvested in RM852. In RY12, 12 cows were taken in RM850 and 11 moose (10 cows, 1 unknown) were harvested in RM852 (Table 5).

Registration moose hunts with harvest quotas are in place in the heavily hunted portions of Units 22B, 22C and 22D along the Nome road system (RM840) and in the central portion of Unit 22A near Unalakleet (RM841). In RY11 a total of 411 people reported hunting in RM840 and 85 bull moose were harvested (Table 5). In Unit 22B, west of the Darby Mountains, hunters harvested 14 bulls (93% of 15 bull quota). In Unit 22C hunters harvested 26 bulls (96% of 27 bull quota). In Unit 22D Kuzitrin and 22D Southwest hunters harvested 45 bulls (83% of 54 bull quota). Registration moose hunt RM841 was administered in the central portion of Unit 22A, 64 hunters harvested 15 moose (14 bulls, 1 unknown; 107% of 14 bull quota).

In RY11, winter registration moose hunt RM843 was administered in Unit 22B, west of the Darby Mountains, and 9 hunters harvested 2 antlered bulls (25% of quota). The winter hunt utilizes a portion of the total harvest quota from Unit 22B, west of the Darby Mountains, as recommended by the Northern Norton Sound Advisory Committee. Winter registration hunt RM849 was administered in Unit 22D Kuzitrin and 22D Southwest where 5 hunters harvested 1 antlered bull (10% of quota). The RM849 hunt utilizes unfilled quota from the fall RM840 hunt.

In RY12, a total of 413 people reported hunting in RM840 and 85 moose (82 bulls, 2 cows, 1 unknown) were harvested (Table 5). In Unit 22B West hunters harvested 20 bulls out of the 15 bull quota (133% of 14 bull quota). In Unit 22C, hunters harvested 14 bulls (108% of 13 bull quota). In Unit 22D Kuzitrin and 22D Southwest hunters harvested 51 bulls (94% of 54 bull quota). Registration moose hunt RM841 was administered in the central portion of Unit 22A; 52 hunters harvested 15 bulls (68% of 22 bull quota).

In RY12, winter registration moose hunt RM843 was administered in Unit 22B, west of the Darby Mountains, and 12 hunters harvested 2 antlered bulls (40% of quota). Winter registration hunt RM844 also occurred in the central portion of Unit 22A and 1 hunter reported hunting; however no moose were harvested. The RM844 winter hunt utilized unfilled quota from the fall RM841 hunt.

The registration hunts with harvest quotas require reporting within 3 days of harvesting a moose. Reporting by people who hunt but fail to harvest a moose has typically been lax in the past, but increased emphasis on the need to report has increased the reporting rate in the registration hunts.

<u>Nonresident Permit Hunts</u>. In RY11, nonresident registration hunt RM842 was administered in Unit 22D Remainder. Twenty one hunters reported in RM842, 16 nonresidents hunted, and 9 bulls were taken. In RY12, nonresident registration hunt RM842 was administered in Unit 22D Remainder, and 8 hunters reported. Eight nonresident hunters hunted and 6 bulls were harvested (Table 5).

There was one drawing permit hunt administered during the reporting period. There are up to 8 permits issued annually for DM845 that allow nonresident hunters to harvest moose in Unit 22B, east of the Darby Mountains. In RY11, 6 permits were issued and 6 hunters hunted, of which 5 hunters harvested bull moose. In RY12, 4 permits were issued, 3 hunters hunted, and 3 hunters harvested bull moose.

Hunter Residency and Success. Unit 22 residents accounted for 73% of the harvest in RY11 and 76% of the harvest in RY12 (Table 6). From 1994 through 2004 the proportion of harvest attributable to local residents ranged 69–74%; however, since 2005 local resident harvest has been higher, 73–90%. Nonresidents accounted for 9% of the harvest in RY11 and 7% of the harvest in RY12. Alaska residents residing outside of Unit 22 accounted for 15% of the harvest in RY11 and 11% of the harvest in RY12. Eight (8%) percent of harvest residency during the reporting period is unknown because of incomplete harvest ticket information.

Harvest Chronology. Shortened season lengths have consolidated much of the harvest into the months of August and September in most parts of the unit (Table 7). Previously, long seasons that ran from August through January in many parts of the unit and through March in Unit 22E allowed harvest to occur over a period of up to 8 months. Most of the hunter effort and reported harvest occurred during September (80%), August (5%) and October (5%) during the reporting period. Hunters harvested 90% of Unit 22 moose during the months of August, September, and October during the reporting period.

Transport Methods. During this reporting period 36% of successful moose hunters used 3- or 4-wheelers, 32% used boats, 10% used off-road vehicles, 7% used highway vehicles, 7% used snowmachines, and 1% of the harvest was by hunters using airplanes. One percent (1%) of hunters used other methods, airboats, or hunted on foot, and 6% of hunters used an unknown method of transportation because of incomplete harvest ticket information (Table 8).

Other Mortality

No surveys were attempted to determine natural mortality rates of Seward Peninsula moose. We believe that bear density in Unit 22 has increased over the last decade and that predation by bears on calf and adult moose is a significant factor suppressing moose populations in many parts of the unit. Recruitment rates are generally very low in most parts of the unit. A 1996–1998 radio collar study of cow moose in western Unit 22B found that up to 75% of the moose calves observed died within 3 months of birth and 71% of calf mortality occurred within a month of birth. Although calf viability may be a factor, such high mortality shortly after birth suggests predation, presumably by brown bears since anecdotal and harvest information suggest wolf numbers were relatively low during the collaring study period. Wolves have become more numerous on the Seward Peninsula, especially in areas occupied by wintering caribou from the Western Arctic caribou herd and muskox herds that have expanded their historic range eastward.

HABITAT

Assessment

Habitat surveys were not completed during the reporting period. We completed browse surveys in 2004 and 2006 to help determine whether habitat limitations are contributing to the long-term decline of moose populations in parts of the unit. Results from browse transect surveys are summarized in Table 9. Surveys completed since 2004 show moose have influenced shrub architecture on the central Seward Peninsula, but shrubs appear to be sustaining a compensatory response to browsing pressure without substantial shrub mortality.

Along with moose browse biomass surveys, adult female twinning rates, and adult female parturition rates, 10-month old calf weights are considered an indicator of nutritional health in interior Alaska moose populations (Boertje et al. 2007). Research completed on interior Alaska moose populations found short-yearling weights less than 385 lb were an indication moose were resource limited. During April 2006–2009 department staff weighed male and female10-month old moose calves to further assess nutritional health of Unit 22 moose populations. A total of 118 moose were weighed, with no significant difference between males and females ($P = 0.12$). A sample of 29 moose weighed during April 2006 in Units 22B and 22C found average weights of 417 lb and 411 lb, respectively. A sample of 30 moose weighed during April 2007 in Units 22C and 22D found average weights of 419 lb and 379 lb, respectively (Table 10). A sample of 30 moose weighed during April 2008 in Units 22C and 22D found average weights of 374 lb and 393 lb, respectively. Short yearlings weighed during 2008 were born during the deeper than normal snow year of 2007, which National Weather Service data show as the third deepest snow fall in Nome's history. A sample of 30 moose weighed during April 2009 in Units 22C and 22D found average weights of 371 lb and 372 lb, respectively. Short yearlings weighed during 2009 were born during another deep snow year in 2008, which National Weather Service data show as the second deepest snow fall in Nome's history. Although the sample set from this project is small ($n = 118$), initial results indicate short yearlings from the smaller river drainages in Unit 22C tended to be more affected by changes in annual snow depth than their counterparts in the central portions of the Seward Peninsula during 2006–2009 compared to moose weighed in the larger Kuzitrin and Pilgrim river drainages. Although calf weights in Unit 22D are consistently low (381 lb, 2007–2009), low weights in Unit 22D may be influenced by competition for browse related to higher densities of moose associated with broad riparian zones. In contrast, the smaller drainages in Unit 22C have lower moose densities with less competition for browse, yielding higher calf weights, except in years when browse is unavailable due to deep accumulation of snow. Less extensive winter habitat in Unit 22C compared to the larger river drainages may mean that deep snow limits moose mobility and dramatically reduces the availability of forage. Future research may substantiate this snow-forage interaction.

