

Moose Management Report and Plan, Game Management Unit 21B:

Report Period 1 July 2010–30 June 2015, and
Plan Period 1 July 2015–30 June 2020

Nathan J. Pamperin



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This species management report and plan was reviewed and approved for publication by Doreen I. Parker McNeill, Management Coordinator for the Division of Wildlife Conservation, Fairbanks.

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Purpose of this Report

This report provides a record of survey and inventory management activities for moose in Unit 21B for the previous 5 regulatory years and plans for survey and inventory management activities in the 5 years following the end of that period. A regulatory year (RY) begins 1 July and ends 30 June (e.g., RY10 = 1 July 2010–30 June 2011). This report is produced primarily to provide agency staff with data and analysis to help guide and record its own efforts but is also provided to the public to inform them of wildlife management activities. In 2016 the Alaska Department of Fish and Game's (ADF&G) Division of Wildlife Conservation launched this type of 5-year report to more efficiently report on trends and describe potential changes in data collection activities over the next 5 years. It replaces the moose management reports of survey and inventory activities that were previously produced every 2 years and supersedes the 1976 draft Alaska wildlife management plans (ADF&G 1976).

I. RY10–RY14 Management Report

Management Area

Unit 21B is located in western Interior Alaska, south of the Yukon River, and east of Galena (Fig. 1). Unit 21B encompasses 9,330 mi², and the terrain is a combination of hills and lowland riparian areas. Mean elevation within the unit is 825 feet (range = 136–4,473 feet). Vegetation is dominated by white and black spruce (*Picea glauca* and *Picea mariana*) forests, low and tall shrub, mixed and deciduous forest, and grassland/herbaceous communities (Boggs et al. 2012). Portions of 3 ecoregions found in Unit 21B include the Kuskokwim Mountains, Ray Mountains, and Yukon River lowlands (Nowacki et al. 2001). Maps for Unit 21B 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 21B

The earliest accounts of this portion of Interior Alaska mentioned the presence of moose (*Alces alces*; Osborne 1990). Moose had apparently become abundant by the time gold seekers converged on the area in the early 1900s. The village of Ruby had a population of 10,000 people during the 1910 gold rush, and many moose were harvested to supply the community with meat. Several severe winters in the late 1960s and early 1970s initiated widespread declines in moose populations throughout the interior, including Unit 21B.

The Nowitna River to the east of Ruby is a popular hunting area for residents of Ruby, Tanana, and, to a lesser extent, Galena. It is also a popular hunting area for Fairbanks residents who use boats and aircraft for access. Because of its long history of use by both local and nonlocal hunters, this area has been the focus of much of the management effort in Unit 21B.

