Species Management Report and Plan ADF&G/DWC/SMR&P–2023–15

Moose Management Report and Plan, Game Management Unit 22:

Report Period 1 July 2010–30 June 2015, and

Plan Period 1 July 2015–30 June 2020

Sara R. Germain

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Alaska Department of Fish and Game Division of Wildlife Conservation

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Species management reports and plans provide information about species that are hunted or trapped and management actions, goals, recommendations for those species, and plans for data collection. Detailed information is prepared for each species every 5 years by the area management biologist for game management units in their areas, who also develops a plan for data collection and species management for the next 5 years. This type of report is not produced for species that are not managed for hunting or trapping or for areas where there is no current or anticipated activity. Unit reports are reviewed and approved for publication by regional management coordinators and are available to the public via the Alaska Department of Fish and Game's public website.

This species management report and plan was reviewed and approved for publication by Phillip Perry, Management Coordinator for the Division of Wildlife Conservation.

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Cover Photo: A bull moose browses on young spruce. ©2018 ADF&G. Photo by Sara Germain.

Contents

List of Figures

List of Tables

Purpose of this Report

This report provides a record of survey and inventory management activities for moose (*Alces alces*) in Game Management Unit 22 for the 5 regulatory years 2010–2014 and plans for survey and inventory management activities in the next 5 regulatory years, 2015–2019. A regulatory year (RY) begins 1 July and ends 30 June (e.g., RY14 = 1 July 2014–30 June 2015). This report is produced primarily to provide agency staff with data and analysis to help guide and record agency efforts but is also provided to the public to inform it of wildlife management activities. In 2016 the Alaska Department of Fish and Game's (ADF&G, the department) Division of Wildlife Conservation (DWC) launched this 5-year report to report more efficiently on trends and to describe potential changes in data collection activities over the next 5 years. It replaces the moose management report of survey and inventory activities that was previously produced every 2 years.

I. RY10–RY14 Management Report

Management Area

Unit 22 encompasses approximately 25,230 mi^2 of mainland in western Alaska and covers much of the Seward Peninsula and southern Norton Sound. It also includes St. Lawrence and Little Diomede islands, but moose are not present on either of island. Unit 22 is divided into 5 administrative units (22A, 22B, 22C, 22D, and 22E; Fig. 1). Mainland terrain varies from rugged mountains and river valleys to flat coastal wetlands. Spruce forests characterize eastern portions of the unit (Units 22A and 22B), while western portions are treeless and largely tundra covered with willow thickets along the riparian corridors.

Summary of Status, Trend, Management Activities, and History of Moose in Unit 22

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 (Nelson 1995). Moose populations grew rapidly in the 1960s through the early 1980s and reached probable high densities of 1.0–1.5 moose/mi^2. Severe winters in 1989, 1990, and 1992 caused declines in moose densities because winter browse was insufficient to maintain such large populations, especially in Units 22B and 22D. Populations in these areas have never recovered and have currently stabilized at lower densities (0.20–0.5 moose/mi^2). Fall composition surveys indicate that bull-to-cow ratios in Unit 22C have been below 30 bulls:100 cows since 1992 (Gorn 2012). A baseline for plant architecture was established during 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. Moose have influenced shrub architecture on the central Seward Peninsula, but shrubs appeared to be sustaining a compensatory response to browsing pressure without substantial shrub mortality (Gorn 2012). 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 abundance based on moose telemetry in Unit 22B during 1996–1998 (Gorn 2012).