Enhancement

There were no habitat enhancement activities conducted in Unit 22 during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

There were no nonregulatory management needs during the reporting period.

CONCLUSIONS AND RECOMMENDATIONS

The moose population on the Seward Peninsula grew steadily in size from the 1960s through the early 1980s and began to decline during the late 1980s and early 1990s. Declines since the 1980s were likely caused by a combination of winter mortality, reduced productivity, low recruitment, and increased predation, reducing the population size to between 4,500 and 6,500 animals. Survey and inventory projects completed during this reporting period show the population in Unit 22B, west of the Darby Mountains, continues to be stable and is likely not growing because of low recruitment rates at or below 10% since 1999. The Unit 22B, west of the Darby Mountains, 2013 population estimate of 618 observable moose indicates a 3% annual rate of increase between 2010 and 2013. The 767 moose estimate reported in Appendix 1 and Figure 2 includes a sightability correction factor not collected during 1999, 2004, and 2010 surveys, which only reported the estimated number of observable moose. Results from a research study in western Unit 22B in the late 1990s indicate several factors are contributing to low recruitment in that portion of the unit. Predators, especially bears, are abundant in the area, and bear predation on calves is probably the most significant factor in calf mortality. Additionally, during the last 10 years wolf numbers have increased on the Seward Peninsula, since the Western Arctic caribou herd began wintering there. Moose numbers in Units 22B, west of the Darby Mountains, and 22D have changed little since the initial decline found in the late 1980s. The populations in both areas appear to have stabilized at lower densities. We know very little about moose habitat on the Seward Peninsula (see previous discussion), but given results of habitat surveys completed in 2004 and 2006 and results from short-yearling moose capture weights between 2006 and 2009, it seems reasonable to suggest moose densities in Unit 22D are sustainable at current levels, but densities in Unit 22B, west of the Darby Mountains, would only be sustainable if populations remain below the pre-crash population level in this area. However, densities in Unit 22B (west of the Darby Mountains) could likely double before they approach the levels of the late 1980s.

The moose population in Unit 22C declined during the reporting period, likely in part due to antlerless moose hunts administered in the area since 2000, and is now near our population objective of 450–525 moose. Between 2000 and 2010 realized antlerless moose harvest rates fluctuated 2%–4%, but managers increased antlerless hunt quotas in 2011 and 2012 due to concerns over increased population levels and habitat limitations and realized harvest rates for those 2 years were 6% and 7% respectively. The GSPE population survey completed during the reporting period found a 9% annual decline between 2010 and 2013, and the antlerless hunt first authorized in 1999 by the Board of Game has been cancelled. Current harvest management is structured to maintain densities near current levels (0.27 moose/mi^2) and increase bull: cow ratios in the area. The department will estimate moose in Unit 22C again in 2016 (see below).

The Unit 22A moose population survey completed during the reporting period showed a 14% rate of increase between 2008 and 2012, and current densities (0.23 moose/ mi^2) are above what was found in the area during the late 1980s. It is important that staff continues to work with local residents on the importance of harvest reporting, ensures conservative harvest continues in the local area, and monitors the area's recovering moose population.

A stratified moose census is completed in each of the units once every 3 years and future censuses are scheduled as follows: 2014–Units 22D/E, 2015–Unit 22A, 2016–Units 22B/C, 2017–Units 22D/E, 2018–Unit 22A.

Compliance with regulations and harvest reporting is thought to be reasonably high in the Nome area and has improved as a result of education efforts associated with the new registration hunts. However, in the remainder of the unit some residents do not acquire licenses and/or harvest tickets prior to hunting and much of the harvest is unreported. Public education programs and a visible enforcement effort improve compliance with regulations, but we have found the community-based harvest assessment programs started in 1999 to be the most effective way to collect accurate harvest data from village residents. This data has been essential in providing the Board of Game with a realistic picture of moose harvest and timing in Unit 22 and has greatly influenced the board in its regulatory decisions. If regulatory change is required in areas of Unit 22 off the Nome road system this program should be continued to provide ongoing estimates of moose harvest and subsistence use of moose by village residents.

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Please cite any information taken from this section, and reference as:

Gorn, T., and W. R. Dunker. 2014. Unit 22 moose management report. Pages 31-1 through 31-38 [*In*] P. Harper and Laura A. McCarthy, editors. Moose management report of survey and inventory activities 1 July 2011–30 June 2013. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2014-6, Juneau.

While this unit report was actually published in 2016, it is part of the set of 2014 unit species management reports, so we suggest citing the report as a 2014 report to maintain its relationship to the other 2014 unit reports.

Product names used in this publication are included for completeness but do not constitute product endorsement.

Table 1. Unit 22 historical moose harvest by sex, hunter effort, and success rate RY69–RY12.

Regulatory year	Males	Females	Unknown sex	Total harvest	Total hunters[a]	Percent success
RY69	69	1	2	72	182	40
RY70	70	0	1	71	139	51
RY71	59	0	1	60	168	36
RY72	44	0	0	44	99	44
RY73	103	32	1	136	317	43
RY74	149	72	1	222	479	46
RY75	136	0	2	138	389	35
RY76	186	51	3	240	611	39
RY77	151	88	5	244	457	53
RY78	198	97	2	297	596	50
RY79	193	75	2	270	760	36
RY80	156	71	1	228	492	46
RY81	225	72	1	298	696	43
RY82	244	100	0	344	904	38
RY83	291	68	46	405	1,292	31
RY84	298	91	6	395	1,086	36
RY85	279	92	3	374	876	43
RY86	306	101	1	408	892	46
RY87	286	20	4	310	775	40
RY88	332	36	7	375	748	50
RY89	208	82	0	290	713	41
RY90	280	70	0	350	700	50
RY91	207	95	0	302	656	46
RY92	217	72	0	289	645	45
RY93	225	21	1	247	553	45
RY94	201	10	0	211	486	43
RY95	169	13	3	185	469	39
RY96	176	20	2	198	456	43
RY97	197	6	0	203	423	48
RY98	195	13	3	211	510	41
RY99	244	5	3	252	581	43
RY00	194	27	0	221	536	41
RY01	119	8	0	127	421	30
RY02	160	12	0	172	563	31
RY03	182	12	2	196	587	33
RY04	179	13	0	192	530	36
RY05	154	8	2	164	544	30
RY06	159	16	0	175	520	34
RY07	184	15	1	200	653	31
RY08	159	16	0	175	520	34
RY09	172	18	3	193	655	30
RY10	148	22	0	170	620	27
RY11	168	26	2	196	607	32
RY12	153	25	0	178	651	27

[a] Minimum known number of hunters.

