Species Management Report and Plan ADF&G/DWC/SMR&P–2025–13

Moose Management Report and Plan, Game Management Unit 21D

Report Period 1 July 2015–30 June 2020, and

Plan Period 1 July 2020–30 June 2025

Glenn W. Stout

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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 Jason R. Caikoski, Management Coordinator for Region III for the Division of Wildlife Conservation.

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Purpose of this Report

This report provides a record of survey and inventory management activities for moose (*Alces alces*) in Unit 21D for the 5 regulatory years 2015–2019 and plans for survey and inventory management activities in the following 5 regulatory years, 2020–2024. A regulatory year (RY) begins 1 July and ends 30 June (e.g., RY19 = 1 July 2019–30 June 2020). 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 more efficiently report 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. RY15–RY19 Management Report

Management Area

Unit 21D (12,093.6 mi^2) is located in western Interior Alaska and encompasses the Koyukuk River drainage upstream of the Dulbi River drainage. Portions of 4 ecoregions found in Unit 21D include the Nulato Hills, Ray Mountains, Kuskokwim Mountains, and Yukon River lowlands (Nowacki et al. 2001). Maps showing current Unit 21D boundaries and special management areas are found at http://www.adfg.alaska.gov/index.cfm?adfg=maps.main.

Summary of Status, Trend, Management Activities, and History of Moose in Unit 21D

Moose are abundant in much of Unit 21D. Local residents first reported seeing occasional moose tracks during winters in the 1930s. During the 1940s and early 1950s, the numbers of moose and wolves (*Canis lupus*) slowly increased (Huntington 1993). During the 1950s, federal wolf control and aerial shooting reduced the wolf population, allowing a rapid expansion of the moose population during the late 1950s and through the 1960s. Expansion may have begun slowing in 1959 when statehood brought an end to federal wolf control. The moose population reached peak numbers around 1970 (S. Huntington, personal communication with T. Osborne, Wildlife Biologist, ADF&G, Galena) and then stabilized or declined slightly in localized areas in response to increased predation and hunting pressure. Increased predation may have been related to passage of the federal Airborne Hunting Act in 1972, which halted aerial shooting of predators by the public (Regelin et al. 2005).

In early winter 1993, moose densities were high along the Yukon River floodplain (3–6 moose/mi^2), and very high on the Koyukuk River in the Three Day Slough trend count area (TCA) where densities reached 13.3 moose/mi^2. ADF&G biologists estimated that 6,340 moose inhabited the portion of Unit 21D with the best habitat of the area, and extrapolation of comparable low-density data to the remainder of Unit 21D suggested a unitwide population of 9,000–10,000 in 1993.

A population estimation survey in fall 1997 in the lower Koyukuk drainage and Kaiyuh Flats indicated moose numbers were similar to the 1993 estimate (Huntington 1998). However, a population estimation survey in 2001 suggested the population had declined marginally to 8,500–9,500 moose by winter 2001–2002, which seemed to be corroborated by declining recruitment parameters observed in the TCAs during 1997–2001. Since 2001 there have been fluctuations in the abundance of moose due to stochastic changes in productivity and survival, but no clear trend in the recent trajectory of the population is apparent.

Residents of the 4 communities within Unit 21D (Kaltag, Nulato, Koyukuk, and Galena) and the village in Unit 21B near the boundary with Unit 21D (Ruby) have traditional hunting areas within Unit 21D. Those local residents often traveled as much as 100 miles up the Koyukuk River in the 1980s–2000s until fuel prices began to restrict travel in the 2000s–2010s. Nonlocal hunters using Unit 21D mostly concentrated their hunting activities within the Koyukuk River between the Kateel River and Dulbi Slough. Hunting pressure from nonlocal hunters appeared to gradually shift farther upriver as hunters from outside the unit learned the logistics of accessing the area.

The Koyukuk Controlled Use Area (CUA) was established in 1978 and prohibits the use of aircraft for moose hunting in the area; therefore, most moose hunters access the area by boat. The Koyukuk CUA consists of 4,791 mi^2; it includes portions of northern Unit 21D and southern Unit 24 and overlaps with a large portion of the Koyukuk National Wildlife Refuge. Surveys of the Koyukuk CUA moose population are completed by combining the data from the Koyukuk River mouth, Three Day Slough, and Dulbi River mouth TCAs in Unit 21D with the Huslia Flats and Treat Island TCAs from Unit 21D (Stout 2014). These 5 TCAs are considered the *Core-5 TCAs*.

Since 1983 the department has operated a hunter checkstation on the Koyukuk River, 15 miles upstream from the village of Koyukuk. In 1990 the Koyukuk River checkstation became a mandatory stop for all hunters. The checkstation enables accurate determination of the number of hunters using the river to access the Koyukuk CUA within Unit 21D during the fall hunting season. It is also used to collect biological data from harvested animals, educate local residents concerning licensing and reporting requirements, and to inform nonlocal hunters about regulations specific to the area and locations of private property near the river.

The fall hunting season dates changed several times during 1975–1981. In 1981–1996 there was a 21-day fall season for the entire unit. Harvest of cows was allowed during the last 5 days. A 10-day season in early March also provided hunting opportunities for Alaska residents. In 1991 nonresidents were restricted to bulls with an antler spread of ≥50 inches or at least 3 brow tines on one side. In 1992 the minimum number of brow tines on one side was increased to 4. Also beginning in 1992, meat of the hindquarters, forequarters, and ribs of any moose taken in the Koyukuk CUA had to remain on the bone. In 1996, due to increasing moose hunter numbers and moose harvest, subsistence and general registration hunts were established for the Koyukuk CUA downstream from Huslia. In 2000, resident and nonresident drawing hunts were added. By 2006, all of Unit 21D was managed through subsistence registration hunts with antler destruction disincentives or limited drawing permit hunts.

Management Direction

EXISTING WILDLIFE MANAGEMENT PLANS

The *Koyukuk River Moose Management Plan 2000–2005: Unit 24 and the northern portion of Unit 21D* was published in March 2001 and is still referenced on some issues (Koyukuk River Moose Hunters Working Group 2001). This plan identified predation on moose as significant and increasing. It stipulated an objective to provide for increased harvest of predators of moose (including wolves) and a recommendation to implement aerial wolf control to make progress toward intensive management objectives for moose abundance and harvest.

Direction for the management of the remainder of Unit 21D 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 management plan for moose in Unit 21D for regulatory years 2020–2024.

GOALS

G1. Manage moose in the Koyukuk River drainage on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

C1. Unit 21 has a positive finding for customary and traditional uses for moose and amounts reasonably necessary for subsistence uses (ANS) of 600–800 moose from the unitwide population on an annual basis (5 AAC 99.025).

   a. To evaluate the ANS objective, the population estimate (lower range approximation) was multiplied by a harvest rate of 5% in order to determine the harvestable surplus. The Unit 21D harvestable surplus was added to the derived harvestable surpluses of the remaining subunits of Unit 21. The total Unit 21 harvestable surplus was compared to the lower value (600) of the ANS range. This conservative approach ensures the minimum amount of harvestable surplus provided by the population will meet the ANS objective.

Intensive Management

Unit 21D has a positive finding for intensive management (IM) (5 AAC 92.108).

C2. Population objective: 7,000–10,000 moose.

   a. To evaluate this objective, the population estimate (midpoint) was compared to the lower range value of the IM population objective (7,000).

C3. Harvest objective: 450–1,000 moose.

MANAGEMENT OBJECTIVES

M1. Maintain a moose population of 5,200 observable moose in the Kaiyuh Flats and western Galena combined subareas.

M2. Maintain a bull-to-cow ratio of 30:100 in the Koyukuk CUA Core-5 TCAs.

M3. Provide for a harvest of moose not to exceed 700 moose or 7% of the annual moose population estimate each regulatory year.

M4. Provide for moose hunting opportunities not to exceed 950 hunters per regulatory year.

MANAGEMENT ACTIVITIES

1. Population Status and Trend

The regulatory year moose population estimate is based on previously reported values (Stout 2012a), RY15–RY19 trend count surveys, and RY10–RY18 GSPE surveys. I developed the RY19 moose population estimate for Unit 21D by individually estimating moose densities in each of the 6 drawing permit hunt areas within Unit 21D. To accomplish this, I used data from the historical GSPE surveys (Stout 2018), GSPE surveys conducted in RY17 and RY18, as well as fall 2015–2020 TCA data. For those areas that did not have survey data, I used recent density estimates from GSPE surveys in similar habitat within Unit 21D. Therefore, to varying degrees, estimates for each permit area were a combination of GSPE survey data, trend count survey data, and extrapolated data. I included range approximations for population estimates to indicate uncertainty in the estimate. Range approximations were variable based on knowledge of the area. Values that include a 90% confidence interval (CI) were statistically derived variances. However, values followed by a (±) symbol that do not have a 90% CI designation were based on knowledge of the area and previously conducted surveys.

ACTIVITY 1.1. Conduct geospatial population estimation surveys (objectives C1, C2, C3, M1).

Data Needs

A statistical estimate of the moose population derived from geospatial population estimator (GSPE), including a measure of the precision, is needed to detect change in the population. A statistical estimate is needed to evaluate whether the objective to maintain a combined population of 5,200 observable moose in the western Galena and Kaiyuh Flats subareas is achieved.

In cooperation with the U.S. Fish and Wildlife Service (USFWS), we need to conduct high-intensity GSPE surveys once and low-intensity GSPE surveys twice during each 5-year reporting period, and we need to estimate abundance (90% CI <15%) to evaluate population status. We need calf-to-cow ratios (90% CI ± 10–20%) and yearling bull-to-cow ratios (90% CI ± 20–30%) to evaluate annual productivity and recruitment. We need total bull-to-cow ratios (90% CI ± 10–20%) to evaluate harvest sustainability.

Using the GSPE estimates, in combination with other data, we need to estimate the total Unit 21D moose abundance to calculate harvest rate and harvestable surplus and assess objectives C1 and C2.