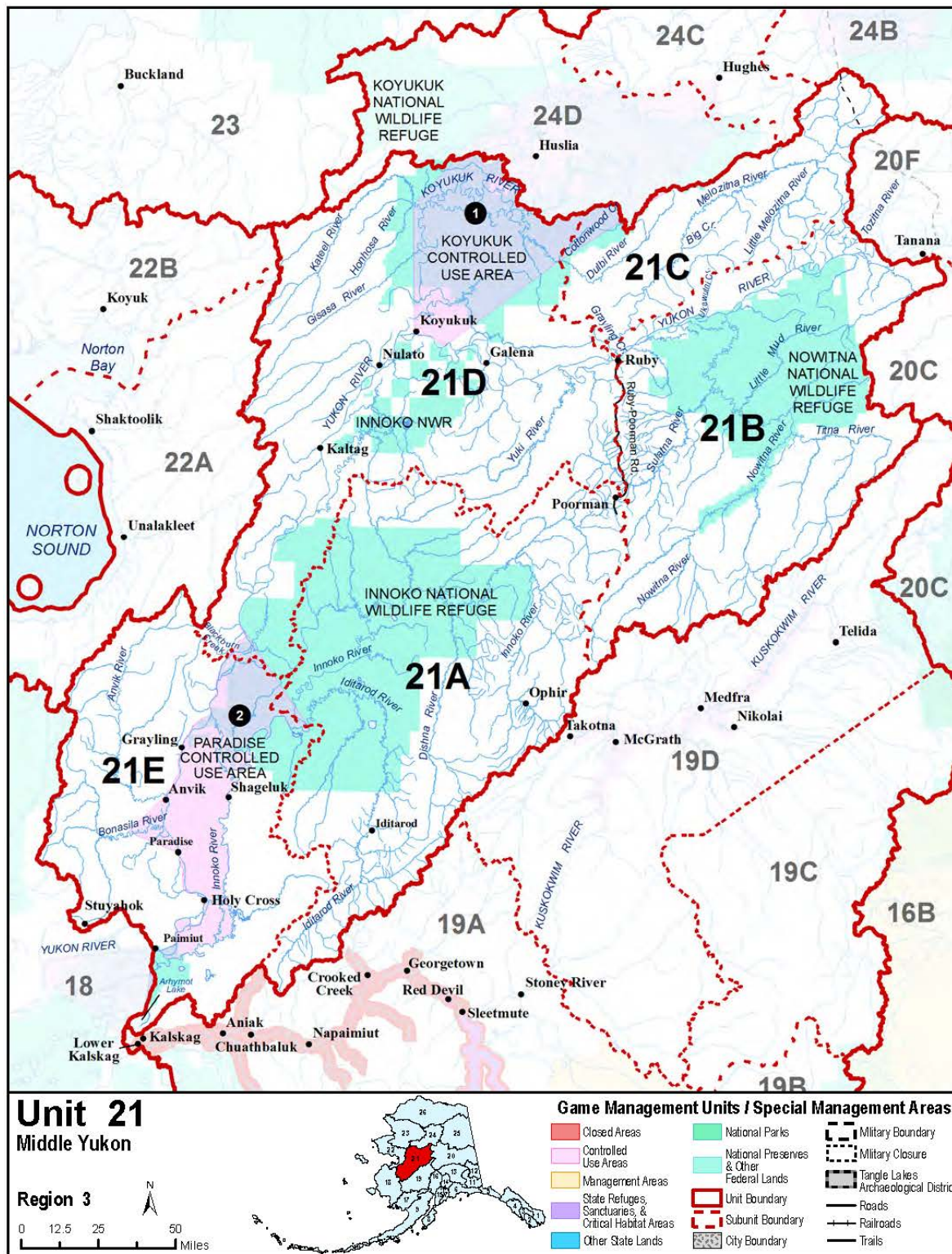


Figure 1. Map of Game Management Unit 21, Interior Alaska.

In addition to the lower Nowitna River drainage, Unit 21B includes the area east of the Ruby–Poorman Road, the banks of the Yukon River from Ruby to Tanana, the Blind River, and the Boney River drainages. The Alaska Board of Game (board) made several changes related to Unit 21B in 2004 and 2006 that substantially changed the data collection and analysis reflected in this report. In 2004 the board adopted regulations to implement 3 drawing hunts and a registration hunt for the entire unit. In 2006 the board added the upper Nowitna drainage (formerly part of Unit 21A) to Unit 21B, adopted an additional drawing permit and a registration permit hunt in part of the area added, and added 10 days of fall moose hunting opportunity for resident hunters.

The most recent unitwide population estimate was conducted in 2008, and current trends in the Unit 21B moose population are unknown. Management activities conducted by ADF&G in Unit 21B in the last 10 years have been limited to infrequent population estimation surveys and annual harvest monitoring. The U.S. Fish and Wildlife Service (USFWS) conducts annual trend count area (TCA) surveys to assess composition in parts of Unit 21B, but these data are collected independent of the department’s plan for moose management. USFWS also operates a hunter checkstation on the lower Nowitna River during the fall hunting season.

Management Direction

EXISTING WILDLIFE MANAGEMENT PLANS

- Direction for the management of Unit 21B 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 21B.

GOALS

- Manage Unit 21B moose 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 that 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.