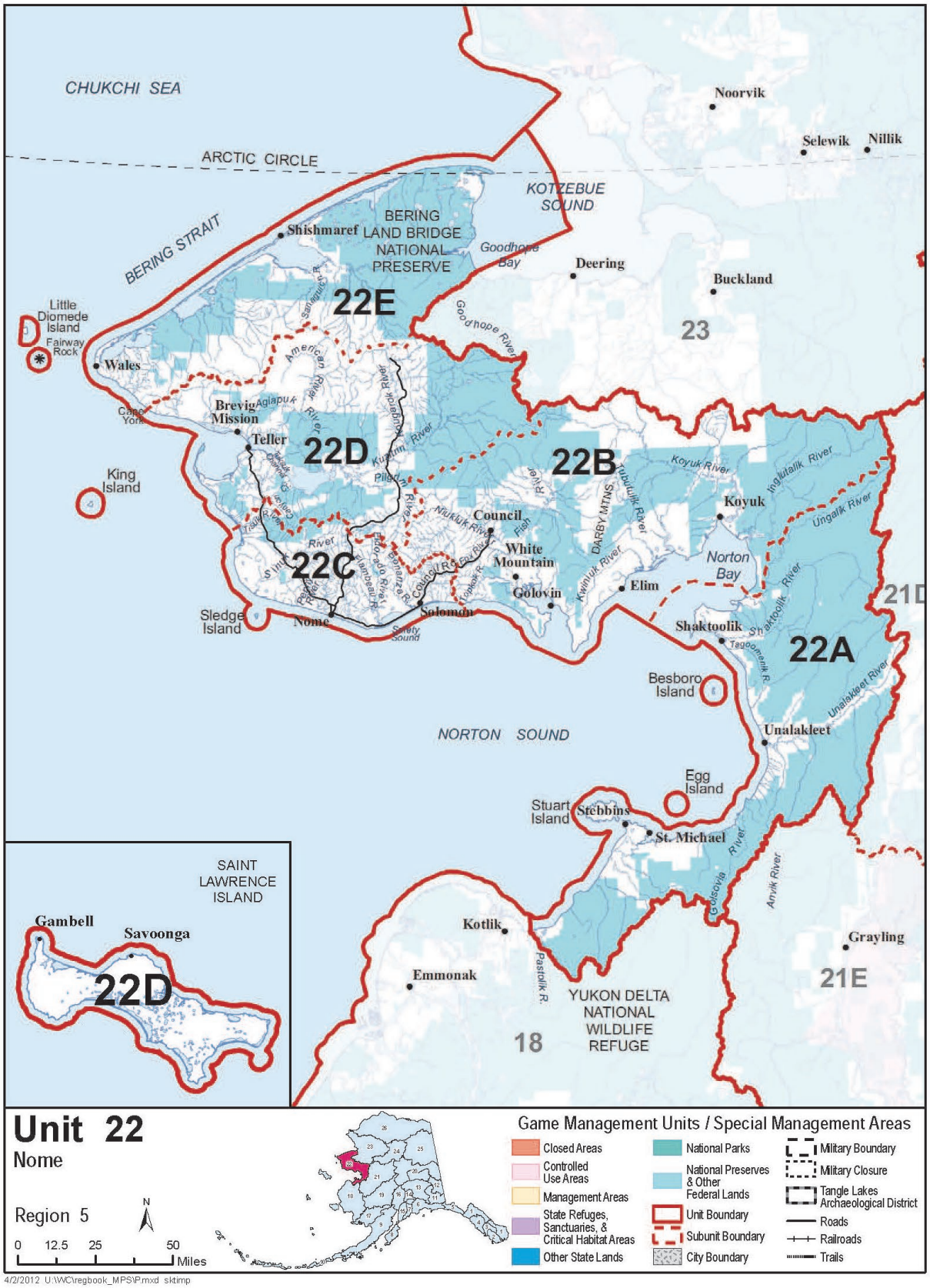

Figure 1. Map of Unit 22 in northwest Alaska.

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 general season hunters is high throughout the unit. Gravel roads, trails, navigable rivers, and winter trails provide hunters with easy access to suitable moose habitat (Machida 1997). Annual reported harvest has ranged from a low of 44 moose in 1972 to a high of 408 moose in 1986 (Gorn 2012). Beginning in 2001, the continued decline of moose populations first observed in the early 1990s prompted the Alaska Board of Game (BOG, board) to implement restrictions intended to reduce harvest in many parts of Unit 22. However, the most accessible portions of Unit 22 still have 14-day fall hunting seasons with bull moose harvest quotas that are adjusted annually to prevent overharvest.

Hunting restrictions began in the early 2000s when the board authorized registration permit hunts with harvest quotas in the most accessible areas of the Unit 22 road system (Unit 22B west of the Darby Mountains [Unit 22 West], Unit 22C, Unit 22D Kuzitrin River Drainage). Seasons in this portion of the unit occur during 1–14 September and were intended to allow fall hunting opportunity while protecting moose during the rut. Winter registration hunts occur during 1–31 January and antlered bull bag limits were authorized during the same time period to allow additional opportunity if harvest quotas were not reached during fall. A permanent winter season with a dedicated portion of the annual harvest quota was created in Unit 22B West to satisfy the season date preferences of Golovin and White Mountain residents. Other portions of Unit 22 have similar winter seasons that 'may be announced' if fall quotas are not reached. A 4-year moose hunting closure in Unit 22A was initiated in 2005 through a public stakeholder process. Bull-to-cow ratios along the Nome road system hunt areas (Units 22C and 22D; Fig. 1) generally range from 15 to 30 bulls per 100 cows (Gorn 2012) and have low densities (0.2–0.7 moose/mi^2) that support annual harvest rates from 2% to 5%.

An antlerless harvest has occurred in Unit 22C since 2002 to address concerns that the local moose population had exceeded its carrying capacity and a severe winter would cause a large mortality event. The antlerless moose harvest rate was increased in 2010 in response to sustained population increase in Unit 22C. The antlerless harvest was discontinued in RY13 after an abundance survey in the previous year indicated a decline in the population.

Unit residents take most of the annual reported harvest, which has been 150–200 moose since 2002 (Gorn 2012). Community-based harvest assessment programs were started in 1999 in an attempt to increase harvest reporting from community residents. Nonresident hunting opportunity exists, and hunting effort occurs in portions of Units 22A, 22B, 22D, and 22E. A nonresident season exists in Unit 22C, but low bull-to-cow ratios combined with a long-term age structure skewed towards younger bulls makes it difficult to find legal moose (50-inch antlers or 4 or more brow tines on at least 1 side). The long-term reported harvest indicates that less than 1 moose per year is harvested from the area by nonresidents.

Management Direction

Existing Wildlife Management Plans

Direction in the Seward-Kobuk-Noatak moose management plan (ADF&G 1976) has been reviewed and modified through public comments, staff recommendations, and Board of Game actions over the years. A record of these changes can be found in the division's management report series. The plan portion of this report contains the current management plan for moose in Unit 22.