Table 2. Summary of Unit 22 spring moose censuses, 1987–2012.

Area	Year	Size (mi^2)	Census estimate (No.)			Density(No../mi^2)		Calves per 100 Adults	Percent calves	Census method
			Adults	Calves	Total[a]	Adult	Total			
Unit 22A Unalakleet Drainage	1989	1,124	273	52	325	0.24	0.29	19	16	Gasaway
Unit 22A Unalakleet Drainage	2003	2,000	71	11	75	0.04	0.04	15	15	Geostatistical
Unit 22A Unalakleet Drainage	2005	2,400	113	10	123	0.05	0.05	9	8	Geostatistical
Unit 22A Unalakleet Drainage	2008	2,400	282	60	339	0.12	0.14	21	18	Geostatistical
Unit 22A Unalakleet Drainage	2012	2,400	440	106	545	0.18	0.23	24	19	Geostatistical
Unit 22B West	1987	2,105	1,676	218	1,894	0.80	0.90	13	12	Gasaway
Unit 22B West Reduced area	1992	859	603	95	698	0.70	0.81	16	14	Mod. Gasaway
Unit 22B West	1999	2,105	749	49	798	0.36	0.38	7	6	Geostatistical
Unit 22B West Reduced area	1999	859	448	28	476	0.52	0.58	6	6	Geostatistical
Unit 22B West	2004	2,400	529	53	586	0.22	0.24	10	9	Geostatistical
Unit 22B West	2010	2,400	512	58	570	0.21	0.24	11	10	Geostatistical
Unit 22B West[b]	2013	2,400	698	69	767	0.29	0.32	10	9	Geostatistical
Unit 22C	1990	1,368	322	85	407	0.24	0.30	26	21	Gasaway
Unit 22C	1995	1,368	394	85	479	0.29	0.35	22	18	Mod. Gasaway
Unit 22C	2001	1,368	413	139	558	0.30	0.41	34	25	Geostatistical
Unit 22C	2004	1,368	442	102	530	0.32	0.39	23	19	Geostatistical
Unit 22C	2007	1,368	533	87	620	0.39	0.45	16	14	Geostatistical
Unit 22C	2010	1,368	533	130	663	0.39	0.48	24	20	Geostatistical
Unit 22C	2013	1,368	373	56	429	0.22	0.27	15	13	Geostatistical

Area	Year	Size (mi^2)	Census estimate (No.)			Density(No../mi^2)		Calves per 100 Adults	Percent calves	Census method
			Adults	Calves	Total[a]	Adult	Total			
Unit 22D Kuzitrin Drainange	2011	1,610	810	90	900	0.50	0.56	11	10	Geostatistical
Unit 22D Kuzitrin Drainage	2006	1,610	821	145	966	0.51	0.60	18	15	Geostatistical
Unit 22D Kuzitrin Drainage	2002	1,456	911	114	1,028	0.63	0.71	13	11	Geostatistical
Unit 22D Kuzitrin Drainage	1988	1,456	1,673	278	1,951	1.14	1.34	17	14	Gasaway
Unit 22D Kuzitrin Drainage Reduced	1993	856	943	153	1,096	1.10	1.28	16	14	Mod. Gasaway
Unit 22D Kuzitrin Drainage	1997	1,456	1,019	232	1,251	0.70	0.86	23	19	Mod. Gasaway
Unit 22D Agiapuk Drainage	1988	1,041	782	159	941	0.75	0.90	20	17	Gasaway
Unit 22D Agiapuk Drainage Reduced	1993	723	406	77	483	0.56	0.66	19	16	Mod. Gasaway
Unit 22D Agiapuk Drainage	1997	1,041	451	127	578	0.43	0.56	28	22	Mod. Gasaway
Unit 22D Agiapuk Drainage	2002	1,041	485	82	567	0.47	0.54	17	14	Geostatistical
Unit 22D Agiapuk Drainage	2006	1,271	443	156	599	0.35	0.47	35	26	Geostatistical
Unit 22D Agiapuk Drainage	2011	1,271	687	94	781	0.54	0.61	14	12	Geostatistical
Unit 22E	1991	NA	208	18	226	NA	NA	9	8	Riparian Survey
Unit 22E	1996	NA	164	32	196	NA	NA	20	16	Riparian Survey
Unit 22E	2001	NA	157	12	169	NA	NA	8	7	Riparian Survey
Unit 22E	2003	4,500	408	96	504	0.09	0.11	23	19	Geostatistical
Unit 22E	2006	4,500	481	106	587	0.11	0.13	22	18	Geostatistical
Unit 22E	2011	4,500	602	67	669	0.13	0.15	11	10	Geostatistical

[a] Totals may not equal the sum of adults and calves. Each census estimate column is an independent computer-generated estimate using the census method noted in the census method column.
[b]Estimate of total moose abundance.

Table 3. Unit 22 aerial moose composition surveys, fall of 1992, 1994, and 2000–2013.

Survey area	Year	Bulls per 100 cows	Calves per 100 cows	Total calves	Percent calves	Total adults	Total moose
Unit 22A							
Unalakleet River	2003	69	20	7	10	59	66
Golsovia River	2003	50	67	8	31	18	26
Unalakleet River	2006	69	34	20	26	58	78
Unit 22B							
American Creek	1992	58	10	4	10	38	42
	1994	28	28	8	18	37	45
Niukluk River	2000	27	8	7	6	108	115
	2001	30	14	8	10	73	81
	2008	34	15	12	10	110	122
Koyuk River	2004	12	0	0	0	56	56
Unit 22C							
Snake River	1992	11	30	11	21	41	52
	1994	14	32	12	22	42	54
	2000	10	25	16	19	69	85
Snake/Stewart Rivers	2001	25	21	24	15	140	164
	2002	24	43	32	26	93	125
	2004	11	31	28	22	101	129
	2005	27	39	26	24	84	110
	2006	14	20	18	15	104	122
	2007	17	27	26	19	111	137
	2008[1]	11	10	17	8	194	211
	2009[1]	13	19	38	14	230	268
	2010	11	16	30	13	187	217
	2011	13	15	23	12	171	194
	2012	17	17	30	13	207	237

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Table 3 continued.

Unit 22D							
Henry/Washington Ck.	1994	40	23	22	14	133	155
Kougarok/Noxapaga	2000	16	11	19	9	197	216
	2001	15	19	16	14	98	114
	2003	26	15	24	10	208	232
	2004	30	9	5	7	68	74
	2005	20	33	31	21	114	145
	2006	22	17	23	12	169	192
	2008	33	10	12	7	162	174
	2011	28	15	26	11	216	242
	2013	23	16	34	12	261	295
Agiapuk	2000	44	23	43	14	275	318
	2001	30	6	5	4	107	112
	2003	24	27	40	18	183	223
	2011	35	18	28	11	216	244

[1] Expanded survey area included Snake, Stewart, Flambeau, Eldorado, and Bonanza river drainages.

Table 4. Unit 22 short yearling recruitment surveys, spring 1991–2011.