Intensive Management

- | | | | |
|-----|--------------------|--|-------------------------------------|
| C2. | <u>Unit</u>
21B | <u>Population objective</u>
4,000–6,000 moose | <u>Harvest objective</u>
200–300 |
|-----|--------------------|--|-------------------------------------|

MANAGEMENT OBJECTIVES

- M1. Provide for harvest of 50–200 moose or 5% of the posthunt fall moose population estimate, whichever is less.
- M2. Maintain a moose population of 4,000–6,000.

MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Geospatial population estimation (GSPE) surveys. (C1, C2, M1, M2)

ACTIVITY 1.2. Monitor USFWS trend count data for information on age-sex composition. (M1)

Data Needs

Age and sex composition data are important for informing management decisions on appropriate harvest levels. Abundance estimates are also needed to evaluate intensive management and management population objectives.

Methods

No population estimates were conducted in Unit 21B during RY10–RY14. Methods for the GSPE survey conducted in 2008 in Unit 21B are described in Pamperin (2012). USFWS methods for surveying their TCAs are described in Pamperin (2012, 2014).

Results and Discussion

Population Size

No population estimates were conducted in Unit 21B during RY10–RY14. The most recent unitwide population estimate survey for Unit 21B was conducted in 2008 and indicated 2,317 observable moose ($\pm 18\%$ relative error = 1,899–2,736 observable moose, 90% CI) in the survey area (Table 1). This resulted in an overall density of 0.27 moose/mi². Population trends from 2008 to present are unknown.

Population Composition

TCA surveys conducted during RY10–RY14 by USFWS at the Nowitna mouth and Nowitna–Sulatna confluence continued to show variable ratios of calves, bulls, and yearling bulls:100 cows (Fig. 2, Tables 2 and 3). In RY13 and RY14 fewer total moose were counted in TCAs, but these surveys were conducted with low snow levels, so it is uncertain whether the decline in numbers of moose is real or related to reduced sightability. The yearling bull:cow ratios were low in 2010 and likely a carryover from poor production and survival of the calf cohort after the severe winter of 2008–2009 and remained low in RY13 and RY14 (Fig. 2). The bull:cow ratio appeared to increase in RY14 but was the result of a decrease in the number of cows counted as opposed to an increase in bulls. Poor survey conditions existed in RY12 which prevented the inclusion or comparison of those data.

Table 1. Unit 21B moose population estimates, Interior Alaska, regulatory years^a 2008–2014.

Regulatory year	Area mi ²	Bulls:100 Cows	Calves:100 Cows	Yrlg bulls:100 Cows	Percent calves	Adults	Population estimate (90% CI ^b)	Density
2008 ^c	8,565	50 (±24%)	49 (±28%)	12 (±41%)	25	1,747	2,317 (±18%)	0.27

^a Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2008 = 1 July 2008–30 June 2009).

^b Confidence interval (% ±).

^c Geospatial population estimator (GSPE) analysis without a sightability correction factor (observable moose).

Table 2. Unit 21B Nowitna–Sulatna confluence aerial moose composition counts^a, Interior Alaska, regulatory years^b 2010–2014.

Regulatory year	Survey area (mi ²)	Bulls:100 cows	Yrlg bulls:100 cows	Calves:100 cows	Twins:100 cows	Percent calves	Moose	Moose/mi ²
2010	149	32	3	42	5	24	185	1.2
2011	149	28	14	38	8	23	224	1.5
2013 ^c	149	28	5	18	0	12	140	0.9
2014 ^c	149	43	4	26	0	12	115	0.8

^a Conducted by U.S. Fish and Wildlife Service.

^b Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).

^c Low snow conditions during survey.

Table 3. Unit 21B Nowitna mouth aerial moose composition counts^a, Interior Alaska, regulatory years^b 2010–2014.