Goals

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- Provide the greatest sustained-yield opportunity to participate in hunting moose.
- Provide an opportunity for nonconsumptive uses (e.g., to view and photograph moose).

Codified Objectives

Amounts Reasonably Necessary for Subsistence Harvest

The Alaska Board of Game made a positive customary and traditional use determination finding for moose in Unit 22 in 1987 which has remained in effect since. The current unitwide amount reasonably necessary for subsistence (ANS) value was set in 1992 at 250–300 moose.

Intensive Management

In 2001 the Alaska Board of Game adopted a positive finding for intensive management (IM) of moose in Unit 22. Current intensive management objectives are as follows:

- Population objective: 5,100–6,800 moose.
- Harvest objective: 300–680 moose.

MANAGEMENT OBJECTIVES

1. Manage moose populations at the following levels:

    a. Unit 22A: maintain a population of 600–800 moose.

    b. Unit 22B West (west of the Darby Mountains): maintain a population of 1,000–1,200 moose.

    c. Unit 22B East (remainder of Unit 22B): maintain a population of 800–3,000 moose.

    d. Unit 22C: maintain a population of 450–525 moose.

    e. Unit 22D: maintain a population of 2,000–2,500 moose.

    f. Unit 22E: maintain a population of 600–800 moose.

    g. Unit 22 (unitwide): maintain a population of 5,000–7,000 moose.

2. Manage for a post-hunt (fall) sex ratio of 30 bulls:100 cows in Units 22A, 22B, 22D, 22E; and 20 bulls:100 cows in Unit 22C.

3. Monitor percentage of 10-month calves in late winter as a measure of calf recruitment in Unit 22.

The Unit 22 intensive management population objective (5,100–6,800 moose), recommended by the Alaska Department of Fish and Game and adopted by the Board of Game in November 2001, provides the basis for moose population management in Unit 22. The current objective is a revision from the previous management goal of 5,700–7,300 moose, which was thought to exceed carrying capacity at the time of board action. In Units 22A, 22B, and 22D, our goal is to increase and stabilize the population to achieve recovery from a period of steady decline in moose numbers. We have not estimated abundance in the northern and southern portions of Unit 22A, nor in Unit 22B East. However, historic moose densities in Unit 22B West (similar to Unit 22B East with respect to terrain and habitat) suggest 800 to 3,000 moose are likely sustainable in Unit 22B East. In Unit 22C, the upper end of the objective was increased (from 475 to 525) based on results of a 2004 habitat survey and is intended to maintain optimum abundance within winter browse carrying capacity. In Unit 22E our objective is to maintain a population of 600 to 800 moose. Understanding precise population potential in most areas of Unit 22 is difficult due to the lack of habitat assessment information related to habitat quantity and quality.

MANAGEMENT ACTIVITIES

Assessing population status and trends, monitoring harvest and mortality, and assessing habitat conditions are integral components of management programs in Unit 22. Survey and inventory (S&I) management activities used to monitor moose populations in Unit 22 are described below.

1. Population Status and Trend

ACTIVITY 1.1. Estimate late winter abundance in at least one survey area annually. Estimate calf recruitment in at least one late winter survey area annually.

Data Needs

Moose abundance is a basis from which sustainable harvest may be estimated and provides a density context for interpreting nutritional condition relative to habitat conditions. Poor flying weather generally precludes fall abundance estimates in Unit 22, but surveys of age and sex composition before antler drop are feasible in at least one portion of Unit 22 on an annual basis. Spring surveys to estimate abundance also allow estimates of percentage of 10-month calves in the population as a recruitment index shown to be correlated with moose population trend in other tundra ecosystems of Alaska (Carroll 2012).

Methods

Geospatial population estimator (GSPE; Kellie and Delong 2006) surveys with an estimate of sightability correction are conducted in various parts of the unit as feasible during February and March as weather and snow conditions allow (see intended rotation schedule below). The sightability correction factor (SCF) was implemented beginning in 2013 to improve survey precision (W. Dunker, Wildlife Biologist, ADF&G, DWC, Nome, Unit 22 spring moose population survey results memorandum, 21 March 2013). This procedure produces population estimates and statistically bounded sex and age composition estimates by using fixed or random sampling designs and geostatistical models of autocorrelation. It is designed for high search intensity (8–12 min/mi^2) from a PA18 Super Cub or equivalent aircraft to obtain a relatively unbiased estimate of moose numbers. Stratifying the survey area based on habitat type and prior moose counts is relatively inexpensive and can be done with as few as 2 pilot-observer teams. Stratifying also significantly improves the precision of the overall moose abundance estimate. Estimating sightability, the proportion of moose seen in the area searched, provides a sightability correction factor that can be used to estimate total moose abundance with minimal sightability bias (Caughley 1974).

In Unit 22, stratification flights are typically conducted with a 4-person team flying at approximately 1,000 feet above ground level (AGL) in a Cessna 185 type aircraft. Stratification of survey units into high and low moose density strata is based on observed moose, presence of moose tracks, and availability of favorable habitat. Habitat can be both linear along river corridors and scattered throughout interior and coastal areas. Stratification in Unit 22 tends to result in approximately 80% of the survey units being classed as high density units and 20% as low density units.