Survey area and survey year	No. calves	No. adults	Total	Percent Calves
Unalakleet, main stem (Unit 22A)				
2000	7	77	84	8
2003	3	16	19	16
2006	13	37	50	26
2007	12	70	82	15
Central Portion (Unit 22A)				
2006	27	137	164	16
2007	12	82	94	13
Shaktoolik, main stem (Unit 22A)				
2000	5	40	45	11
2003	2	11	13	15
Ungalik, main stem (Unit 22A)				
2000	1	28	29	3
2003	0	1	1	0
Golsovia drainage (Unit 22A)				
2000	4	11	15	27
2003	6	23	29	21
Pikmiktalik main stem (Unit 22A)				
2000	2	4	6	33
2003	6	11	17	35
Fish River (Unit 22B)				
1991	12	202	214	6
1993	11	227	238	5
1994	15	255	270	6
1995	16	384	400	4
Niukluk River (Unit 22B)				
1991	30	319	349	9
1995	13	133	146	9
1997	6	77	83	7
2000	9	81	90	10
2003	6	59	65	9
West of Darby Mountains (Unit 22B)				
2006	19	189	208	9
2007	3	83	86	3
Koyuk River (Unit 22B)				
1999	21	208	229	9
2000	19	223	242	8
2004	12	54	66	18
2005	13	89	102	13

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Table 4 continued

Snake River (Unit 22C)				
1993	15	63	78	19
1994	18	39	57	32
1999	33	92	125	26
2000	21	98	119	18
2001	20	76	96	21
2009	9	69	78	12
22C Expanded[a]				
2009	36	299	335	11
Lower Kougarok River (Unit 22D)				
1991	14	103	117	12
1994	33	153	186	18
1995	42	227	269	16
2000	16	168	184	9
2003	32	180	212	15
2009	14	196	210	7
Kuzitrin/Noxapaga River (Unit 22D)				
1991	23	191	214	11
1994	16	71	87	18
2000	14	203	217	6
2003	52	276	328	16
2007	25	298	323	8
2009	8	164	172	5
Kuzitrin Below Bridge (Unit 22D)				
2000	17	271	288	6
2003	16	87	103	16
2009	20	226	246	8
Pilgrim River (Unit 22D)				
2009	3	69	72	4
American River (Unit 22D)				
1995	51	248	299	17
Agiapuk/American (Unit 22D)				
2003	74	246	320	23

[a] Includes Cripple, Sinuk, Penny, Snake, Nome, Flambeau, and Eldorado rivers.

Table 5. Unit 22 Registration moose hunt statistics for RY11 and RY12.

RY	Hunt	Total moose killed	Males killed	Females killed	Unknown killed	Total permittees reporting	Hunted	Did not hunt
RY11	RM840	85	85	0	0	514	411	103
RY11	RM841	15	14	0	1	67	64	3
RY11	RM842	9	9	0	0	21	16	5
RY11	RM843	2	2	0	0	9	9	0
RY11	RM849	1	1	0	0	17	5	12
RY11	RM850	13	0	13	0	15	15	0
RY11	RM852	11	0	11	0	24	18	6
RY11	RM853	2	2	0	0	18	8	10
RY12	RM840	85	82	2	1	507	413	94
RY12	RM841	15	15	0	0	57	52	5
RY12	RM842	6	6	0	0	8	8	0
RY12	RM843	2	2	0	0	13	12	1
RY12	RM844	0	0	0	0	1	0	1
RY12	RM849	0	0	0	0	1	0	1
RY12	RM850	12	0	12	0	18	18	0
RY12	RM852	11	0	10	1	29	23	6
RY12	RM853	1	1	0	0	9	3	6

Table 6. Residency and success of moose hunters in Unit 22, RY11 and RY12.

Regulatory Year/Unit	Residency of successful hunters					Residency of unsuccessful hunters				
	Unit[a]	State[b]	Nonresident	Unknown	Total	Unit[a]	State[b]	Nonresident	Unknown	Total
RY11										
22A	24	0	1	0	25	54	3	0	0	57
22B	19	5	5	1	30	52	6	2	1	61
22C	47	4	0	0	51	130	13	5	0	148
22D	50	18	9	1	78	103	15	9	0	127
22E	4	3	2	3	12	5	4	6	3	18
22 unk	0	0	0	0	0	0	0	0	0	0
Total	144	30	17	5	196	344	41	22	4	411
RY12										
22A	21	2	3	1	27	32	7	1	2	42
22B	24	3	3	0	30	58	8	2	2	70
22C	35	2	0	0	37	140	5	0	0	145
22D	51	12	6	1	70	164	27	3	1	195
22E	5	1	1	7	14	4	3	2	2	11
22 unk	0	0	0	0	0	10	0	0	0	10
Total	136	20	13	9	178	408	50	8	7	473

[a] Resident of Unit 22.

[b] Other Alaska resident.

Table 7. Chronology of Unit 22 moose harvest, RY11 and RY12.

Regulatory year/ Unit	Month of harvest									
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Unknown	Total
<u>RY11</u>										
22A	3	20	0	0	0	1	1	0	0	25
22B	2	20	0	6	0	2	0	0	0	30
22C	0	51	0	0	0	0	0	0	0	51
22D	3	56	16	0	2	1	0	0	0	78
22E	1	9	0	0	0	1	0	0	1	12
22 Unknown	0	0	0	0	0	0	0	0	0	0
Total	9	156	16	6	2	5	1	0	1	196
<u>RY12</u>										
22A	2	22	0	0	0	3	0	0	0	27
22B	3	21	0	3	0	2	0	0	1	30
22C	0	37	0	0	0	0	0	0	0	37
22D	0	58	9	0	2	0	0	0	1	70
22E	4	6	1	0	0	3	0	0	0	14
22 Unknown	0	0	0	0	0	0	0	0	0	0
Total	9	144	10	3	2	8	0	0	2	178

Table 8. Means of transportation reported by successful Unit 22 moose hunters, RY09 and RY10.

Regulatory Year/Unit	Aircraft	Horse	Boat	3- or 4-Wheeler	Snowmobile	Off-road vehicle	Highway vehicle	Air boat	Unknown	Total
RY09										
22A	1	0	15	2	2	1	1	0	3	25
22B	1	0	14	5	8	0	0	0	2	30
22C	0	0	4	34	0	5	7	0	1	51
22D	2	0	21	40	3	6	3	1	2	78
22E	0	0	2	4	1	4	1	0	0	12
Total	4	0	56	85	14	16	12	1	8	196
RY10										
22A	0	0	11	1	3	5	1	0	6	27
22B	0	0	18	3	5	0	0	0	4	30
22C	0	0	3	20	0	3	10	0	1	37
22D	1	0	25	22	2	11	1	0	8	70
22E	0	0	6	4	3	1	0	0	0	14
Total	1	0	63	50	13	20	12	0	19	178

Table 9. Categorization of browse shrub architecture and health of moose winter range in parts of Unit 22, 2004–2006.

Area	Date	n[a]	% unbrowsed	% browsed by moose	Broom index[b]	% browsed by hare	% none dead	% less dead	% more dead	Average No. dead[c]
22A Unalakleet	Aug 2005	859	24.3	55.3	19.3	6.7	3.8	90.7	5.5	0.41
22C Nome/Snake/ Flambeau	Mar 2004	960	7.6	32.6	64.7	0	1.1	87.0	11.9	0.44
22B Fish/Niukluk	Jun 2004	531	8.7	47.5	46.7	2.2	0	96.4	3.6	0
22D Kuzitrin	Jun 2004	545	4.5	29.0	69.5	0.2	0.4	92.1	7.5	0
22D Agiapuk	Sep 2006	960	1.0	29.7	70.0	0	0	98.5	1.5	0
22B Fish/Niukluk	April 2006	900	3.0	42.7	56.0	0	0.2	94.5	5.3	0.03

[a] Number of shrubs categorized along linear transect, across all transects in count area.