Methods

Beginning in 1999, we conducted population estimation surveys and analyzed data using GSPE (Ver Hoef 2001, 2008; Kellie and DeLong 2006). GSPE surveys were conducted according to methods and in areas described in Stout (2018).

- Based on past results we applied a 70:30 percent ratio of high- to low-density sample units (SU).
- In Unit 21D (in combination with the upper Koyukuk subarea portion of Unit 24D) we conducted high-intensity GSPE surveys (<15% CI; 300–350 SUs) twice during the 5-year period, that included an aerial stratification, and no additional low-intensity GSPE surveys (<20% CI; 275–300 SUs) for those areas during the 5-year period.
- In RY17, a survey was conducted in 1,894 mi^2 of the Kaiyuh Flats subarea of 21D, and in RY18 a survey was conducted in 1,903 mi^2 of the Western Galena subarea of 21D.
- The upper 90% CI of the combined GSPE estimate for the western Galena and Kaiyuh Flats Slough subareas was compared to the management objective of 5,200 observable moose.

Results and Discussion

Density estimates in the western Galena GSPE analysis area of Unit 21D indicated a stable trend through 2019 (Table 1). In 2017 the USFWS classified 2,141 moose during the GSPE survey (covering 1,894 mi^2 in the Kaiyuh Flats subarea). In 2018 we classified 2,424 moose during the GSPE survey (covering 1,903 mi^2 in the Western Galena subarea).

The population estimate for the total survey block calculated from the 2011 survey was not significantly different (95% CI) from the 2001 or 2004 estimates; however, the 2011 point estimate was lower than 2001 and 2004. By combining estimates for individual drawing hunt areas in Unit 21D, I estimated a Unit 21D total population of 8,611 observable moose in RY11. This estimate changed to 8,749 for RY14 due to calculation corrections (Stout 2018). The 21D estimate was revised to 10,478 in RY19 using the survey estimates from 2017 and 2018 (Table 2). Increased abundance in the Kaiyuh Flats subarea accounted for 90% of the increase. The increased moose abundance in the Kaiyuh Flats subarea is likely due to habitat response to wildfires that burned over 500,000 acres in the area since 2000. Anecdotal reports of decreased black bear abundance and the mild winters of 2013–2017 may have also contributed to the increase.

Table 1. Units 21D and 24D aerial moose population estimates, Interior Alaska, regulatory years 1987–2018.

Area	Regulatory year	Area (mi^2)	Bulls: 100 cows	Calves: 100 cows	Yearling bulls: 100 cows	Percent calves	Adults	Population estimate	90% CI[a]	Density (moose/mi^2)
Unit 21D Kaiyuh Flats	1987[b]	1,582	61	46	15	22	1,389	1,790	±18%	1.1
	1997[c]	1,582	42	28	13	17	1,113	1,335	±17%	0.8
	2001[d]	1,843	45	22	9	13	1,558	1,800	±32%	1.1
	2004[d]	1,843	35	43	12	25	1,119	1,487	±10%	0.8
	2011[d]	1,843	31	39	10	23	1,463	1,897	±11%	1.0
	2017[d,e]	1,894	32	50	12	28	3,009	4,116	±10%	2.2
Unit 21D Western Galena	1987[b]	1,508	37	38	12	22	3,220	4,118	±14%	2.7
	1997[c]	1,508	31	32	8	20	2,612	3,250	±12%	2.2
	2001[d]	1,734	27	17	6	12	2,995	3,403	±19%	2.0
	2004[d]	1,841	26	36	11	22	2,564	3,299	±5%	1.8
	2011[d]	1,841	29	25	9	16	2,811	3,360	±7%	1.8
	2018[d]	1,903	26	23	9	15	3,139	3,703	±9%	2.0
Unit 21D Yuki River and Bear Creek	2010[d]	3,516	64	27	10	15	1,477	1,727	±14%	0.5
Unit 24D Upper Koyukuk	2001[d]	1,949	35	18	6	11	3,228	3,642	±16%	1.9
	2004[d]	1,843	33	34	13	20	2,531	3,181	±5%	1.7
	2011[d]	1,843	38	23	9	14	2,249	2,627	±8%	1.4
Total area	1987[b]	3,090	43	40	13	7	4,609	5,908	±15%	1.9
	1997[c]	3,090	34	31	9	18	3,725	4,585	±14%	1.5
	2001[d]	5,526	33	18	7	12	7,849	8,924	±13%	1.6
	2004[d]	5,527	30	37	12	18	6,514	7,967	±4%	1.4
	2011[d]	5,527	32	28	9	17	6,524	7,885	±4%	1.4

[a] CI = confidence interval.
[b] Gasaway survey, MOOSEPOP analysis estimate (Woolington 1998) with sightability correction factor.
[c] Gasaway survey, regression analysis estimate, with sightability correction factor.
[d] Geospatial population estimation survey without sightability correction factor.
[e] Data collected by U.S. Fish and Wildlife Service.

Table 2. Unit 21D moose population estimate by drawing hunt areas, Interior Alaska, regulatory year 2018.

Drawing hunt number	Drawing hunt area	Area (mi^2)	Density estimate (moose per mi^2)	Population estimate[a]
DM816	Yuki River and Bishop Creek[b]	545	1.44	785
	Remainder[c]	1,555	0.37	575
	Subarea total	2,100	–	1,360
DM817	Nulato River and Kaiyuh Flats[b]	612	3.99	2,442
	Remainder[c]	2,329	0.35	815
	Subarea total	2,941	–	3,257
DM818	Papa Willie Slough[b]	360	1.30	468
	Remainder[c]	1,096	0.35	383
	Subarea total	1,456	–	851
DM823–DM830	Koyukuk Controlled Use Area[b]	1,929	1.92	3,703
	Remainder[c]	469	0.35	164
	Subarea total	2,398	–	3,867
DM814, DM815, DM819	Bear Creek Subarea total[c]	916	0.75	687
DM820	Gisasa and Kateel rivers Subarea total[c]	2,283	0.20	456
Unit 21D total		12,094	–	10,478 (±1,572)[d]

[a] Population estimates for each permit area were a combination of population estimation survey data, trend count survey data, and extrapolation data to varying degrees.
[b] Survey block area.
[c] Area that was not part of a survey block; density estimate was extrapolated.
[d] The range on the estimate is not a statistically derived confidence interval. The 15% relative error of ±1,572 moose is a presumed level of uncertainty with no empirical basis.

Recommendations for Activity 1.1

Continue with a GSPE population estimate objective of a block area that combines the western Galena and Kaiyuh Flats subareas in Unit 21D (Table 1). Population estimation surveys in the western Galena and Kaiyuh Flats subareas should be conducted as a high-intensity GSPE survey once every 5 years and at least 2 low-intensity GSPE surveys during that 5-year period. Using the 2001 GSPE point estimate for those 2 areas combined, establish an initial objective of 5,200 moose.

An improved assessment of the harvestable surplus of moose in those high harvest portions of Unit 21D is needed. This would likely require an enhanced understanding of dispersal and movement patterns between areas that are highly accessible and areas that are more removed from access.

ACTIVITY 1.2. Conduct trend count area (TCA) surveys (objectives C1, C2, M2).

Data Needs

Where a GSPE cannot be conducted regularly enough to monitor population trend, trend count surveys will be conducted to monitor change in calf-to-cow, yearling bull-to-cow, and total bull-to-cow ratios. Calf-to-cow and yearling bull-to-cow ratios will assess productivity and recruitment, and total bull-to-cow ratios will assess harvest effects on the population.

We need to assess trends in ratio parameters and conduct a TCA survey annually in the Unit 21D Three Day Slough TCA. In cooperation with USFWS, we need to conduct TCA surveys in Koyukuk River mouth, Dulbi River mouth, Squirrel Creek, Kaiyuh Slough, and Pilot Mountain TCAs.

Methods

Composition data included results of GSPE surveys and TCA surveys. Moose in 6 TCAs (Koyukuk River mouth, Three Day Slough, Dulbi River mouth, Squirrel Creek, Kaiyuh Slough, and Pilot Mountain) were classified as cows, calves, yearling bulls (<30″ antler width and no brow tine definition), medium bulls (≥30″ and <50″ antler width), or large bulls (≥50″ antler width) using methods previously described (Stout 2010). Trend count area surveys were conducted in cooperation with staff from the Koyukuk National Wildlife Refuge during RY15–RY20; TCA surveys were not conducted in RY16 due to poor survey conditions. Assessment of the Koyukuk CUA bull-to-cow ratio was completed by combining the data from the Core-5 TCAs: Koyukuk River mouth, Three Day Slough, and Dulbi River mouth TCAs in Unit 21D, and Huslia Flats and Treat Island TCAs from Unit 21D (Stout 2014).

Guidelines reported by Franzmann and Schwartz (1998) were used to interpret sex and age indices as reported in Stout (2010).

- Ratios of 15 bulls:100 cows are sufficient for breeding (Woolington 1998); however, ratios of 30–40 bulls:100 cows provide for increased harvest or trophy hunting opportunity. High numbers of bulls suggest less hunting pressure in most cases, but Unit 21D is subject to unreported cow harvest, which can inflate bull ratios.

- The calf-to-cow ratio observed during November surveys provides an index to calf survival during the calves' first 5 months. Black bears (*Ursus americanus*), grizzly bears (*U. arctos*), and wolves are the primary predators that reduce calf numbers (Osborne et al. 1991). A November calf-to-cow ratio of 20–40 calves:100 cows may allow a population to remain stable. Calf-to-cow ratios may indicate population change depending on subsequent overwinter mortality. Ratios of <20 calves:100 cows may indicate a decreasing population and ratios of >40 calves:100 cows can be found in growing populations.
- The percentage of yearling bulls within the herd provides an index of the recruitment of young adults to the breeding population. It can also provide an indication of overwinter survival of calves if the calf-to-cow ratio for the previous fall is known. Generally, the yearling bull percentage averages 4–8%, with anything less indicating poor recruitment and anything higher indicating good recruitment.