Unit 22 abundance surveys are typically conducted in March and result in an abundance estimate as well as an estimate of short-yearling recruitment (percentage of 10-month-old calves relative to all moose observed). Declines in moose abundance in the tundra ecosystem of Unit 26A occurred when the proportion of calves reached estimated levels less than 15–20% (Carroll 2012). Thus, realized estimates of recruitment rates less than 15–20% may be used to indicate the need for improved precision of abundance surveys when detecting declines in abundance is critical to prevent unsustainable harvest. Surveys are conducted on a 3-year rotation among units

to infer trends and are planned such that estimates of observable moose abundance and calf recruitment will have 90% confidence intervals that are within 15% of the estimates. The Unit 22 survey schedule is as follows.

1) Unit 22A: 2012, 2015, 2016.

2) Unit 22B West (west of the Darby Mountains) and Unit 22C: 2010, 2013, 2017.

3) Unit 22D and Unit 22E: 2011, 2014, 2018.

Note: Exceptions to the 3-year cycle are made when poor conditions preclude a survey. Survey schedule includes years outside of the RY10–RY14 report period.

Results and Discussion

GSPE surveys and spring calf recruitment surveys were completed during each year as planned during the reporting period, except for 2015 and 2016 when the originally scheduled Unit 22A GSPE moose survey was cancelled due to poor survey conditions and rescheduled for 2017. Results from this reporting period are summarized below. Abundance estimates directly address management objectives in these instances because sampling occurred in entire units or designated areas (e.g., Unit 22B West).

The current unitwide abundance of moose in Unit 22 is approximately 6,000 individuals based on abundance estimates in all survey areas combined with extrapolations of abundance estimates to similar adjacent subunits. Abundance has been stable since the last reporting period and remains within the intensive management population objective of 5,100 to 6,800 moose. Results for individual administrative units are discussed below.

Unit 22A. The Unit 22A moose population appears to be increasing. A GSPE survey was conducted in 2012; additional surveys could not be completed during the reporting period due to poor weather and flying conditions that precluded the completion of the survey in 2015. The 2012 abundance estimate of 545 moose (90% CI = 452–639) stemmed from the highest number of moose found in the survey area since 1989 and showed a 13% annual rate of increase since the previous survey in 2008. The point estimate was below the bottom range of the management objective of 600 to 800 moose; however, the confidence interval extends into the target range. The next abundance survey, now scheduled for 2016, will help assess whether the target management range is being met. In spring of 2012 composition surveys resulted in an estimated 19% calves, which is above the management objective.

Unit 22B. GSPE surveys in Unit 22B West in 2010 and 2013 both indicated that the moose population has remained stable since the 2007 survey. In 2013 a sightability correction factor of 1.26 was estimated in the Unit 22B West survey area. The 2010 Unit 22B West abundance estimate of 570 moose (90% CI = 422–718) and density estimate of 0.23 moose/mi^2 has been stable since 2004. In 2013 the Unit 22B West abundance estimate of 618 moose (90% CI = 503–732) and density estimate of 0.25 moose/mi^2 were similar to surveys completed in 2010 and 1992. This population remains well below the management objective of 1,000 to 1,200 moose. The next abundance survey is scheduled for 2017. In both spring 2010 and spring 2013 composition surveys resulted in an estimated 9% calves, which is below the management objective of 15%.

Unit 22C. GSPE surveys in Unit 22C in 2010 and 2013 indicated that abundance declined during this reporting period, which is consistent with managed intent. The Unit 22C estimate in 2010 of 663 moose (90% CI = 551–774) was similar to the abundance estimated from a survey conducted in 2007. However, the 2013 survey yielded a lower abundance estimate of 429 moose (90% CI = 356–502) representing a 12% annual rate of decrease since the 2010 survey. This is likely the result of antlerless moose hunts administered in the area between 2001 and 2012 and associated increased antlerless moose harvest rates between 2010 and 2013. The 2013 point estimate was below the management objective of 450 to 525 moose; however, the confidence interval included the lower part of the target range. The next abundance survey is scheduled for 2017. Composition surveys conducted in spring 2010 resulted in an estimated 17% calves and 13% calves in spring 2013. The estimated percentage of calves in 2010 was above the management objective but the 2013 estimated percentage was below the management objective; however, the confidence intervals were within management objectives.

Unit 22D. The 2011 abundance estimate of 1,601 moose (90% CI = 1,126–2,235) indicated abundance in Unit 22D had remained relatively stable. Four population surveys completed between 1997 and 2011 resulted in point estimates between 1,565 and 1,829 moose. However, the 2014 abundance survey estimate of 1,106 moose (90% CI = 1,003–1,209) shows a 13% annual rate of decline since 2011. Survey conditions were poor during this survey and pilot-observer teams spent approximately 80% more time searching units compared to the 2011 survey, so the results of this survey should be interpreted with caution. This moose population remains well below the management objective of 2,000 to 2,500 moose. The next abundance survey is scheduled for 2018. Composition surveys conducted in spring 2011 resulted in an estimated 11% calves and an estimated 14% calves in spring 2014, both of which were below the management objective.