Regulatory year	Survey area (mi ²)	Bulls:100 cows	Yrlg bulls:100 cows	Calves:100 cows	Twins:100 cows	Percent calves	Moose	Moose/mi ²
2010	102	23	1	29	0	19	167	1.6
2011	102	32	12	14	0	10	203	2.0
2013 ^c	102	22	8	14	0	10	140	1.4
2014 ^c	102	34	4	39	2	26	121	1.2

^a Conducted by U.S. Fish and Wildlife Service.

^b Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).

^c Low snow conditions during survey.

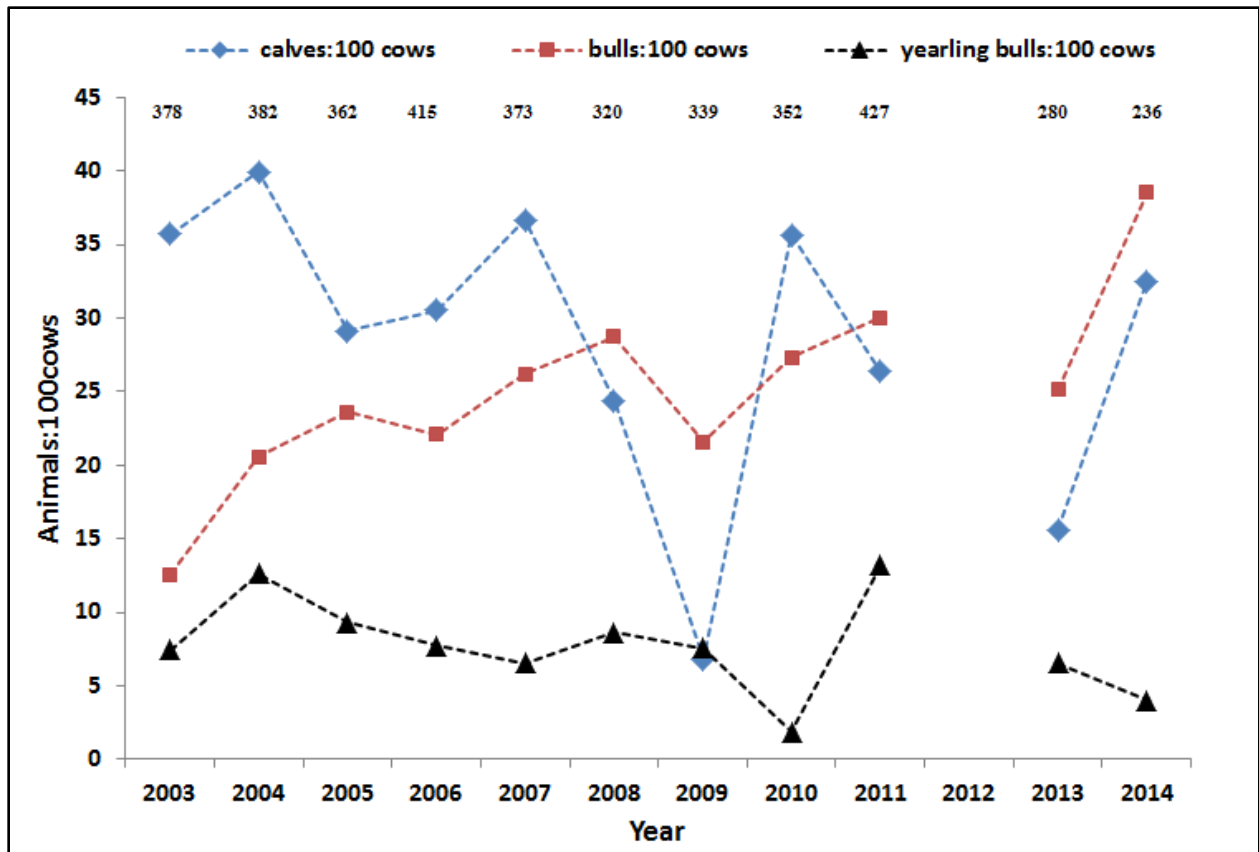


Figure 2. Ratios of calves, bulls, and yearling bulls per 100 cows in Nowitna mouth and Nowitna–Sulatna confluence trend count areas, Interior Alaska. The number of moose counted during each survey is provided at the top of the figure. Data collected by U.S. Fish and Wildlife Service.