[b] Index is proportion of shrubs receiving any browsing that were broomed ((broomed / [browsed + broomed])* 100), by respective herbivore.

[c] Average number of dead shrubs encountered during the course of getting 30 live shrubs to evaluate.

Table 10. Short-yearling moose weight results in parts of Unit 22, 2006–2009.

	Unit 22B		Unit 22C		Unit 22D Kuzitrin drainage	
Year	No.	Mean weight, lb	No.	Mean weight, lb	No.	Mean weight, lb
2006	15	417	14	411		
2007			14	419	16	379
2008			5	374	24	393
2009			16	371	14	372

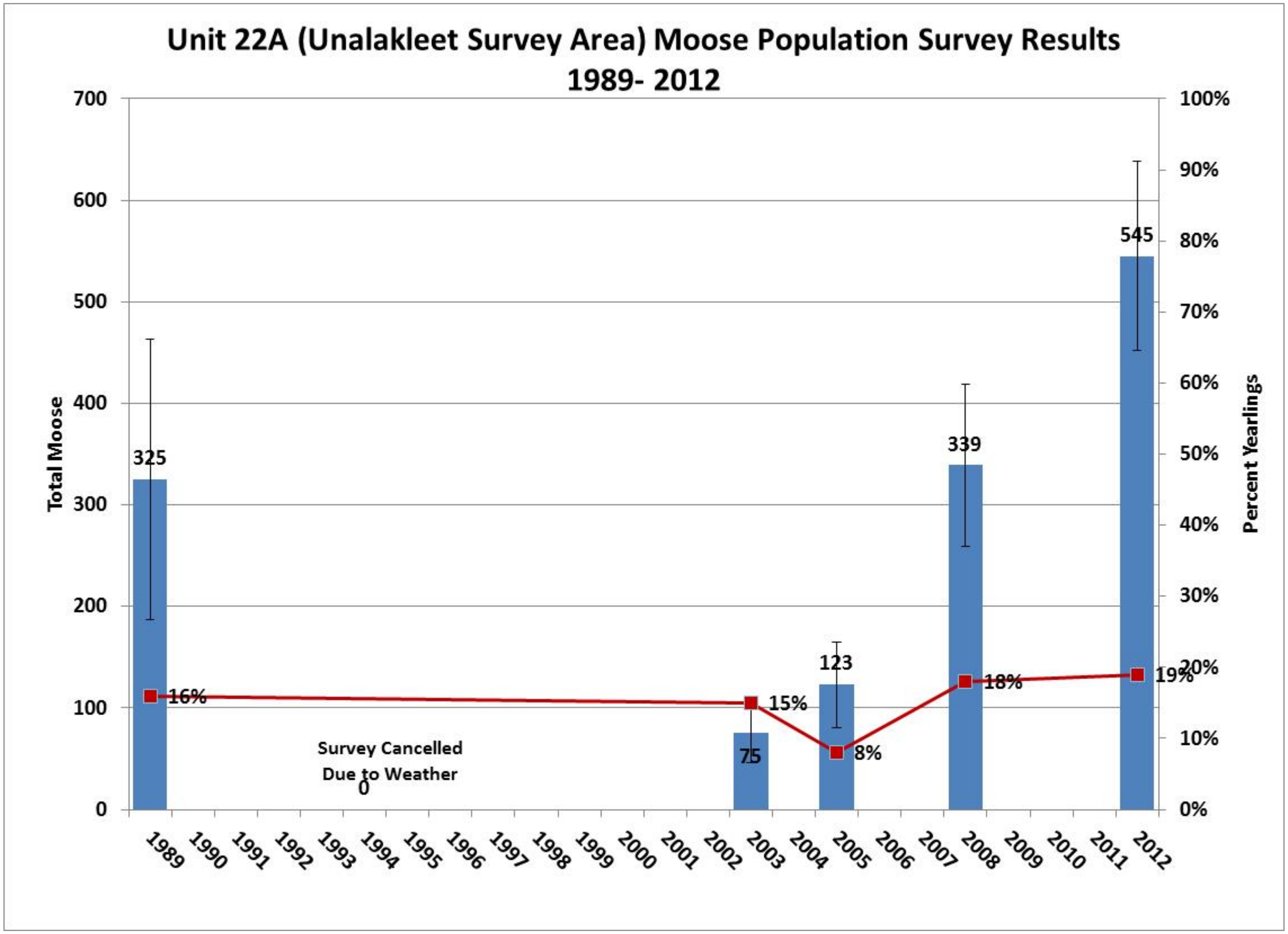

Figure 1. Unit 22A (Unalakleet Survey Area) moose population survey results.