Unit 22E. The 2011 Unit 22E abundance estimate of 669 moose (90% CI = 564–775) indicated a 4% annual rate of increase since the last survey completed in 2006. Six population surveys were completed in Unit 22E since 1991, and the 2011 survey result was the highest estimated number of moose in the area. The 2014 estimate of 701 moose (90% CI = 602–799) indicated that abundance has been stable since the 2011 population survey. Unit 22E abundance is within the management objective of 600 to 800 moose. The next abundance survey is scheduled for 2018. Composition surveys conducted in spring 2011 resulted in an estimated 10% calves and estimated 13% calves in spring 2013, both of which were below the management objective.

Recommendations for Activity 1.1

Continue. There are no recommended changes to the survey schedule or methods. Continued biometric review will provide sampling guidance to better estimate sightability in survey areas.

ACTIVITY 1.2. Estimate fall composition in at least one survey area annually.

Data Needs

Estimating age-sex composition (bull-to-cow and calf-to-cow ratios) in a survey area during fall (before spring abundance surveys with percent calf estimates occur) will augment analysis of trends in abundance and help to gauge overwinter survival of calves. Moose classified as bulls (by age-class estimated from antler size), cows, and calves in a sample that is at least 33% of the

most recent abundance estimate for a survey area will provide an index of population composition.

Methods

Fall composition surveys using a Piper PA-12 aircraft were conducted in several areas during the reporting period (Table 1). These surveys have typically been conducted when management concerns exist with low bull-to-cow ratios in hunt areas with easy access and high hunting pressure and when suitable survey conditions occur. However, future surveys should follow a stricter schedule to ensure consistent data is collected throughout all survey areas. Composition counts conducted in late fall before bulls have dropped their antlers provide data on pre-winter calf survival, and ratios of males to females in the adult segment of the population. Counts of yearling bulls also provide information on recruitment, or survival of male calves from the previous year that are likely to become part of the harvestable bull segment of the population. Conducting these surveys in the same area periodically yields data on general trends in abundance and productivity accurate enough to detect large changes in bull-to-cow ratios. October and November weather patterns in most areas of Unit 22 produce long periods of conditions difficult for flying, thus making GSPE surveys difficult to complete. Conversely, fall composition surveys can be completed with comparative ease because only 3 to 5 days are needed compared to 7 to 14 days for a GSPE survey.

Results and Discussion

Fall composition surveys were completed each year of this reporting period and occurred in Units 22C, 22D, and for the first time in Unit 22E during 2014 (Table 1).

Unit 22C. The bull-to-cow ratio remains below the management objective at less than 20 bulls:100 cows. This suggests hunt management should continue to protect bulls in the population. Calves per 100 cows and percent calves results have been stable (Table 1).

Table 1. Unit 22, Alaska moose fall composition counts from aerial surveys conducted during regulatory years 2010–2014.

Survey area	Year	Bulls: 100 cows	Calves: 100 cows	Total calves	Percent calves (95% CI[a])	Total adults	Total moose
Unit 22C	2010	11	16	30	14 (8.0–16.0)	187	217
	2011	13	15	23	12 (7.5–17.0)	171	194
	2012	18	19	35	14 (9.7–18.0)	214	249
	2014	21	20	23	14 (8.6–19.0)	137	160
Unit 22D	2011	28	15	26	11 (7.1–15.0)	216	242
	2013	23	16	34	12 (8.4–16.0)	261	295
Unit 22D	2011	35	18	28	12 (8.0–16.0)	216	244
Unit 22E	2014	41	17	20	11 (6.5–15.5)	164	184

[a] 95% confidence interval (CI).

Overwinter calf survival was high from fall 2012 (14% calves; Table 1) to spring 2013 (13% calves) suggesting a low degree of wolf predation.

Unit 22D. Two fall composition surveys performed in the Kuzitrin drainage indicated 23 and 28 bulls:100 cows, respectively. These bull-to-cow ratios were below the management objective. A survey in the Agiapuk Drainage showed 35 bulls:100 cows, which is above the management objective. Fall calf metrics were similar to other survey areas in Unit 22 (Table 1). In the Kuzitrin drainage, overwinter calf survival was high from fall 2013 (12% calves; Table 1) to spring 2014 (11% calves) suggesting a low degree of wolf predation.

Unit 22E. The first fall survey occurred in 2014, indicating 41 bulls:100 cows, which is above the management objective. The calf-to-cow ratio of 17 calves:100 cows was the highest among areas surveyed during RY10–RY14 (Table 1).

Recommendations for Activity 1.2

Continue. Biometric consultation may improve the sampling design for fall trend composition surveys. Attempts will be made to complete fall composition surveys in areas scheduled for a subsequent spring abundance survey. Scheduling surveys this way provides an assessment of overwinter calf survival by comparing the percentage of calves in the population from fall and spring.

ACTIVITY 1.3. Estimate moose body condition as appropriate to understand sustainable density.

Data Needs

Unit 22 moose suffered a decline in density in the early 1990s attributed to severe winters and insufficient winter browse. Thus, monitoring moose nutritional condition or habitat proxies is warranted. Indicators of nutritional health in Alaska moose populations include adult female parturition and twinning rates, 10-month-old calf weights, and browse biomass removal (Boertje et al. 2007).

Methods

Calf-weight studies were completed during April 2006–2009. Department staff weighed 10-month old moose calves of both sexes to assess nutritional health of Unit 22 moose populations (Gorn 2012).

Results and Discussion

No work was done on this activity during the reporting period.

Recommendations for Activity 1.3.