Results and Discussion

Overall, the moose population trend counts in Unit 21D indicated mostly stable parameters during RY15–RY20 (Tables 3–9). However, calf and yearling counts decreased during this period. The most significant declines in calf-to-cow ratios and yearling bull-to-cow ratios were in the Koyukuk River drainage portion of 21D.

Bull-to-cow ratios were generally stable throughout 21D, with modest improvements in the northern TCAs. The Koyukuk CUA Core-5 TCAs bull-to-cow ratio was near the management objective of 30 bulls:100 cows in RY15 through RY20, likely due to efforts to reduce harvest impacts implemented in the Koyukuk CUA, including reduced permit offerings.

Recommendations for Activity 1.2

Continue annual TCA surveys to evaluate abundance, productivity, survival, recruitment, and sex ratios. Document details of surveys in memorandums and archive in ADFG'S Wildlife Information Network (WinfoNet); keep management reports concise. If USFWS is unable to continue cooperative survey efforts, we will reexamine the viability of this activity.

Table 3. Unit 21D Three Day Slough trend count area aerial moose composition counts, Interior Alaska, regulatory years 2015–2020.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins: 100 cows with calves	Percent calves	Moose	Moose/mi^2
2015	193.6	20	8	36	8	23	801	4.1
2017	193.6	18	8	28	7	19	950	4.9
2018	193.6	20	8	15	5	11	894	4.6
2019	193.6	21	4	21	2	15	870	4.5
2020	193.6	26	7	21	5	14	973	5.0

Note: Surveys used geospatial population estimator sample units (Stout 2004).

Table 4. Unit 21D Dulbi River mouth trend count area aerial moose composition counts, Interior Alaska, regulatory years 2015–2020.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins: 100 cows with calves	Percent calves	Moose	Moose/mi^2
2015	111.1	21	6	47	14	28	450	4.0
2017	111.1	35	13	31	3	19	393	3.5
2018	116.7	24	10	26	4	17	316	2.7
2019	111.1	26	3	21	8	14	298	2.7
2020	111.1	27	6	22	8	15	389	3.5

Note: Surveys used geospatial population estimator sample units (Stout 2004). Data collected by U.S. Fish and Wildlife Service.

Table 5. Unit 21D Koyukuk River mouth aerial moose composition counts, Interior Alaska, regulatory years 2015–2020.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins: 100 cows with calves	Percent calves	Moose	Moose/mi^2
2015	118.8	23	12	41	14	25	607	5.1
2017	118.8	21	10	40	15	25	686	5.8
2018	118.8	19	8	30	10	20	536	4.5
2019	118.8	27	9	33	4	21	577	4.9
2020	118.8	21	7	27	4	18	569	4.8

Note: Surveys used geospatial population estimator sample units (Stout 2004). Data collected by U.S. Fish and Wildlife Service.

Table 6. Unit 21D Squirrel Creek aerial moose composition counts, Interior Alaska, regulatory years 2015–2020.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
2015	90.9	47	21	52	15	26	382	4.2
2017	90.9	27	11	54	15	30	506	5.6
2018	90.9	26	12	44	17	26	461	5.1
2019	90.9	34	9	46	12	26	470	5.2
2020	90.9	27	5	26	2	17	343	3.8

Note: Surveys used geospatial population estimator sample units replaced Gasaway units (Stout 2004). Data collected by U.S. Fish and Wildlife Service.

Table 7. Unit 21D Pilot Mountain Slough aerial moose composition counts, Interior Alaska, regulatory years 2015–2020.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
2015	91.0	15	8	62	16	35	656	7.2
2017	91.0	10	4	56	13	34	637	7.0
2018	91.0	11	7	44	8	29	543	6.0
2019	91.0	15	8	44	6	28	508	6.0
2020	91.0	12	5	33	5	23	544	6.0

Note: Surveys used geospatial population estimator sample units (Stout 2004). Data collected by U.S. Fish and Wildlife Service.

Table 8. Unit 21D Kaiyuh Slough aerial moose composition counts, Interior Alaska, regulatory years 2015–2020.

Regulatory year	Survey area (mi^2)	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
2015	126.3	41	18	60	17	30	355	2.8
2017	126.3	41	15	45	22	24	479	3.8
2018	126.3	37	10	31	8	18	422	3.3
2019	126.3	49	8	28	12	16	493	3.9
2020	126.3	46	5	35	3	20	369	2.9

Note: Surveys used geospatial population estimator sample units (Stout 2004). Data collected by U.S. Fish and Wildlife Service.

Table 9. Unit 21D and Unit 24D (Stout 2014), Koyukuk controlled use area Core-5 aerial moose composition counts combined results, Interior Alaska, regulatory years 2015–2020.

Regulatory year	Survey area (mi^2)	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Twins:100 Cows with calves	Percent calves	Moose	Moose/mi^2
2015	712.6	26	9	39	12	24	3,039	4.3
2017	712.6	26	10	32	10	20	3,292	4.6
2018	712.6	28	10	22	7	15	2,991	4.2
2019	712.6	28	6	21	6	14	2,888	4.1
2020	712.6	30	6	22	6	14	3,066	4.3

Note: Surveys used geospatial population estimator sample units replaced (Stout 2004). Data collected by ADF&G and U.S. Fish and Wildlife Service.

ACTIVITY 1.3. Conduct spring twinning surveys in Unit 21D (objectives C1, C2, M1).

Data Needs

Twinning surveys need to be conducted to collect twinning rate data, which serve as indicators for body condition and productivity of cows. An assessment of body condition and productivity is integral to management on a sustained yield basis for the long term and for the goal of protecting moose habitat.

Methods

Beginning in 1990, twinning surveys were conducted to determine the proportion of moose calf twins among all cows with calves in the areas of Three Day Slough and Dulbi River mouth, Kaiyuh Flats and Pilot Mountain Slough, and Natlaratlen River and Bear Creek. During RY15-RY19, these surveys were conducted in cooperation with staff from the Koyukuk National Wildlife Refuge. Aerial twinning surveys consisted of parallel transects flown by experienced pilots at approximately ¼-mile intervals at ≤500 feet above ground level in a PA-18 or similar aircraft. Our goal was to observe at least 50 cows with calves (Boertje et al. 2007) in each area, but funding and weather sometimes prevented us from achieving that goal. Moose were classified as bull, yearling, calf, cow, cow with 1 calf, or cow with 2 or more calves. Timing was critical; surveys were flown in late May within a few days of the presumed median calving date (Boertje et al. 2007), when approximately 50% of the cows observed had calves. This avoided early mortality factors such as predation, which could lead to underestimating twinning rates. Twinning rate was calculated as the proportion of cows with more than 1 calf from a sample of all cows with calves. In Unit 21D an assessment of annual calf productivity and potential mortality factors was completed using spring twinning rates, reported parturition rates (Boertje et al. 2007), and fall calf-to-cow ratios.

Results and Discussion

Moose twinning rates during RY15–RY19 (5-year averages of 31% in Three Day Slough and Dulbi River mouth; 32% in Kaiyuh Flats and Pilot Mountain; and 30% in Natlaratlen River and Bear Creek) suggest above average nutritional status (Boertje et al. 2007) and productivity in those areas of Unit 21D (Tables 10–12).

Recommendations for Activity 1.3

Continue twinning surveys in Unit 21D annually and evaluate abundance, body condition, and productivity. Document details of surveys in memorandums and archive in WinfoNet; keep management reports concise. GSPE surveys, TCA surveys, and twinning surveys should continue to be outlined as independent activities in the plan.

Table 10. Unit 21D moose aerial twinning surveys in the Three Day Slough and Dulbi River mouth areas, Interior Alaska, regulatory years 2015–2019.

Regulatory year	Cows without calves	Cows with 1 calf	Cows with twins	Twinning %[a]	Yearlings	Dates in May
2015	58	34	17	33	29	24–25
2016	63	37	15	29	18	24–25
2017	105	39	11	22	44	25–26
2018	69	44	19	30	14	24–25
2019	60	30	21	41	18	25–27

[a] Percent of cows with calves that had 2 or more calves.

Table 11. Unit 21D moose aerial twinning surveys in the Pilot Mountain Slough and Kaiyuh Flats areas, Interior Alaska, regulatory years 2015–2019.

Regulatory year	Cows without calves	Cows with 1 calf	Cows with twins	Twinning %[a]	Yearlings	Dates in May
2015	73	37	21	36	45	23–25
2016	61	34	29	46	25	23–24
2017	100	50	19	28	32	24–25
2018	80	57	30	34	35	24, 25, 28
2019	84	73	16	18	15	23–25

Note: Data collected by U.S. Fish and Wildlife Service.
[a] Percent of cows with calves that had 2 or more calves.

Table 12. Unit 21D moose aerial twinning surveys in the Natlaratlen River and Bear Creek areas, Interior Alaska, regulatory years 2015–2019.

Regulatory year	Cows without calves	Cows with 1 calf	Cows with twins	Twinning %[a]	Yearlings	Dates in May
2015	103	34	19	36	35	24, 26
2016	71	44	23	34	25	23–25
2017	83	39	14	26	27	24–27
2018	92	45	18	29	30	24–26
2019	42	40	14	26	19	25–27

Note: Data collected by U.S. Fish and Wildlife Service.
[a] Percent of cows with calves that had 2 or more calves.

ACTIVITY 1.4. Research age structure modeling techniques and determine whether harvested bull moose tooth-age data and aerial survey data from the Koyukuk CUA can be used to construct an age structure analysis in Unit 21D, in combination with the Unit 24D portion of the Koyukuk CUA (objectives C1, C2, C3, M1).

Data Needs

Using hunter-harvested moose teeth ages and survey data, we need to construct an age structure analysis of the moose population to evaluate annual contribution of individual cohorts to the harvestable surplus and estimate abundance. An age structure analysis is needed to supplement a lack of aerial survey data in years of fiscal constraints or poor survey conditions. Age structure analysis can also help refine the assessment of aerial moose surveys that were conducted.