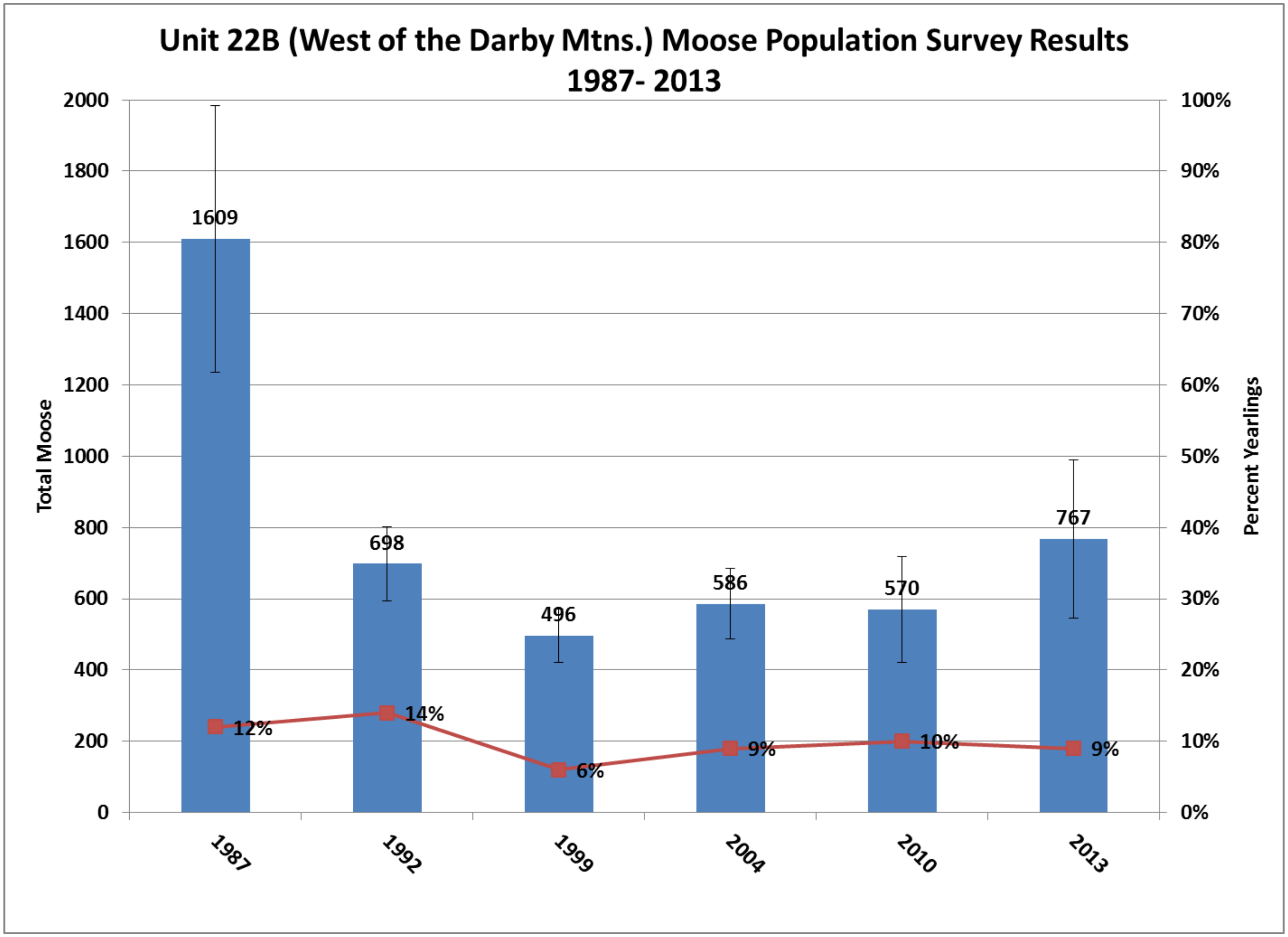

Figure 2. Unit 22B (West of the Darby Mountains) moose population survey results.

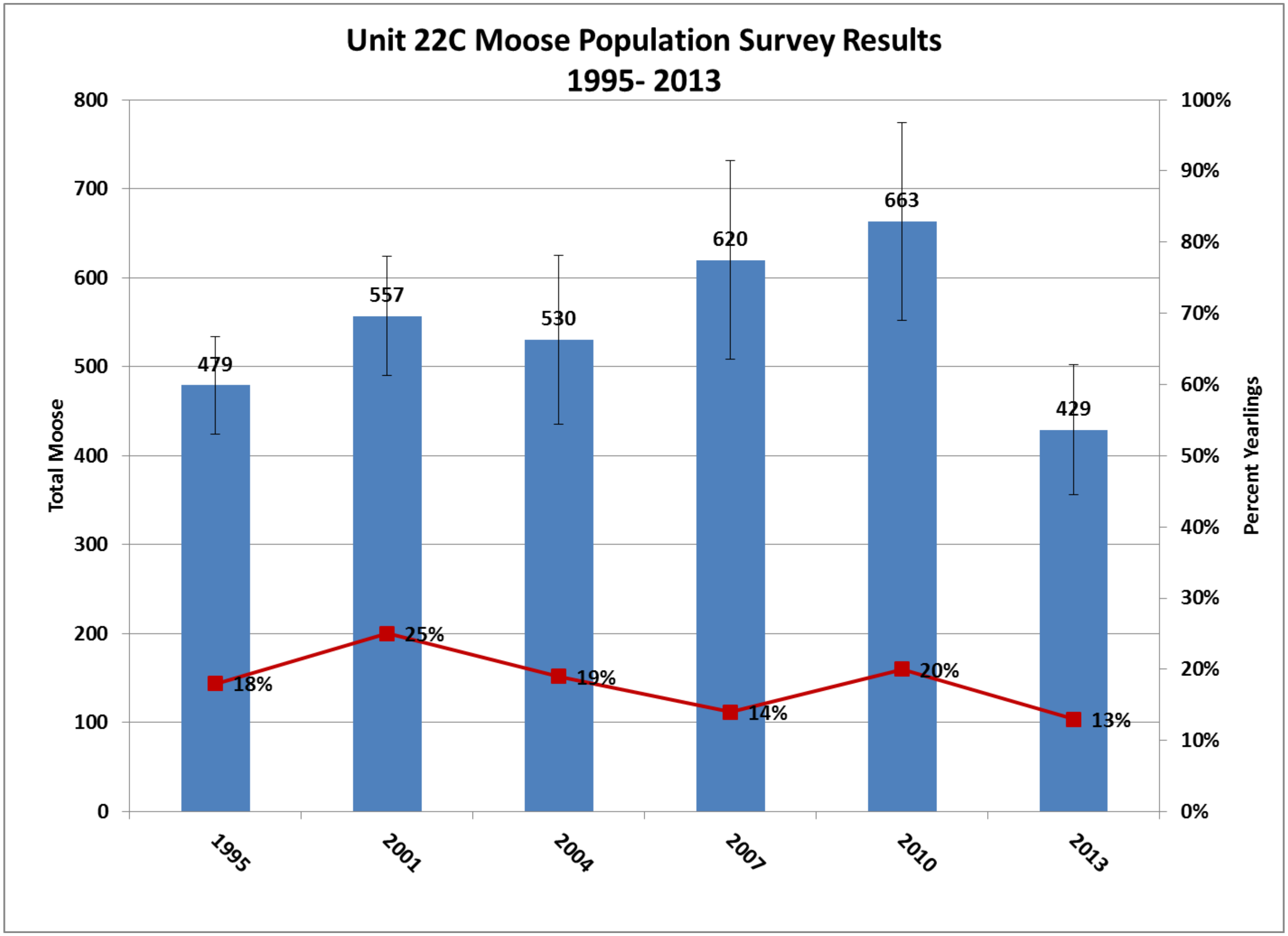

Figure 3. Unit 22C moose population survey results.

Appendix 1. 2013 Unit 22B and Unit 22C moose population survey results.

THE STATE of ALASKA
GOVERNOR SEAN PARNELL

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Fish and Game
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TO: R5 Staff

DATE: March 21, 2013

PHONE NO: 907-443-8189

FROM: Tony Gorn, Unit 22AB
Bill Dunker, FWT Tech III

SUBJECT: Unit 22 spring moose population survey results

THRU: Brian Taras, Biometrician

2013 Unit 22B and 22C Moose Population Survey Summary

ADF&G staff completed a moose population survey of Unit 22B West of the Darby Mountains (Unit 22B West) and Unit 22C between February 16- 23, 2013. The crew was grounded for 3 days (Feb. 19- 21) because of high winds. Survey participants included ADF&G staff: Tony Gorn, Jim Dau, Letty Hughes, Bill Dunker, Kate Persons, and Pete Rob. Austin Ahmasuk (Nome) was a volunteer for the project. Bruce Seppi represented the Bureau of Land Management. Charter pilots were Andy Greenblatt, Lance Williams, and Marty Webb.

METHODS

Stratification: We did not stratify the survey area using the C-185 during the 2013 population survey because of scheduling conflicts between survey participants. Nome staff desk-topped the stratification using stratification notes from previously completed surveys from years with similar snow cover (2004 and 2010). The desk-top stratification appeared to be accurate, as we only found 12 moose in 60 low stratum survey units (SU) during the survey (0.2 moose per SU). Six of the twelve moose observed in low stratum SU were observed in one low SU adjacent to a high stratum SU in the Sawtooth Mountains, which in retrospect could have been classified as a high using the "paint with a broad brush" rule often associated with stratification. For comparison, we found 24 moose in 88 low stratum SU during the 2010 survey when snow conditions were thought to be ideal, and we were able to complete in-survey stratification flights using the C-185

Standard Survey: We used five Piper Cub type aircraft to conduct searches in SU. Pilot observer teams all had prior experience conducting GSPE moose surveys. We followed the recommendation from Brian Taras (biometrician) to increase the number of high stratum SU searched from 60% to 70% of the total sample. This recommendation was based on an optimal allocation analysis (Gasaway et al. (1986:43)) using 2004 and 2010 survey results for Unit22B, which indicated a consistent trend of pure lows (few boxes with >0 moose), which indicated the optimal allocation called for searching 85% highs (Figure 1). We chose to be less aggressive, since in-survey stratification flights were not completed. This guarded against the possibility of observing more moose in low stratum SUs while still increasing the possibility of achieving the precision objectives with a lower sample size. Also, we needed to ensure a sufficient number of low SUs were surveyed in both subunits. We planned to survey 175 high SUs and 50 low SUs and reserve an additional 25 low SUs to fill holes.