Continue activity as warranted when a change in moose abundance or habitat condition is noticed.

2. Mortality-Harvest Monitoring and Regulations

ACTIVITY 2.1. Monitor mortality and harvest in Unit 22 annually.

Data Needs

Annual summaries of harvest are needed to establish harvest quotas to ensure sustained yield. Monitoring harvest data and improving harvest reporting through public education, vendor support, improved communication, and by conducting community-based harvest assessment surveys in selected villages is needed to understand harvest in relation to moose population assessments. Analysis of harvest data will facilitate department recommendations for Board of Game proposals.

Methods

Moose harvests were monitored using DWC's WinfoNet harvest database for registration and general season moose hunts in Unit 22. Management decisions to close quota-based hunts by emergency order are also informed by monitoring village vendor activity, assessing the number of hunters in the field during impromptu aerial surveys, and checking phone messages for hunt reports.

Season and Bag Limit

Current Unit 22 moose season dates and bag limits are available on the ADF&G website: http://www.adfg.alaska.gov/index.cfm?adfg=wildliferegulations.hunting.

Results and Discussion

Accurate harvest reporting is necessary for understanding patterns and levels of harvest that inform hunt management. A lack of harvest reports for moose generally stems from hunter confusion or cultural values about hunting. Biologists can sometimes reduce confusion with regulations by coordinating state hunts with federal hunts. Moose hunts in Unit 22A, 22B, 22D, and 22E include areas of federal land, and regulations among state and federal managers are aligned to the greatest extent possible to reduce public confusion and promote harvest reporting.

Harvest by Hunters-Trappers

A summary of Unit 22 reported moose harvest is presented in Table 2. In each year and on average, reported harvests fell short of the ANS and the intensive management harvest objectives.

The average annual total harvest reported for all hunts during RY10 through RY14 was 174 moose (range = 146–197; Table 2). The lowest harvests were reported during the later years of this reporting period. Managers continued increased antlerless hunt quotas in RY11 and RY12 due to concerns over habitat limitations for the current moose abundance. Realized antlerless moose harvest rates between RY00 and RY10 fluctuated between 2% and 4%. Managers continued increased antlerless hunt quotas in RY11 and RY12 due to concerns over habitat limitations for the current moose abundance. The realized harvest rates for moose in Unit 22 for RY11 and RY12 were 6% and 7%, respectively. The average annual harvest was similar to the

average annual harvest of 179 during RY00 through RY14, but lower than the peak harvests during the 1980s (RY80–RY89 annual average of 343). Lower harvests since RY00 are partially a result of regulatory changes instituted in the 2000s to reduce harvests following indicators that the moose population was at carrying capacity (Gorn 2012).

Table 2. Unit 22 reported moose harvest, number of hunters, and success rate for regulatory years 2010 to 2014, Alaska.

Regulatory year	Male	Females	Unknown	Total	Total hunters	Harvest success
2010	146	23	2	171	686	25%
2011	169	26	2	197	689	26%
2012	150	25	2	177	662	27%
2013	157	1	0	158	649	24%
2014	162	2	3	167	634	26%

General harvest information for specific hunt types (general season, registration, drawing) harvest history, hunt area harvest, transportation methods used, harvest by residency, and seasonality of harvest are available to the public for hunt planning on the ADF&G website: https://secure.wildlife.alaska.gov/index.cfm?adfg=harvest.main.

Permit Hunts

General season moose hunts occurred in portions of Units 22A, 22B, 22D, and all of 22E during the reporting period. Registration moose hunts (RM) with harvest quotas are used in the most accessible portions of Units 22B, 22C, and 22D along the Nome road system (RM840) and in the central portion of Unit 22A near Unalakleet (RM841). Registration hunts with harvest quotas require reporting within either 2 or 3 days of harvest, depending on the hunt. Reporting by hunters who hunt but fail to harvest a moose has improved through time, and increased emphasis on the need to report has improved the reporting rate in registration hunts. Harvest reporting by more remote Unit 22 village residents has been less complete.

Hunter Residency and Success

Alaska residents took 82–91% of the total harvest each year during RY10 through RY14 (range = 130–174). Nonresidents harvested 13 to 24 moose annually.

Other Mortality

There are no collared moose in Unit 22 to provide insight into natural mortality rates or primary causes of mortality. However, anecdotal reports from staff biologists and members of the public report annual observations of brown bear and wolf predation on moose. Future research will be initiated to better understand the causes of mortality among adult moose.

Alaska Board of Game Actions and Emergency Orders

The BOG addressed several Unit 22 moose proposals during meetings held in November 2011 and January 2014. The BOG reauthorized antlerless hunts, extended the resident Unit 22E moose

season to 1 January through 15 March, and established a "to be announced" winter registration moose season with 1 December through 31 December season dates in the central portion of Unit 22A. BOG meeting summary information is available on the ADF&G website: http://www.adfg.alaska.gov/index.cfm?adfg=gameboard.meetinginfo

Emergency orders were issued to manage registration hunts by the department during the reporting period. Emergency orders were issued in each year of the period to extend the fall RM841 season to 20 September. The orders were issued at the request of the Native Village of Unalakleet so residents could harvest the full antlered bull quota of 22 animals while still protecting breeding bulls in late September.