Methods

With biometric and research staff assistance, research age structure modeling techniques and analyze moose age data from hunter-killed moose. Investigate funding options and contracting services to complete this analysis.

Results and Discussion

No progress was made on developing an age structure population estimate during the reporting period. However, a preliminary effort was initiated to collect genetic materials from archived teeth to determine if a close-kin mark–recapture population estimate could be modeled (Bravington et al. 2016). That effort is ongoing.

Moose age data was used to explain to hunters that there was a temporary shift within the population age structure to a greater proportion of younger animals. Fall aerial survey data and harvested moose age data corroborated with one another, helping to explain this shift. Although the RY16–RY18 large bull age class abundances were below the RY01–RY20 average, the trend was reversed by the strong cohorts of yearling and medium bulls that were recruited into the large-sized age classes by RY19 (Fig. 1). Large bulls are those bulls we estimate to have overall antler widths greater than 50 inches; medium bulls are the remaining bulls with antler widths less than 50 inches, not including yearlings.

Recommendations for Activity 1.4

Continue this activity.

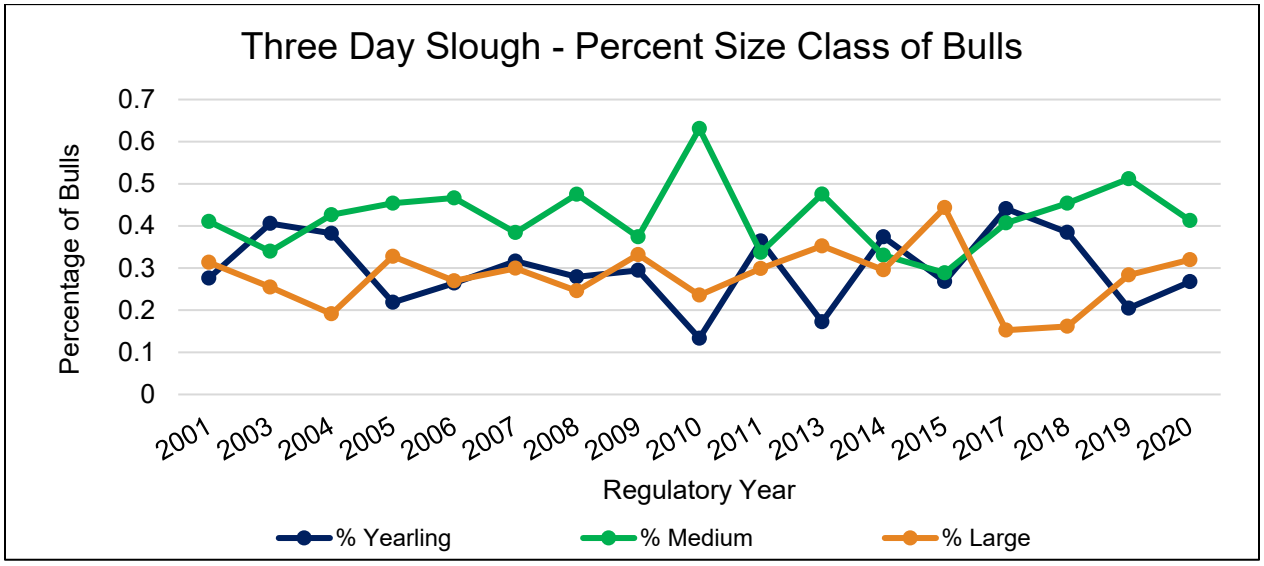

Figure 1. Unit 21D percentage of bulls among three size (age) classes observed during aerial surveys in the Three Day Slough Trend Count Area (TCA) from regulatory years 2001–2020.

2. Mortality-Harvest Monitoring and Regulations

ACTIVITY 2.1 In combination with the Koyukuk CUA portion of Unit 24D, monitor hunter use levels in the Koyukuk River drainage portion of Unit 21D (objectives C1, C3, M3, M4).

Data Needs

Harvest estimates are needed to establish that harvest of the moose does not exceed sustained yield in the Koyukuk River drainage in the northern portion of Unit 21D, because historically nearly 70% of the Unit 21D annual harvest occurs in that portion. Harvest data are compiled and added to a moose database in WinfoNet annually, to be used for assessing trends in harvest. The number of moose harvested, harvest location, and hunter effort are critical elements needed to assess harvest trends and corroborate aerial survey observations.

Methods

Hunting mortality and harvest distribution were monitored through the statewide harvest monitoring system, including registration and drawing permit reports, door-to-door subsistence surveys, and a hunter checkstation on the Koyukuk River. Hunters with registration or drawing permits received 1 or 2 reminder letters and usually an e-mail and telephone call if we did not receive timely harvest reports. Report and survey information were used to determine total harvest, harvest locations, hunter residency and success, sex of animals harvested, harvest chronology, and transportation used.

An estimate of the unreported harvest was based on past ADF&G Subsistence Division reports (Andersen et al. 1998; Brown et al. 2004), previous management reports (Osborne 1996) and public interviews (Table 13). The largest portion of the unreported estimate was calculated proportionally, using subsistence harvest estimates (Andersen et al. 1998; Brown et al. 2004) and report card numbers from the same years. Estimated 4-year averages for unreported harvest in RY96–RY99, RY01, and RY02 were 92% in Kaltag and 47% in Nulato. An estimated 6-year average for unreported harvest in Galena was calculated at 42%. For the total Unit 21D harvest, the weighted average was 56% unreported harvest by local residents. For nonlocal resident and nonresident hunters, the unreported harvest was estimated at 17.7% (Gasaway et al. 1992). On an annual basis, information about additional unreported harvest was also obtained incidentally through hunter contacts, phone interviews, state trooper reporting, or public reports. In RY08 the total estimated unreported harvest was approximated to be 150 moose. Since that time, Unit 21D has become all drawing and registration permit hunts with more stringent reporting requirements. As a result, I reduced the estimated unreported harvest to 125 moose in RY10 to better reflect current trends. For RY15–RY19, data for ceremonial and potlatch harvest was incorporated in the estimate. Known harvest for those uses for each year was subtracted from the 125 constant used for estimated unreported moose harvest (Table 13).

Results and Discussion

Harvest by Hunters

Harvest of moose in Unit 21D during RY15–RY19 was mostly stable, except for a slight drop observed in RY19, which was assumed to be related to poor fall hunting conditions (Tables 13–15). Hunting pressure relative to harvestable surplus in the Koyukuk River mouth and Pilot

Mountain Slough areas remained high and likely led to suppressed bull-to-cow ratios in those areas. Cow harvest was reported during RY18–RY19, during the new March hunt in the Kaiyuh Flats portion of Unit 21D. Illegal cow harvest during winter continues to be a concern. Potlatch, stickdance, and ceremonial moose harvest also included cows.

During RY15–RY19, an average of 58% of the Unit 21D harvest was in the Koyukuk River drainage in the northern portion of Unit 21D (Table 16). This was down from the RY10–RY14 reporting period when 67% of the harvest was in the river drainage in the northern portion of Unit 21D. Increasing moose abundance in the southern portion of 21D has benefited hunters in that area.

Table 13. Unit 21D moose harvest, Interior Alaska, regulatory years 2015–2019.

Regulatory year	Harvest by hunters				Unreported harvest[a]	Potlatch/ stickdance[b]	Total
	Bull	Cow	Unk	Total			
2015	315	1	1	317	111	14	442
2016	278	0	0	278	119	6	403
2017	318	0	0	318	116	9	443
2018	287	8	1	296	113	12	419
2019[c,d]	238	11	0	249	120	5	374

[a] Unreported harvest based on ADF&G Division of Subsistence door-to-door surveys and other sources.
[b] Includes all potlatch, stickdance, ceremonial, and cultural permit harvest.
[c] Preliminary data.
[d] COVID-19 related impacts began in February 2020.

Table 14. Koyukuk River checkstation moose harvest in Units 21D and 24, Interior Alaska, regulatory years 2015–2019.

Regulatory year	Number of bulls	Number of cows	Percentage of cows	Total harvest
2015	236	1	<1	237
2016	216	1	0	217
2017	246	0	0	246
2018	205	0	0	205
2019	150	0	0	150

Table 15. Koyukuk River checkstation moose hunter residency and success, Interior Alaska, regulatory years 2015–2019.

Regulatory year	Local resident[a]		Nonlocal resident[b]		Nonresident		Total	
	Hunters	Moose	Hunters	Moose	Hunters	Moose	Hunters	Moose
2015	211	111	205	119	10	7	426	237
2016	224	101	208	108	11	8	443	217
2017	218	108	217	132	11	6	446	246
2018	232	100	182	97	10	8	424	205
2019	190	70	191	76	4	1	385	147

Note: This table includes hunter reports from both Units 21D and 24, including Huslia.
[a] Local residents include those who live in Units 21B, 21D, or 24.
[b] Includes residents of Alaska that do not live in Units 21B, 21D, or 24.

Table 16. Distribution of reported moose harvest in Unit 21D, Interior Alaska, regulatory years 2015–2019.

	Percent of harvest		
Regulatory year	Northern Unit 21D[a]	Southern Unit 21D[b]	Total harvest
2015	60	40	316
2016	61	39	273
2017	64	36	316
2018	56	44	291
2019[c]	46	54	244

[a] Northern 21D refers to the portion of Unit 21D north of the Yukon River, including the Koyukuk River drainage.
[b] Southern 21D refers to the portion of Unit 21D including the Yukon River and the remainder of Unit 21D south of the Yukon River.
[c] Preliminary data.

Hunter Residency and Success

Hunter residency and success can be misleading because Unit 21D residents historically did not report unsuccessful hunt information reliably (Table 17; Stout 2012a). Harvest and hunter participation by Unit 21D residents during RY15–RY19 was relatively constant. Unit 21D local hunter success rates averaged 41% in RY15–RY19. Average success rate was 51% for nonlocal residents and 55% for nonresident hunters during RY15–RY19.