Sightability Correction Factor (SCF) Surveys: This is the first effort since beginning GSPE surveys in unit 22 (i.e., since Gasaway surveys) to estimate sightability. Recognizing resource constraints and a lack of experience in conducting SCF surveys we opted to focus our efforts in Unit 22B to gain experience and obtain a useful SCF in an area of management concern with the potential for lower sightability. We concentrated on high stratum SUs in Unit 22B. We omitted low stratum SUs due to resource constraints and because previous surveys found very few moose in the low stratum which would impose a negative bias on the estimate of total moose and its variance assuming the SCF for the low stratum would be very small compared to the overall uncertainties. Simulations were performed for a number of possible scenarios to assess the robustness of this approach.

We largely followed recommendations from a similar SCF survey in Unit 19A and guidance in The Geospatial Survey Operations Manual (Kellie and Delong 2006; ADF&G). Our survey objective was to conduct SCF surveys in 20-25 (preferably 25, if possible) surveyed high stratum search units.

Thirty (30) SUs were randomly selected from surveyed high stratum search units to conduct SCF surveys. The north or south half section (3.19 mi^2)of each selected SU was randomly selected prior to the survey. SCF surveys were to be initiated within 2 hours of completing the standard survey and the pilot/observer team planned to allot between 9 and 12 min/mi^2 during these surveys.

RESULTS and DISCUSSION

Observable Moose Abundance for the Entire Survey Area: The population survey estimate for the entire survey area is 1047 observable moose (+/-14% at 90% C.I.). Re-allocation of sampling effort from the low stratum to the high stratum appears to have increased the precision of this survey (nearly the same relative precision as in 2004 during which 242 SUs were sampled). This represents a 5% annual rate of decrease between 2010 and 2013, though inference to the population is confounded due to the lack of sightability correction and by not evaluating the statistical significance of the difference. The recruitment rate (% short ylgs) was 11%, which represents a decline since 2010 when recruitment was 15%. Survey conditions were generally good, despite high winds during the middle of the survey that prevented standard and SCF surveys for three days. Bright light and recent snow fall in Unit 22C provided very good sightability in stringers of riparian moose habitat, but the same bright light cast long shadows in many of the tree covered boxes in Unit 22B West. Pilot and observer teams were able to search 220 SUs effectively of which 73% (160 of 220 SUs) were in the high stratum. We observed 389 moose (0.43 moose/mi^2) in high stratum SUs and 12 moose (0.04 moose/mi^2) in low stratum SUs. The stratification seemed accurate as evident by the low number of moose found in low strata SUs. For comparison, we observed 388 moose (0.56 moose/mi²) in high stratum SUs and 24 moose (0.05 moose/mi²) in low stratum SUs during the 2010 survey.

The survey ended on February 24, 2013 due to high winds, charter plane schedules, and aircraft maintenance schedules (100 hr inspections). We intended to complete standard surveys in an additional 25 to 30 SUs in Unit 22B if given the opportunity, however, winds remained high in the survey area for several days. During this time staff generated an estimate and it was determined the completion of additional surveys was unnecessary. The habitat in the last 25 to 30 SUs was similar to habitat surveyed in previous SUs, and there was no expectation that higher moose density existed in this small area that would significantly change the overall estimate. These factors combined with the precision (+/-14% at 90% C.I.) of the estimate led to the decision to end the 2013 GSPE survey.

Observable Moose Abundance for the Unit22C: The Unit 22C (1674 mi²) population survey estimate is 429 observable moose (+/-17% at 90% C.I.), and 13% recruitment (Table 1). The density (0.27/mi²) represents a point estimate decline when compared to surveys completed in 2007 and 2010 when densities were ~0.40/mi². We administered an antlerless hunt between 2001 and 2012 in Unit 22C to reduce the local moose population to our management goal of 450-525 moose because of concerns regarding available winter habitat and potential resource limitation during years of high snowfall. We found weights from Unit 22C short yearlings weighed in 2008 and 2009 averaged 374lbs and 371lbs respectively when snow depth was above 110 inches per year. Average weights from Unit 22C short yearlings weighed in 2006 and 2010 were 411lbs and 398lbs respectively when snow depth was less than 97 inches per year. The lower weights implied nutritional limitation in heavy snow years (Boertje et al 2007) suggesting antlerless hunts be used to slowly reduce the Unit 22C moose population to reduce competition, avoid chronically low weights, and decrease susceptibility to a weather related population decline. Local hunters harvested an average of 22 antlerless moose per year between 2010 and 2013 which is approximately 3% of the 2010 population survey point estimate. We plan to issue an emergency order to cancel the 2013 (15 Sept – 30 Sept) antlerless hunt in Unit 22C. I included results of populations surveys with confidence limits from previous Unit 22C population surveys to provide a long term perspective of the population in Unit 22C (Figure 1).

Table 1 compares Unit 22C census results.

Area	Year	Estimated Number of Moose	Calves/ 100 Adults	Census Technique
Unit 22C	1990	407	26	Gasaway
Unit 22C	1995	479	22	Gasaway
Unit 22C	2001	557	34	GSPE
Unit 22C	2004	530	23	GSPE
Unit 22C	2007	620	16	GSPE

Unit 22C	2010	639	20	GSPE
Unit 22C	2013	429	15	GSPE

Observable Moose Abundance for the Unit22B: The Unit 22B West (2510 mi.^{2}) population survey estimate was 618 observable moose (+/-19% at 90% C.I.), and 9% recruitment (Table 2). The density (0.25/ mi.^{2}) remained relatively unchanged since 1992 when four population surveys found densities between 0.20/ mi.^{2} and 0.27/ mi.^{2}. Our limited knowledge of habitat availablity and quality in Unit 22B and our population objective (increase and stabilize the population at 1000-1200 moose) suggest the area can sustain a higher density moose population. The 2013 estimate suggests the Unit 22B West moose population has stabilized at a lower density since the decrease in moose numbers found in Table 2. Census and spring recruitment survey efforts found chronically low calf numbers over the last decade. I included results of populations surveys with confidence limits from previous Unit 22B population surveys to provide a long term perspective of the population and evaluate the survey technique's ability to detect change in Unit 22B (Figure 3).

Table 2 compares Unit 22B West census results.