Unit 22 registration permits include 1- to 3-day reporting requirements and allow managers to close the season before harvest reaches unsustainable levels. Winter seasons exist in some portions of Unit 22 that allow additional opportunity if quotas from fall seasons in the RM840 hunt areas were not met.

Emergency orders were issued in each year of the period to extend the fall RM841 season to 20 September. The orders were issued at the request of the Native Village of Unalakleet so residents could harvest the full antlered bull quota of 22 animals while still protecting breeding bulls in late September.

Emergency orders are not presented in this report in their entirety but are available from staff, with the most recent year on the ADF&G website on the Hunting, Trapping and Wildlife page: http://www.adfg.alaska.gov/index.cfm?adfg=wcnews.main

Recommendations for Activity 2.1

Continue. Monitor total harvest for comparison with the IM and ANS harvest objectives.

3. Habitat Assessment-Enhancement

No habitat assessment or enhancement surveys were completed during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

There were no nonregulatory management needs during the reporting period.

Data Recording and Archiving

- GSPE data are stored on an internal database housed on a server (http://winfonet.alaska.gov/index.cfm). Field data sheets are stored in file folders located in the Nome Area Biologist's cubicle.

- Field data sheets are scanned and housed on the computer server in the Nome area biologist office (V:\Wildlife\Moose\) and stored in file folders located in the Nome area biologist's cubicle.

Agreements

A data sharing agreement was established with the National Park Service (NPS) Bering Land Bridge National Preserve (BELA) in regard to 2014 moose survey results in (Appendix)

Permitting

None.

Conclusions and Management Recommendations

The Unit 22A moose abundance survey completed during the reporting period showed a 14% rate of increase between 2008 and 2012. The current estimated density of 0.2 moose/mi^2 is above what was estimated during the late 1980s. The 4-year moose hunting closure initiated in 2005 through the Board of Game process was effective in reducing harvest and recovery in abundance is an apparent short-term success. Accurate monitoring of this population's status will require staff to continue working with local residents and emphasize the importance of harvest reporting at normally scheduled advisory committee meetings. We recommend the continued application of conservative harvest rates that are at or below 3% of the realized or confirmed post-hunt harvest rate until local moose population metrics suggest higher levels of harvest are sustainable.

Unit 22B West moose density continues to be stable at a low density of 0.2 moose/mi^2. Since 1999, growth in abundance appears to be inhibited by low recruitment rates of less than 10%. The 2013 abundance point estimate of 618 observable moose in Unit 22B West indicates a 3% annual rate of increase between 2010 and 2013; however, the increase is not statistically significant. Results from a research study conducted in western Unit 22B during the late 1990s indicated that 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 and 22D have changed little since the initial decline that occurred in the late 1980s.

Little information exists about moose habitat quality or quantity on the Seward Peninsula 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. Densities in Unit 22B West on the other hand would only be sustainable if abundance remains below the level observed before the observed crash in the late 1980s. However, current densities in Unit 22B West would need to double before they approach such levels.

The moose abundance in Unit 22C declined during the reporting period. This was largely driven by administering antlerless moose hunts in the area to bring the abundance within the management objective of 450 to 525 moose. The GSPE abundance survey completed during the reporting period indicated a 12% annual decline in abundance between 2010 and 2013. Subsequently, the antlerless hunt first authorized in 1999 and that had been held annually thereafter was cancelled by the Board of Game for RY14. Current harvest management is

structured to maintain densities near current levels of 0.3 moose/mi^2 and to increase bull-to-cow ratios in the area. The department will estimate moose abundance in Unit 22C again in 2016.

The GSPE survey of Unit 22D completed in spring 2014 indicated a 13% annual rate of decline between 2011 and 2014. Snow conditions during the 2014 survey were poor and moose distribution was different than what would be expected during a normal spring survey. Instead of high concentrations of moose along river corridors in the area, high numbers of moose were observed at upper elevations similar to what was present during the fall 2014 composition survey. Given our understanding of moose movement between Unit 22D Remainder and Unit 22E, it is plausible that moose normally found in Unit 22D were perhaps located in Unit 22E during the 2014 survey. It is a priority to complete a GSPE survey covering both Units 22D and 22E in 2018 to better understand moose densities in the area. Future survey planning should consider snow depth and moose distribution relative to previously completed surveys to provide data that are comparable.

The first GSPE moose abundance survey conducted in Unit 22E was completed during 2003 and resulted in an estimated 504 moose. This result indicated abundance increased 3% annually between 2003 and 2014. The spring GSPE completed in spring 2014 indicated abundance remained relatively stable between 2011 and 2014. Access to Unit 22E is difficult and hunt reports are somewhat incomplete compared to areas around the Nome Road system, but harvest from the area is believed to be approximately 3–6% of the moose population using results from harvest ticket data combined with results from Community-based Harvest Assessment surveys that are completed by the Division of Subsistence periodically to help estimate unreported harvest.

Because of recent growth in moose abundance in Unit 22E, it would be beneficial to understand habitat quality and quantity in the area to develop an understanding of carrying capacity.

In Unit 22 compliance with regulations and harvest reporting is thought to be reasonably high in the Nome area (Unit 22C) and has improved as a result of education efforts associated with 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 community residents. This data has been essential in providing the BOG 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 away from the Nome Road system, this program should be continued to provide ongoing estimates of moose harvest and subsistence use of moose by community residents.