Harvest Chronology

There were no apparent changes in harvest chronology during RY15–RY19 (Table 18). However, about 20% of the estimated annual harvest probably occurred during winter as unreported harvest. Much of the unreported harvest was likely taken during October–March (Andersen et al. 1998; Brown et al. 2004).

Transport Methods

Due to the area's extensive river system, and the prohibition of personal aircraft within the Koyukuk CUA during moose hunting season, boats were the primary transportation method during RY15–RY19 (Table 19). These patterns have changed little since 1980.

Table 17. Unit 21D moose hunter residency and success, Interior Alaska, regulatory years 2015–2019.

	Successful					Unsuccessful					
Regulatory year	Local[a] resident	Nonlocal[b] resident	Nonresident	Unk	Total	Local[a] resident	Nonlocal[b] resident	Nonresident	Unk	Total	Total hunters
2015	141	162	14	0	317	192	153	6	0	351	668
2016	124	143	11	0	278	184	134	10	1	329	607
2017	131	179	8	0	318	151	138	15	1	305	623
2018	132	132	21	0	285	188	157	14	0	359	644
2019[c]	91	130	14	0	235	175	142	11	1	329	564

[a] Unit 21D and Ruby residents only.
[b] Includes residents of Alaska that do not live in Units 21B, 21D, or 24.
[c] Preliminary data.

Table 18. Unit 21D moose harvest chronology percent by date range, Interior Alaska, regulatory years 2015–2019.

	Percent of harvest			
Regulatory year	22–31 August	1–14 September	15–25 September	Total moose
2015	2	40	58	316
2016	3	34	64	272
2017	3	32	64	317
2018	3	37	60	284
2019[b]	5	25	70	233

[b] Preliminary data.

Table 19. Unit 21D moose harvest percent by transport method, Interior Alaska, regulatory years 2015–2019.

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV[a]	Highway vehicle	Unknown	Total moose
2015	2	0	92	3	0	0	0	6	316
2016	3	0	92	2	0	1	1	3	277
2017	1	0	93	3	0	1	0	6	316
2018	2	0	90	1	0	1	2	6	283
2019[b]	3	0	88	5	0	1	2	4	233

[a] ORV = off-road vehicle.
[b] Preliminary data.

Other Mortality

Wolves and black bears were common throughout Unit 21D. Grizzly bears were common in the uplands of the Nulato Hills and Kaiyuh Mountains. Wolves and grizzly bears prey on both calves and adult moose. Hunters continued to report increased observations of grizzly bears during the fall moose season. Anecdotal reports by Unit 21D residents also suggested grizzly bears were increasing and becoming more common intruders at fish camps. Black bears were shown to kill more than 40% of moose calves (<5-months-old) annually in Unit 21D (Osborne et al. 1991).

Recommendations for Activity 2.1

Continue this activity.

Activity 2.2. Operate the Koyukuk River checkstation (objectives C1, C3, M3, M4).

Data Needs

Like activity 2.1, harvest data are compiled and added to a moose database in WinfoNet annually for assessing trends in harvest. However, because reporting by hunters is lower among rural communities, additional effort is needed to collect those data, and the checkstation is an established public contact site where comprehensive reporting can be accomplished.

Methods

We operated the Koyukuk River moose hunter checkstation annually during the RY15–RY19 reporting period. Moose teeth were collected at the checkstation for age determination. Hunt information and hunter education opportunities were provided at the checkstation (e.g., meat care, landownership, moose biology, predator-prey interactions, reporting procedures). Harvest reports were collected from most hunters at the checkstation. Additional data collected at the checkstation included time in the field, hunting party size, age structure of harvest (tooth extraction), department-measured antler size, a more precise location of harvest (when needed), and caliber of firearm used. Moose ages were determined by counting cementum annuli of the lower incisors from hunter-harvested bull moose (Gasaway et al. 1978; Matson et al. 1993). Harvest data were summarized by regulatory year.

- Hunters were issued permits and provided with information on moose management, moose biology, and hunt regulations specific to the Koyukuk CUA.
- We measured antler morphology using the 7 standard measurements described by the Boone and Crocket Club for scoring moose antlers (https://www.boone-crockett.org/bgRecords/bc_scoring_moose.asp?area=bgRecords&type=Moose), as well as the count of left and right brow points. We recorded antler data on the data form in Appendix A.
- One of the 2 incisors (I_1 or I_2) was extracted and attached by a wire to the antler measurement data form.
- We recorded hunter information on the data form in Appendix B.
- We recorded hunter check-in on the data form in Appendix C.
- Responses to hunter attempts to call-in moose were recorded on the data form in Appendix D.

Results and Discussion

Harvest by Hunters

Three regulations monitored closely at the checkstation were antler width for antler restricted hunts, salvage of meat, and destruction of trophy value of bulls harvested under subsistence registration permits. The regulation requiring meat to be left on the bone improved enforcement efforts to stop waste of moose meat. This regulation was adopted by the Board of Game in 1992 to address the increase of moose hunters in the Koyukuk CUA and the perceived problem of some hunters removing only part of the meat from the carcass so they could carry lighter loads in their boats. At the checkstation, all hunters were notified of this regulation when we issued their permits and checked for compliance upon departure from the hunt area. Destruction of the trophy value of antlers at the checkstation was a controversial regulation when applied and seldom resulted in a positive public contact for the department when it was implemented. Beginning in RY00 hunters were required to cut the antlers at the kill site, which improved that aspect of hunter contact at the checkstation.

Total hunter success rates in the Koyukuk CUA were stable (average 54.6%) during RY15–RY19. Harvest success in the fall hunt during RY15–RY19 was high for nonlocal residents (average 59.5%) and nonresidents (average 66.0%), but local resident success was lower (average 49.7%). This was likely because many local hunting parties consisted of several family members who all obtained permits, but not all permit holders intended to harvest their own moose.

The Koyukuk CUA area is well known as an excellent area to hunt for large (≥50-inch antlers) moose. Of the bulls observed in the Koyukuk CUA TCAs surveyed during RY15–RY19, 28.5% had large antlers. During RY15–RY19, 36.4% of the harvested bulls measured in Koyukuk CUA permit hunts had large antlers (Table 20).

Permit Hunts

The subsistence registration permit that required antler destruction (RM832) was the permit used most by resident Alaskans to hunt within the Koyukuk CUA (Table 19). With the implementation of drawing hunts in the remainder of Unit 21D beginning in 2004 (Tables 21 and 22), hunter numbers were better regulated and distribution of hunters improved. Nonresidents and residents who did not want to destroy the trophy value of their bull moose could apply for a limited drawing permit.

Recommendations for Activity 2.2

We will continue to operate the Koyukuk River checkstation.

Table 20. Large bull moose (≥50 inch antler spread) harvested in the Koyukuk Controlled Use Area, and observed in the Koyukuk Core-5 trend count areas, Interior Alaska, regulatory years 2015–2019.

	Bull moose with ≥50 inch antler spread			
	Koyukuk Controlled Use Area hunting season (September)		Koyukuk Core-5 trend count areas[a] aerial surveys (November)	
Regulatory year	% of total harvest	Number measured	% of total observed	Number counted
2015	51	102	40	190
2016	41	78	_[b]	_[b]
2017	31	64	22	118
2018	29	47	20	116
2019	30	36	32	174

[a] Data includes Koyukuk River Mouth, Three Day Slough, Dulbi River Mouth, Huslia Flats, and Treat Island trend count areas (Stout 2012b).
[b] No survey.

Table 21. Units 21D and 24 within Koyukuk Controlled Use Area, moose harvest by permit hunt, Interior Alaska, regulatory years 2015–2019.

Hunt	Regulatory year	Permits issued	Percent successful hunters[a]	Percent unsuccessful hunters[a]	Percent did not hunt	Bulls (%)		Cows (%)		Unk	Total harvest
RM832	2015	427	54	46	7	216	(100)	1	(0)	0	217
	2016	392	55	45	10	193	(100)	0	(0)	0	193
	2017	396	59	41	5	220	(100)	0	(0)	0	220
	2018	374	54	46	10	183	(100)	0	(0)	0	183
	2019[c]	334	46	54	9	141	(100)	0	(0)	0	141
DM823	2015	2	50	50	0	1	(100)	0	(0)	0	1
	2016	2	100	0	0	2	(100)	0	(0)	0	2
	2017	2	50	50	0	1	(100)	0	(0)	0	1
	2018	2	100	0	0	2	(100)	0	(0)	0	2
	2019[c]	1	0	100	0	0	(100)	0	(0)	0	0
DM825	2015	3	100	0	33	2	(100)	0	(0)	0	2
	2016	3	66	33	0	2	(100)	0	(0)	0	2
	2017	3	100	0	0	3	(100)	0	(0)	0	3

Hunt	Regulatory year	Permits issued	Percent successful hunters[a]	Percent unsuccessful hunters[a]	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
	2018	3	100	0	0	3 (100)	0 (0)	0	3
	2019[c]	1	100	0	0	1 (100)	0 (0)	0	1
DM827	2015	3	33	67	0	1 (100)	0 (0)	0	1
	2016	3	67	33	0	2 (100)	0 (0)	0	2
	2017	3	33	67	0	1 (100)	0 (0)	0	1
	2018	3	67	33	0	2 (100)	0 (0)	0	2
	2019[c]	1	0	0	100	0 (100)	0 (0)	0	0
DM828	2015	20	63	37	60	5 (100)	0 (0)	0	5
	2016	20	62	38	35	8 (100)	0 (0)	0	8
	2017	20	67	33	40	8 (100)	0 (0)	0	8
	2018	20	44	56	55	4 (100)	0 (0)	0	4
	2019[c]	10	100	0	60	4 (100)	0 (0)	0	4
DM829	2015	2	100	0	0	2 (100)	0 (0)	0	2
	2016	2	0	100	50	0 (100)	0 (0)	0	0
	2017	2	0	100	50	0 (100)	0 (0)	0	0
	2018	2	100	0	50	1 (100)	0 (0)	0	1
	2019[b]	1	0	0	100	0 (100)	0 (0)	0	0
DM830	2015	20	67	33	25	10 (100)	0 (0)	0	10
	2016	20	64	36	30	9 (100)	0 (0)	0	9
	2017	20	81	19	20	13 (100)	0 (0)	0	13
	2018	20	59	41	15	10 (100)	0 (0)	0	10
	2019[b]	10	50	50	60	2 (100)	0 (0)	0	2
Total	2015	477	55	45	10	237 (100)	1 (0)	0	238
	2016	442	56	44	12	216 (100)	0 (0)	0	216
	2017	446	60	40	8	246 (100)	0 (0)	0	246
	2018	424	55	45	12	205 (100)	0 (0)	0	205
	2019[b]	358	47	53	12	148 (100)	0 (0)	0	148

[a] Percent successful and percent unsuccessful were calculated using the total number of hunters who completed their report cards with enough information to determine whether they harvested a moose.
[b] Preliminary data.