Area	Year	Estimated Number of Moose	Calves/ 100 Adults	Census Technique
Unit 22B W Darby Mtn.	1987	1894	13	Gasaway
Unit 22B W Darby Mtn.	1992	698	16	Gasaway
Unit 22B W Darby Mtn.	1999	476	6	GSPE
Unit 22B W Darby Mtn.	2004	586	10	GSPE
Unit 22B W Darby Mtn.	2010	597	10	GSPE
Unit 22B W Darby Mtn.	2013	618	10	GSPE

SCF estimate and Total Moose Abundance for the Unit22B:

A Sightability Correction Factor (SCF) of 1.26 (SE = 0.180) was estimated for Unit 22B (west of the Darby Mountains) by resurveying a random sample of surveyed SUs at a greater search intensity. Applying this SCF to the estimate of observable moose yields an estimate of total moose in 22B. Two results will be provided. First, we will assume perfect detection in the low stratum of 22B. The estimate of total abundance in this case is 767 (+/-29% at 90% C.I.) as compared to the observable moose estimate of 618 observable moose (+/-19% at 90% C.I.). The increase in relative precision from 19% to 29% is due to the uncertainty in the SCF, which was greater than expected partly because of a sample size less than planned and partly because of low moose counts in the high stratum SUs surveyed. Both the point estimate and its variance are biased low. A reasonable worst case would be to assume that the sightability in the low stratum was as poor as that in the high straum. The resulting estimate of total moose was 777 (+/-29% at 90% C.I.) leading to an increase of 10 in the abundance and virtually no change in precision. A number of more likely (less extreme) scenarios were evaluate and the bottom line was that negative bias in the point estimate and its precision was negligible, particularly when compared with the overall uncertainties.

A total of 19 SCF surveys were completed in Unit 22B during the survey period. Standard surveys were conducted by 5 pilot/observer teams participating in the GSPE survey, and all SCF surveys were conducted by the same pilot/observer team (Jim Dau/Bill Dunker). All pilot/observer teams conducting standard surveys in Unit 22B west of the Darby Mountains were incorporated into the estimate of sightability for the unit with a range of 2-6 SCF surveys flown per pilot/observer team.

SUs selected to resurvey had an average search intensity of 4.34 min/mi^2 (range: 2.35 to 8.93 min/mi^2). SCF surveys completed in the same SUs had an average search intensity of 9.24 min/mi^2 (range: 4.39 to 14.12 min/mi^2). SCF surveys began an average of 31 min after the completion of the standard surveys. The longest elapsed time between the end of the standard survey and the start of the SCF survey was 1hr 48min.

We reviewed daily track logs from survey flights, data sheet comments, and discussed survey results with pilot and observer teams to determine that 26 moose were observed during the SCF surveys that were observable during the intensive surveys. In comparison, 20 moose were observed during the standard surveys. No moose were observed in 63% of the SU selected for SCF surveys. The standard surveys found zero moose in every SU where zero moose were observed during the SCF survey.

In two cases where habitat was not homogenous throughout the selected SU, the north or south half section containing the majority of the habitat in the SU was selected for SCF survey. In both instances no moose were observed. Brian Taras cautioned against doing so as a general approach because of the potential to bias the SCF estimate. Specific circumstances may warrant further discussion.

RECOMMENDATIONS

Although the desktop method held for this survey, I recommend that we continue stratification flights in the future due to the variability in snow cover and habitat availability along the southern Seward Peninsula coast. Further, I recommend that we conduct stratification flights prior to beginning intensive surveys. Stratification and intensive survey flights were conducted simultaneously during surveys completed during 2004-2010. We should consider change to this approach for future surveys because knowing stratification of the survey area in 2013 allowed us to be more efficient with intensive searches.

SCF survey recommendations:

•To facilitate interpretation of moose observed during the SCF surveys, all pairs should pay attention to moose in a "buffer" surrounding unit and half unit boundaries.

•Moose outside of a unit or subunit section should not be used in estimating the SCF. Using data from areas not flown with specified intensity (opportunistic sightings) can lead to bias. For example, both teams saw two moose to the SE of a corner but if intensively searched as specified for the unit the SCF crew may have found additional moose. A possible exception warranting further consideration is when moose are observed so close to the boundary that they are subjected to the specified search intensity by each team and they are not known as "in" or "out" until plotting their locations.

•Future SCF survey protocol should re-consider change to allow individual pilot/observer crews to fly their own SCFS. This change would likely provide larger sample sizes and more robust SCF estimates given the logistical constraints, large proportion of high strata SU containing zero moose, and brief weather windows suitable for wildlife surveys found in Unit 22. Additional considerations include aircrew safety (not all crews may be capable of flying intensive SCF surveys), the potential for correcting to different extents (i.e., variable SCFc; (Gasaway et al. (1986:31)), and the potential for the same pilot/observer team to miss moose repeatedly because they have previously processed/interpreted a particular search image.

LITERATURE CITED

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Kellie, K.A., and R.A. DeLong. 2006. Geospatial survey operations manual. Alaska Department of Fish and Game, Fairbanks.

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Figure 1 – Estimated sample sizes to achieve an estimate of observable moose with a relative precision of 0.15 at the 95% confidence and the optimal allocation of surveyed samples units (SUs) between the low and high strata.

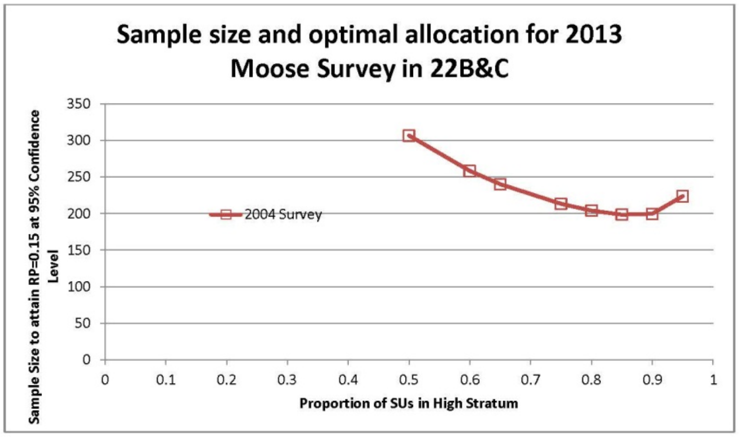

Figure 2 - Unit 22C Moose population survey results from Unit 22C, 1995-2013

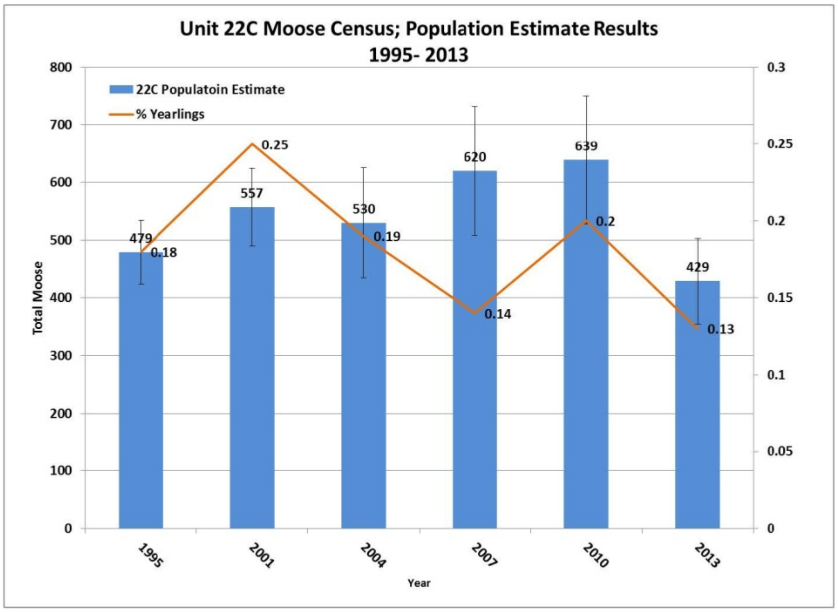

Figure 3 - Unit 22B Moose population survey results from Unit 22B, 1987-2013