Surveys to estimate fall calf-to-cow ratios should be conducted prior to the completion of spring abundance surveys to better assess calf overwinter survival in Unit 22. Enhanced spring abundance surveys that incorporate sightability estimates should be attempted to render more accurate moose density estimates. However, obtaining precise estimates of sightability will likely lengthen surveys, making them more expensive and difficult to complete given Unit 22 weather conditions. The project review should assess the necessary precision of abundance estimates to

manage sustainable moose harvest and how the application of other techniques may complement inferences on trends in abundance.

II. Project Review and RY15–RY19 Plan

Review of Management Direction

Management Direction

There are no changes in the management direction for Unit 22.

Goals

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- Provide the greatest sustained-yield opportunity to participate in hunting moose.
- Provide an opportunity for nonconsumptive uses (e.g., to view and photograph moose).

Codified Objectives

Amount Reasonably Necessary for Subsistence Uses (ANS)

The Unit 22 moose population has a positive Customary and Traditional Use Determination finding. The unitwide amount reasonably necessary for subsistence (ANS) is 250–300 moose.

Intensive Management

In 2001 the Alaska Board of Game adopted a positive finding for intensive management of moose in Unit 22. Current intensive management objectives are as follows:

- Population objective: 5,100–6,800 moose.
- Harvest objective: 300–680 moose.

MANAGEMENT OBJECTIVES

There are no suggested changes to the management objectives.

1. Manage moose populations at the following levels:
    a. Unit 22A: maintain a population of 600–800 moose.
    b. Unit 22B West (west of the Darby Mountains): maintain a population of 1,000–1,200 moose.
    c. Unit 22B East (remainder of Unit 22B): maintain a population of 800–3,000 moose.
    d. Unit 22C: maintain a population of 450–525 moose.
    e. Unit 22D: maintain a population of 2,000–2,500 moose.
    f. Unit 22E: maintain a population of 600–800 moose.
    g. Unit 22 (unitwide): maintain a population of 5,000–7,000 moose.
2. Manage for a post-hunt (fall) sex ratio of 30 bulls:100 cows in Units 22A, 22B, 22D, 22E, and 20 bulls:100 cows in Unit 22C.
3. Manage for ≥15% 10-month calves in late winter as a measure of calf recruitment (overwinter calf survival) in Unit 22.

MANAGEMENT ACTIVITIES

The current management direction and goals for Unit 22 moose remain appropriate and no changes are warranted for the RY15–RY19 plan period. The management activities for the RY15–RY19 plan period have been slightly modified from the RY10–RY14 reporting period.

1. Population Status and Trend

ACTIVITY 1.1. Estimate spring abundance in at least one survey area annually. Estimate calf recruitment (calf survival to 10 months) in at least one survey area annually.

Data Needs

No change from RY10–RY14 report.

Methods

Future surveys will apply similar methods to those described in the report. Based on recommendations from this report, we will consider the cost of achieving greater precision in harvest estimates for managing sustainable harvest outside of registration hunt areas. Biometric review will be sought prior to future moose abundance surveys for optimizing the stratification of survey units to achieve the desired precision of the abundance estimate and to estimate sightability correction when feasible. Additionally, it would be useful to have a calf recruitment index that would identify when a decline in calf recruitment should trigger enhanced monitoring efforts to detect whether there is a decline in abundance and prevent harvests that might exceed sustainable levels. Therefore, we will seek biometric review to define the sample sizes necessary to establish that index.

ACTIVITY 1.2. Estimate fall bull composition in at least one survey area annually.

Data Needs

No change from RY10–RY14 report.

Methods

No change from RY10–RY14 report.

ACTIVITY 1.3. Estimate moose body condition as appropriate to understand sustainable density.

Data Needs

Future research is warranted to substantiate snow-forage interactions found during the 2006 through 2009 calf weight study, especially if moose densities once again approach 0.50 moose/mi^2 in Unit 22C. An additional area to consider for future research is Unit 22E, which had a density of 0.20 moose/mi^2 in 2014. Albeit this may be considered a low density, it represents the highest density of moose ever estimated from the area.

Methods

No change from RY10–RY14 report.

2. Mortality-Harvest Monitoring

ACTIVITY 2.1. Monitor mortality and harvest in Unit 22 annually.

Data Needs

No change from the RY10–RY14 reporting period.

Methods

Conduct harvest monitoring using the same methods as the RY10–RY14 reporting period. Continue to consult with the region's biometrician about better ways to estimate the nonreporting rate.

3. Habitat Assessment-Enhancement

No habitat assessment activities are planned for RY15–RY19. If a marked increase in moose abundance or decline in habitat condition is suspected, browse surveys will be conducted.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

No new issues have been identified.

Data Recording and Archiving

- GSPE data will be stored on an internal database housed on a server (http://winfonet.alaska.gov/index.cfm). Field data sheets will be stored in file folders located in the Nome area biologist's cubicle.
- Field data sheets will be scanned and housed on the computer server in the Nome Area Biologist office (V:\Wildlife\Moose\) and stored in file folders located in the Nome Area Biologist's cubicle.
- Historical (1970–2010) survey notes and data sheets will be scanned for more secure data archival.

Agreements

None.

Permitting

None.

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