Table 22. Unit 21D outside the Koyukuk controlled use area, moose harvest by permit hunt, Interior Alaska, regulatory years 2010–2015.

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)		Cows (%)		Unk	Total harvest
DM814	2015	16	46	54	19	6	(100)	0	(0)	0	6
	2016	16	75	25	50	6	(100)	0	(0)	0	6
	2017	16	62	38	19	8	(100)	0	(0)	0	8
	2018	16	45	55	31	5	(100)	0	(0)	0	5
	2019[a]	16	50	50	38	5	(100)	0	(0)	0	5
DM815	2015	2	100	0	50	1	(100)	0	(0)	0	1
	2016	2	0	0	100	0	(100)	0	(0)	0	0
	2017	2	50	50	0	1	(100)	0	(0)	0	1
	2018	2	50	50	0	1	(100)	0	(0)	0	1
	2019[a]	2	0	100	0	0	(100)	0	(0)	0	0
DM816	2015	25	71	29	32	12	(100)	0	(0)	0	12
	2016	25	38	63	68	3	(100)	0	(0)	0	3
	2017	25	50	50	36	8	(100)	0	(0)	0	8
	2018	25	56	44	28	10	(100)	0	(0)	0	10
	2019[a]	25	68	32	24	13	(100)	0	(0)	0	13
DM817	2015	24	42	58	50	5	(100)	0	(0)	0	5
	2016	31	47	53	45	8	(100)	0	(0)	0	8
	2017	27	54	46	52	7	(100)	0	(0)	0	7
	2018	31	57	43	55	8	(100)	0	(0)	0	8
	2019[a]	31	50	50	55	7	(100)	0	(0)	0	7
DM818	2015	20	60	40	50	6	(100)	0	(0)	0	6
	2016	13	78	22	31	7	(100)	0	(0)	0	7
	2017	9	33	67	67	1	(100)	0	(0)	0	1
	2018	17	90	10	41	9	(100)	0	(0)	0	9
	2019[a]	25	74	26	24	14	(100)	0	(0)	0	14

Hunt	Regulatory year	Permits issued	Percent successful hunters	Percent unsuccessful hunters	Percent did not hunt	Bulls (%)	Cows (%)	Unk	Total harvest
DM819	2015	0	0	0	0	0 (0)	0 (0)	0	0
	2016	0	0	0	0	0 (0)	0 (0)	0	0
	2017	0	0	0	0	0 (0)	0 (0)	0	0
	2018	0	0	0	0	0 (0)	0 (0)	0	0
	2019[a]	0	0	0	0	0 (0)	0 (0)	0	0
DM820	2015	15	43	57	53	3 (100)	0 (0)	0	3
	2016	15	17	83	60	1 (100)	0 (0)	0	1
	2017	15	25	75	47	2 (100)	0 (0)	0	2
	2018	15	50	50	60	3 (100)	0 (0)	0	3
	2019[a]	15	67	33	80	2 (100)	0 (0)	0	2

[a] Preliminary data.

Activity 2.3. Monitor harvest in Unit 21D (objectives C1, C3, M3, M4).

Data Needs

Like activities 2.1 and 2.2, harvest data in WinfoNet need to be updated annually to assess trends in harvest. However, because reporting by hunters among rural communities is lower than urban hunters, additional effort is needed to collect those data.

Methods

Harvest objectives are evaluated on an annual basis. The estimated harvest includes the reported harvest plus an additional 125 moose (minus reported ceremonial, potlatch or stickdance harvest) to adjust for the unreported harvest. The estimated unreported harvest is based on Subsistence Division household surveys, historical management reports, and any other sources that may contribute to developing a total harvest estimate. The 125 moose adjustment is meant to ensure the population is managed conservatively. The annual estimated harvest is compared to the lower range of the IM objectives and the point values of the management objectives. We cooperate with Nulato, Kaltag, and Koyukuk community permit vendors to distribute and collect harvest report cards.

Using the Unit 21D moose population estimate and the estimated total harvest, we assess harvest rate and harvestable surplus. Bull-to-cow ratios complement the assessment and decision framework. Management decisions are developed conservatively due to the lack of broad population estimates and poor harvest reporting. In general, if harvestable surplus calculations suggest additional opportunity, but the 5-year trend in bull-to-cow ratios is simultaneously declining, conservative harvest levels and interpretations of the data are adopted and deference given to the bull-to-cow ratios. Furthermore, if harvestable surplus calculations suggest decreasing opportunity but the bull-to-cow ratio 5-year trend is increasing, deference is given to the harvestable surplus calculation.

Results and Discussion

Harvest data and checkstation results are found in Tables 13–22. Reporting by local residents continues to be an area for improvement. Permit vendors in the rural communities are an important resource for the department and provide the clearest opportunity for improving local reporting. Updated Subsistence Division household surveys are needed to reassess the unreported harvest and determine if there has been a change in reporting since drawing and registration permit hunts were implemented for all hunts in Unit 21D in 2004.

Recommendations for Activity 2.3

Continue this activity with modification, by developing a decision framework that assesses harvest rates, harvestable surplus, and incorporates bull-to-cow ratios. The decision framework must prescribe a conservative strategy due to infrequent population estimates in Unit 21D and the generally poor harvest reporting rates. Clarify the activity to emphasize collection of harvest data and improve reporting from the communities of Kaltag, Nulato, and Ruby.

3. Habitat Assessment-Enhancement

No habitat assessment activities were conducted during RY15–RY19.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Data Recording and Archiving

- Potlatch, ceremonial, and cultural and education permit harvest data were recorded and stored in the office file cabinets of the Galena area biologist, and electronic copies of those memos are stored on the hard drive of the Galena area biologist in the moose harvest files.
- Moose survey records and memos are stored in the office file cabinets of the Galena area biologist, and electronic copies of those memos are stored on the hard drive of the Galena area biologist in the moose survey files. GSPE/TCA Moose Survey Form (Stout, 2018; Appendix A).
- Stratification Flight Survey Form (Stout 2018; Appendix B).
- Moose Twinning Survey Form (Stout 2018; Appendix C).

Global Position System (GPS) location data were logged using WGS 84 datum. GPS files are stored on the Galena area biologist hard drive D:/Moose/Surveys/[year]. Files were saved using MapSource (Garmin Ltd., 2008, Ver. 6.13.7) as *.gpx files. Alternatively, location data for analysis and mapping used ArcGIS (ESRI 2013. ArcGIS Pro: Release 10.2.2. Redlands, California: Environmental Systems Research Institute) and are stored on the Fairbanks Regional DWC hard drive, S:/Stout/Moose/[year]. Memos and data files were archived in the data archive tool in WinfoNet. The D drive of the Galena area biologist's hard drive is backed up weekly onto the area biologist's H network drive.

Hard copies of moose management reports and plans and intensive management operational plans are stored in the Fairbanks Regional Office Library and online at http://www.adfg.alaska.gov/index.cfm?adfg=librarypublications.wildlifemanagement. Memos, data forms, and additional hard copies are stored in the Galena area biologist files in the Fairbanks and Galena offices.

Electronic copies of data, GPS location data, memos, and reports are stored in the WinfoNet – Data Archive | Project Title: Moose Management Program | Project ID: GMU 21D | Primary Region: Region III.

Agreements

None.

Permitting

None.

Conclusions and Management Recommendations

Moose were relatively numerous in the riparian lowlands of Unit 21D during RY15–RY19. While the moose population may have increased in the 21D subarea south of the Yukon River during this reporting period, numbers were stable or declining in northern Unit 21D based on GSPE and TCA surveys. Cow numbers in TCAs throughout the unit continue to be closely monitored. We recommend at least 1 high-intensity GSPE survey and at least 2 low-intensity GSPE surveys every planning period in the high-density areas of the western Galena subarea portion of Unit 21D. Those surveys will be conducted in combination with the upper Koyukuk subarea portion of Unit 24D to assess the population management objective (Ver Hoef 2001, 2008; Kellie and DeLong 2006). Since RY15, high productivity in the form of high twinning rates was likely an important factor in stabilizing the population in Unit 21D.

The key management issues facing Unit 21D during RY15–RY19 continued to be 1) cow harvest, 2) evaluation of harvest success rates, and 3) reallocation of harvest from state-qualified hunters to local federally-qualified subsistence hunters.

The decline in bull-to-cow ratios within the Koyukuk CUA indicated harvest may have been too high during RY10–RY13, so drawing permits were reduced in RY14 through RY20 and the bull-to-cow ratio has been gradually improving since 2013. Bull-to-cow ratios appear to offer a more sensitive metric to assess harvestable surplus than population estimates and prescribed harvest rates. Therefore, monitoring and maintaining robust bull-to-cow ratios will improve fall harvest success rates by local hunters. High fall success rates translate to reduced need for winter harvest and a decreased harvest of cows, because historical harvest data suggests 75% of the winter harvest are cows. Cow harvest must decrease in northern Unit 21D if we are to achieve our population management objectives of observable moose.