Recommendations for Activity 1.1

Discontinue GSPE surveys. Resources are not available to conduct unitwide GSPE surveys given other priorities within the Galena management area.

Recommendations for Activity 1.2.

Continue monitoring TCA data collected by USFWS.

2. Mortality–Harvest Monitoring and Regulations

ACTIVITY 2.1. Monitor annual reported harvest. (C1, C2, M1)

ACTIVITY 2.2. Monitor hunter activity by reviewing summaries of the Nowitna River hunter checkstation operated by USFWS. (C1, C2, M1)

Data Needs

Annual summaries of harvest are needed to evaluate whether we are meeting the harvest objective (M1) in Unit 21B. The IM harvest objective (C2) is based on the number of animals available (prehunt number) for harvest by humans which is more difficult to assess without a prehunt population estimate. Since active management to increase recruitment of moose in Unit 21B is precluded by federal landownership, the IM harvest objective is unrealistic and difficult to assess without updated, statistically valid, abundance estimates. Harvest levels have been stable in Unit 21B, and this further reduces the need to conduct annual population estimation surveys.

Methods

We used ADF&G's Wildlife Information Network (WinfoNet) harvest database queries to construct summaries of reported harvest from drawing, registration, and general season hunts. Hunters received 1 or 2 reminder letters and usually an e-mail and telephone calls if we did not receive timely harvest reports. In addition to harvest, we summarized aspects of hunter residency and success.

Results and Discussion

Harvest by Hunters

Reported harvest in Unit 21B averaged 72 bull moose/year during RY10–RY14 (harvest ticket, drawing, and registration hunts, Table 4). The average number of hunters during RY10–RY14 in Unit 21B was 218 hunters/year (Table 5) of which 45% were checked through the Nowitna River checkstation operated by USFWS (Table 6). Estimates of unreported harvest are discussed in Stout (2006).

Table 4. Unit 21B moose harvest, Interior Alaska, regulatory years^a 2010–2014.

Regulatory year	Harvest by hunters				Unreported	Total
	Bull	Cow	Unk	Total		
2010	81	0	0	81	25	106
2011	73	0	0	73	25	98
2012	69	0	0	69	25	94
2013	66	0	0	66	25	91
2014	72	0	0	72	25	97

^a Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).

Table 5. Unit 21B moose hunter residency and success, Interior Alaska, regulatory years^a 2010–2014^b.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident ^c	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident ^c	Nonlocal Resident	Nonresident	Unk	Total	
2010	26	47	8	0	81 (31)	58	104	15	0	177	258
2011	17	44	12	0	73 (36)	37	80	15	0	132	205
2012	19	34	16	0	69 (37)	42	65	13	0	120	189
2013	12	46	7	1	66 (31)	45	78	25	2	150	216
2014	19	45	8	0	72 (33)	41	95	12	0	148	220

^a Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).

^b Some hunters had multiple permits.

^c Local residents reside in Tanana, Ruby, and Galena.

Table 6. Unit 21B Nowitna River checkstation hunters (R), harvest (H), and percent success (%S), Interior Alaska, regulatory years^a 2010–2014^b.

Regulatory year	Local villages ^c			Other residents			Nonresident			Total		
	R	H	%S	R	H	%S	R	H	%S	R	H	%S
2010	17	2	12	88	32	36	5	0	0	110	34	31
2011	12	4	33	77	33	43	1	0	0	90	37	41
2012	17	5	29	60	21	35	4	2	50	81	28	35
2013	19	3	16	80	27	34	7	1	14	106	31	29
2014	13	1	8	81	28	35	4	1	25	98	30	31

^a Regulatory year begins 1 July and ends 30 June (e.g., regulatory year 2010 = 1 July 2010–30 June 2011).

^b Data collected by U.S. Fish and Wildlife Service.

^c Local residents reside in Tanana, Ruby, and Galena.