In the 21D management plan for RY15–RY19, I recommended a change to the population objective by combining the Kaiyuh Flats and Western Galena subareas and set the combined objective for an estimate of 5,200 observable moose. The combined estimate for the Kaiyuh Flats and Western Galena subareas was 7,819 moose (90% CI = 7,074–8,564 moose), therefore we met the objective. The intensive management (IM) population objective of 7,000–10,000 moose in 21D overall was likely achieved, because the midpoint of the estimate (10,478 moose) exceeded the lower range value (7,000 moose). The objective to provide for a harvest of moose not to exceed 700 moose or 7% of the population was met. Estimated total harvest during RY15–RY19 averaged 416 moose including the estimate of unreported harvest (highest = 443 in RY17, lowest = 374 in RY19), which equaled a harvest rate of 3.6–4.2% of the estimated 10,478 observable moose. A harvest rate of 5% of the estimated population of 10,478 (±1,572) observable moose would have provided a harvestable surplus of 445–602 moose. The IM annual harvest objective of 450–1,000 moose was likely not achieved during RY15–RY19, although the harvestable surplus was sufficient to meet the lower limit. The objective to provide for moose hunting opportunity, not to exceed 950 hunters per regulatory year, was achieved with a total of 668 hunters in RY15 being the highest number of hunters during the reporting period. The Unit 21D harvestable surplus of 445 moose, added to the harvestable surplus of the remaining subunits of Unit 21 was 650 moose (21A = 120, 21B = 95, 21C = 45, 21E = 390; total = 1,095 moose), therefore the ANS objective (600) was met.

The management objective of a bull-to-cow ratio of 30 bulls:100 cows in the Koyukuk CUA Core-5 TCAs was likely met in RY20, but only averaged 27.6 bulls:100 cows during RY15–RY20 (highest = 30 in RY20, lowest = 26 in RY15). The bull-to-cow ratio was below objective in RY15–RY19. Drawing permits in the Koyukuk CUA were reduced to 24 permits in RY19, in an attempt to meet that objective.

II. Project Review and RY20–RY24 Plan

Review of Management Direction

MANAGEMENT DIRECTION

There are no new management plans or changes in management direction.

GOALS

G1. Manage moose in the Koyukuk River drainage on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

C1. Unit 21 has a positive finding for customary and traditional uses for moose and amounts reasonably necessary for subsistence uses of 600–800 moose from the unitwide population on an annual basis.

   a. To evaluate this objective, the Unit 21D population estimate (lower range approximation) will be multiplied by a 5% harvest rate and added to the derived harvestable surplus estimates of the remaining subunits of Unit 21 and compared to the minimum level (600) of the amounts reasonably necessary for subsistence.

Intensive Management

C2. Population objective: 7,000–10,000 moose.

   a. To evaluate this objective, the midpoint of the 21D population estimate will be compared to the lower value of the IM population objective.

C3. Harvest objective: 450–1,000 moose.

MANAGEMENT OBJECTIVES

Existing management objectives will not be changed:

M1. Maintain a moose population of 5,200 observable moose in the Kaiyuh Flats and western Galena combined subareas.

M2. Maintain 30 bulls:100 cows in the Koyukuk CUA Core-5 TCAs.

M3. Provide for a harvest of moose not to exceed 700 moose or 7% of the annual moose population estimate each regulatory year.

M4. Provide for moose hunting opportunities not to exceed 950 hunters per regulatory year.

REVIEW OF MANAGEMENT ACTIVITIES

An estimate of observable moose for the Unit 21D total area will be calculated using a combination of GSPE estimates, TCA trend data, and extrapolated densities of moose (based on known densities in similar habitat for the unsurveyed portions of Unit 21D).

1. Population Status and Trend

ACTIVITY 1.1. Conduct geospatial population estimation (GSPE) surveys (objectives C1, C2, C3, M1).

Data Needs

A statistical estimate is needed to evaluate whether the objective to maintain a combined population of 5,200 observable moose in the western Galena and Kaiyuh Flats areas is achieved. An improved assessment of the harvestable surplus of moose high harvest portions of Unit 21D is needed.

In cooperation with the U.S. Fish and Wildlife Service (USFWS), we need to conduct high-intensity GSPE surveys once and low-intensity GSPE surveys twice during each 5-year reporting period, and we need to estimate abundance (90% CI <15%) to evaluate population status. We need calf-to-cow ratios (90% CI ± 10–20%) and yearling bull-to-cow ratios (90% CI ± 20–30%) to evaluate annual productivity and recruitment. We need total bull-to-cow ratios (90% CI ± 10–20%) to evaluate harvest sustainability.

Using the GSPE estimates, we need to estimate the total Unit 21D moose abundance to calculate harvest rate and harvestable surplus and assess objectives C1 and C2.

Methods

GSPE surveys are described in this document (see "I. RY15–RY19 Management Report | Management Activities | 1. Population Status and Trend | Activity 1.1 | Methods"; Kellie and DeLong 2006).

- Maintain 70:30 percent ratio of high- to low-density sample units (SU).
- In the western Galena and Kaiyuh Flats subareas of Unit 21D (in combination with the upper Koyukuk subarea portion of Unit 24D) conduct a high-intensity survey (<15% CI; 300–350 SUs) once every 5 years that includes an aerial stratification and at least 2 additional years of low-intensity GSPE surveys (<20% CI; 275–300 SUs) for those areas during the 5-year period.
- The upper 90% CL of the combined GSPE estimate for the western Galena and Kaiyuh Flats subareas will be compared to the management objective of 5,200 observable moose.

ACTIVITY 1.2. Conduct trend count area (TCA) surveys (objectives C1, C2, M2).

Data Needs

We need to assess trend in ratio parameters. We need calf-to-cow ratios and yearling bull-to-cow ratios to evaluate annual productivity and recruitment. We need total bull-to-cow ratios to evaluate harvest sustainability.

Methods

TCA survey methods are described in this document (see "I. RY15–RY19 Management Report | Management Activities | 1. Population Status and Trend | Methods").

- In Unit 21D conduct an aerial survey of the Three Day Slough TCA (35 SUs; 193.6 mi^2).
- Every year in Unit 21D, in cooperation with USFWS, conduct an aerial survey of
    - Dulbi River mouth TCA (20 SUs; 111 mi^2),
    - Koyukuk River mouth TCA (21 SUs; 119 mi^2),
    - Squirrel Creek TCA (16 SUs; 91 mi^2),
    - Kaiyuh Slough TCA (22 SUs; 126 mi^2),
    - Pilot Mountain Slough TCA (16 SUs; 91 mi^2)
- In Unit 21D, the midpoint estimate of the bull-to-cow ratio for the Koyukuk CUA will be compared to the management objective of 30 bulls:100 cows. The Huslia Flats and Treat Island TCAs in Unit 24D will be combined with the Koyukuk River mouth, Three Day Slough and Dulbi River mouth TCAs, and analyzed as the Koyukuk CUA Core-5 TCAs. If USFWS is unable to continue cooperative survey efforts, we will reexamine the viability of this activity.

ACTIVITY 1.3. Conduct spring twinning surveys in Unit 21D (objectives C1, C2, M1).

Data Needs

Twinning surveys are a commonly used indicator of body condition and productivity in moose populations (Boertje et al. 2007). Assessments of body condition and productivity are integral to management on a long-term sustained yield basis and to protect moose habitat.

Methods

Twinning surveys are described in this document (see "I. RY15–RY19 Management Report | Management Activities | 1. Population Status and Trend | Methods | Activity 1.3".

- In Unit 21D observe a minimum of 50 cows with calves in the Three Day Slough-Dulbi River mouth areas (90% CI ± <40%).
- In Unit 21D, in cooperation with USFWS, observe a minimum of 50 cows with calves in the Natlaratlen River-Bear Creek and Pilot Mountain-Kaiyuh Slough areas (90% CI ± <40%).

ACTIVITY 1.4. Research age structure modeling techniques and determine whether harvested bull moose tooth-age data and aerial survey data from the Koyukuk CUA can be used to construct an age structure analysis in Unit 21D, in combination with the Unit 24D portion of the Koyukuk CUA (objectives C1, C2, C3, M1).

Data Needs

Age structure data obtained from harvested moose is an independent source of data that currently provides additional context that helps to enhance our understanding of the results of aerial moose surveys that were conducted. A more robust age structure analysis could provide the ability to make inference about the population in years lacking aerial survey data, due to fiscal constraints or poor survey conditions. The age structure data also has the potential to provide a more comprehensive understanding of the population dynamics and over a larger area than where surveys may be conducted.

Methods

Using hunter-harvested moose teeth ages and survey data, we need to construct an age structure analysis of the moose population to evaluate annual contribution of individual cohorts to the harvestable surplus. With biometric and research staff, research age structure modeling techniques and analyze moose age data from hunter-killed moose. Investigate funding options and contracting services to complete this analysis.

2. Mortality-Harvest Monitoring

ACTIVITY 2.1. In combination with the Koyukuk CUA portion of Unit 24D, monitor hunter use levels in the Koyukuk River drainage portion of Unit 21D (objectives C1, C3, M3, M4).

Data Needs

Harvest estimates are needed to establish that the population is not being harvested in excess of sustained yield in the Koyukuk River drainage portion of Unit 21D, because the majority of the annual harvest occurs in that portion of the unit. Moose harvested, harvest location, and hunter effort are critical elements needed to assess harvest trends and corroborate aerial survey observations.

Methods

Harvest data collection and data management are described in this document (see "I. RY15–RY19 Management Report | Management Activities | 2. Mortality-Harvest Monitoring and Regulations | Methods"). We will continue to operate the Koyukuk River checkstation. Harvest data from a moose database in WinfoNet is compiled and analyzed annually to assess trends in harvest.

ACTIVITY 2.2. Operate the Koyukuk River checkstation (objectives C1, C3, M3, M4).

Data Needs

Data collection is described in this report (see "I. RY15–RY19 Management Report | Management Activities | 2. Mortality-Harvest Monitoring and Regulations | Methods").

Methods

We will continue to operate the Koyukuk River checkstation.

- Hunters will be issued permits and provided with information on moose management, moose biology, and hunt regulations specific to the Koyukuk CUA.
- Measure antler morphology using the 7 standard measurements described by the Boone and Crocket Club for scoring moose antlers (https://www.boone-crockett.org/bgRecords/bc_scoring_moose.asp?area=bgRecords&type=Moose), as well as the count of left and right brow points. Record data on the data form in Appendix A. One of the 2 incisors (I_1 or I_2) will be extracted and attached by a wire to the antler measurement data form.
- Record hunter information on the data form in Appendix B.
- Record hunter check-in on the data form in Appendix C.
- Responses to hunter attempts to call-in moose will be recorded on the data form in Appendix D.

ACTIVITY 2.3. Develop programs to improve harvest data collection and assessment in Unit 21D (objectives C1, C3, M3, M4).

Data Needs

Like activity 2.1, harvest data in WinfoNet are needed annually to assess trends in harvest. However, because reporting by hunters among rural communities is lower than urban hunters, additional effort is needed to collect those data.

Methods

Harvest data collection and data management are described in this document (see "I. RY15–RY19 Management Report | Management Activities | 2. Mortality-Harvest Monitoring and Regulations | Methods"). Harvest objectives are an annual objective; therefore the estimated harvest will be compared on an annual basis. The estimated harvest will include the reported harvest plus an additional 125 moose (minus reported ceremonial, potlatch or stick dance harvest) to adjust for the unreported harvest. The estimated unreported harvest is based on Subsistence Division household surveys, historical management reports, and any other sources that may contribute to developing a minimum harvest estimate. The 125 moose adjustment is meant to ensure the population is managed conservatively. The annual estimated harvest will be compared to the lower range of the IM objectives and the point values of the management objectives.

Using the Unit 21D moose population estimate and the estimated total harvest, we will assess harvest rate and harvestable surplus. Bull-to-cow ratios will complement the assessment and decision framework. Management decisions will be assessed conservatively due to the lack of broad population estimates and poor harvest reporting. In general, if harvestable surplus calculations suggest additional opportunity but the bull-to-cow ratio 5-year trend is simultaneously declining, conservative harvest will be adopted and deference will be given to the bull-to-cow ratios. Furthermore, if harvestable surplus calculations suggest decreasing opportunity but the bull-to-cow ratio 5-year trend is increasing, deference will be given to the harvestable surplus calculation.

We will coordinate with Nulato, Kaltag, and Ruby community permit vendors to distribute and collect harvest report cards. We will provide permits, assist community hunting license vendors, and coordinate shipping of permit overlays and report cards. We will attend public meetings and Fish and Game advisory committee meetings and provide information regarding the need for harvest data and moose population management.

3. Habitat Assessment-Enhancement

No habitat assessment will be conducted.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Data Recording and Archiving

- GSPE/TCA Moose Survey Form (Stout, 2016; Appendix A).
- Stratification Flight Survey Form (Stout, 2016; Appendix B).
- Moose Twinning Survey Form (Stout, 2016; Appendix C).

Global Position System (GPS) location data will be logged using WGS 84 datum. GPS files will be stored on the Galena Area Biologist hard drive D:/Moose/Surveys/[year]. Files will be saved using MapSource (Garmin Ltd., 2008, Ver. 6.13.7) as *.gpx files. Alternatively, location data for analysis and mapping will use ArcGIS (ESRI 2013. ArcGIS Pro: Release 10.2.2. Redlands, California: Environmental Systems Research Institute and will be stored on the Fairbanks Regional DWC hard drive, S:/Stout/Moose/[year]. Memos and data files will be archived in the Data Archive tool in WinfoNet. The D drive of the Galena Area Biologist's hard drive will be backed up weekly onto the Area Biologist's "H" network drive.

Hard copies of species wildlife management reports and plans and the intensive management operational plan for Moose – Unit 21D will be stored in the Fairbanks Regional Office Library and online at http://www.adfg.alaska.gov/index.cfm?adfg=librarypublications.wildlifemanagement. Memos, data forms, and additional hard copies will be stored in the Galena Area Biologist files in Fairbanks and Galena offices.

Electronic copies of data, GPS location data, memos, and reports will be stored in the WinfoNet – Data Archive. Project Title: Moose Management Program. Project ID: GMU 21D. Primary Region: Region III.

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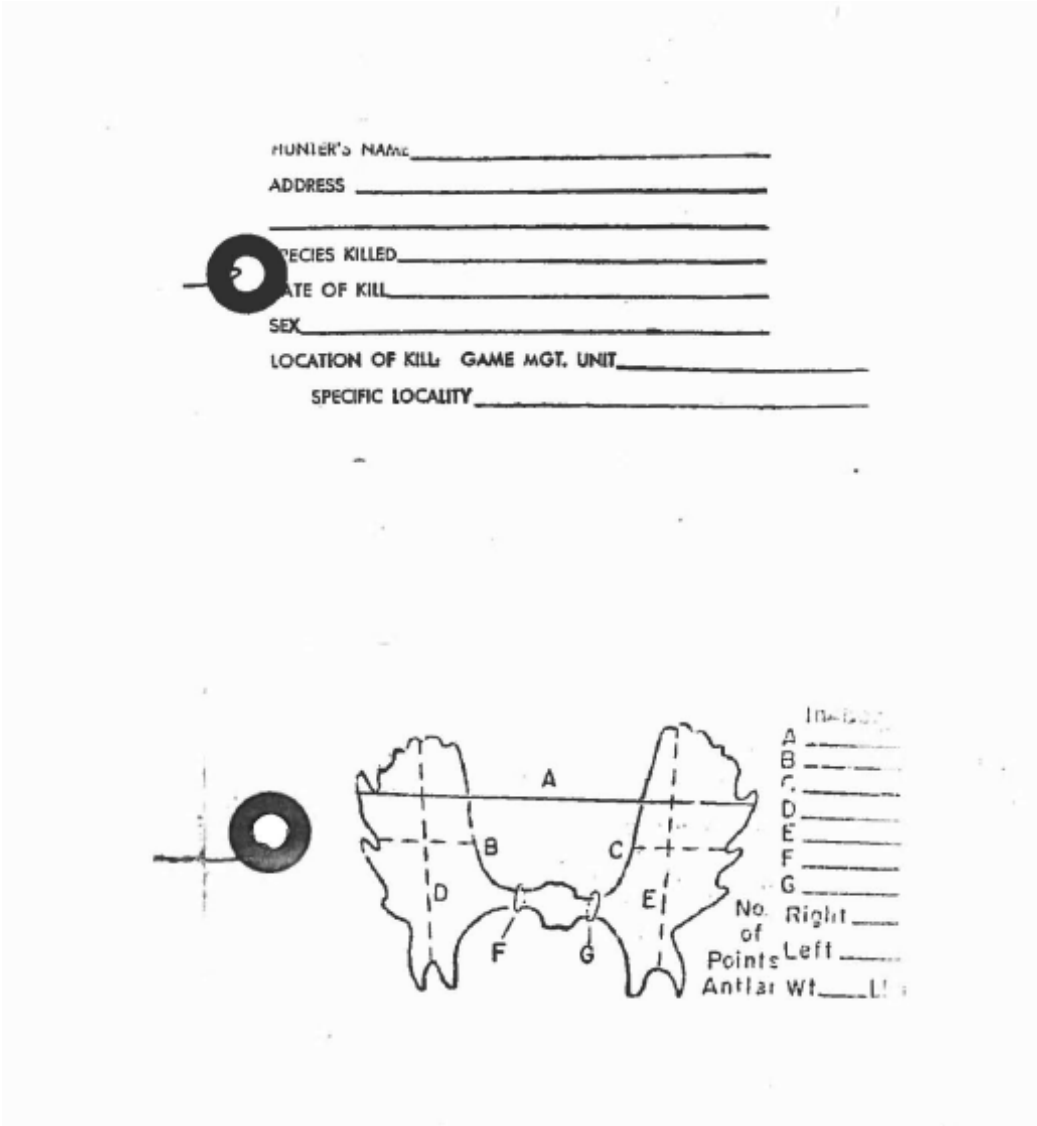
Appendix A. Koyukuk moose tooth and antler measurement data form, Interior Alaska, 2016.



Appendix B. Lower Koyukuk River moose hunter checkstation form, Interior Alaska, 2016.

Roll sheet - Hunter #_____

2016 - MOOSE HUNTER CHECK STATION FORM – Lower Koyukuk River

Hunter Permit #_____

Date Registered:_____, 2016 Time:_____

Hunter Name:_____

Mailing Address:_____

City:_____ State:_____ Zip:_____

Number of hunters in boat:_____ In Party:_____

Hunting License #_____ Boat ID #'s:_____

Kind of boat used: Jetboat Outboard Rubber Raft Other:_____

Boat Registration #_____

Boat Access: _____ Rifle Caliber:_____

Date out:_____, 2016

Other Hunters in Party:_____

Additional trip dates:_____

Name of Guide or Transporter:_____

Moose taken: Yes No Date of Kill:_____, 2016

Sex: Bull Cow Antler measured: Yes No

Kill location:_____

GMU/UCU:_____ Tooth taken: Yes No Age:_____

Comments:_____

_____

Appendix C. Lower Koyukuk moose hunter checkstation roll sheet, Interior Alaska, 2016.

2016 – Moose Hunter Check Station Roll Sheet – Lower Koyukuk

Hunter #	Date in	Name	Home town	Date out	Sex of moose
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
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Hunter #	Date in	Name	Home town	Date out	Sex of moose
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Appendix D. Koyukuk checkstation moose calling form, Interior Alaska, 2016.

2016 KOYUKUK CHECKSTATION MOOSE CALLING FORM

Instructions: Begin with number 1 in "hunter" column and number sequentially; SKIP a line when going to the next boat
Residency is L for local; N for Nonlocal; NR for Nonresident; DOK is Date of Kill; Date Out is Date through Check Static

Hunter	Residency	DOK	Date Out	# Spike/Fork bulls observed	Spike/Fork bulls passed (Y/N)	Comments (why passed?)	Called in?


ALASKA
DEPARTMENT OF FISH AND GAME