Permit Hunts

Annual harvest under drawing permits (DM802, DM805, DM806, and DM808–DM811) during RY10–RY14 averaged 19 moose and an average of 43% of permit winners reported hunting. Hunters reported harvesting an average of 45 moose annually under RM834 during RY10–RY14. Use of the federal permit (FM2101) issued by USFWS was limited and averaged 7 permits annually during RY10–RY14 with an average harvest of 2 moose per year.

Hunter Residency and Success

Annually, Alaska residents composed 88% (range = 84–91%) of the hunters who hunted moose in Unit 21B during RY10–RY14 (Table 5). The high proportion of resident hunters is due to the structure of the registration hunt RM834 which is only available to Alaska residents. On average, 62 residents and 10 nonresidents per year were successful during this period. Success rate for all hunters was 33% during RY10–RY14, which is similar to other areas in Interior Alaska.

Alaska Board of Game Actions and Emergency Orders

No regulation changes were adopted by the board during RY10–RY14.

Recommendations for Activity 2.1.

Continue to monitor reported harvest.

Recommendations for Activity 2.2.

Continue to monitor hunter activity by reviewing summaries of the Nowitna River hunter checkstation operated by USFWS.

3. Habitat Assessment–Enhancement

No habitat assessment or enhancement activities are conducted in Unit 21B.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

Data Recording and Archiving

Harvest and GSPE data will be stored on an internal database housed on a server (WinfoNet; <http://winfonet.alaska.gov/index.cfm>). Field data sheets (if any are generated) will be stored in file cabinets located in the Galena Area Biologist office in Fairbanks. Electronic copies of data and reports will be stored in the WinfoNet – Data Archive. Project Title: Moose Management Program Unit 21B. Project ID: GMU Unit 21B Moose. Primary Region: Region III.

Agreements

None.

Permitting

ADF&G Collecting Permit (Nate Pamperin #09-042).

ADF&G Collecting Permit (Glenn Stout #99-014).

Conclusions and Management Recommendations

Composition data varied within the range of values observed previously within TCAs with the exception of bull:cow ratios in RY14 which appeared high due to the low number of total cows counted. Observed variability in TCAs data is likely a factor of the TCAs' small area which increases sensitivity to changes in the timing and conditions under which surveys are conducted. Total numbers of moose counted in TCAs will be monitored to see if a declining trend persists.

During RY10–RY14 we met the goal to manage Unit 21B moose 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. The moose population continued to support the consumptive demands as well as the nonconsumptive uses identified.

Objective C2 was likely not met, but this assessment is only based on the population estimate from 2008 and assumes no major increase in the moose population.

The harvest objective (M1) of 50–200 moose or up to 5% of the population was met. Total estimated harvest averaged 97 moose during RY10–RY14, approximately 4.2% of the most recent Unit 21B observable moose population (2008 GSPE survey; Table 1).

Management objective M2, to maintain a moose population of 4,000–6,000, was likely not met during RY10–RY14 based on the 2008 GSPE survey, but this assumes no major increase occurred in the population. Current population trends are unknown.

Discontinuation of the GSPE surveys in Unit 21B is recommended. Resources are not available to regularly conduct unitwide surveys given other priorities within the Galena management area, and federal landownership currently precludes the possibility of active management activities related to the intensive management status in Unit 21B.

II. Project Review and RY15–RY19 Plan

Review of Management Direction

MANAGEMENT DIRECTION

There are no major changes to the management direction.

GOAL

The existing goal will be changed to the following:

- Provide a sustained opportunity to participate in hunting moose.

CODIFIED OBJECTIVES

Amounts Reasonably Necessary for Subsistence Uses

- C1. Unit 21, 600–800 moose available for harvest from the unitwide population on an annual basis.

Intensive Management

- | | | |
|-----|-----------------------------|--------------------------|
| C2. | <u>Population objective</u> | <u>Harvest objective</u> |
| | 4,000–6,000 moose | 200–300 |

MANAGEMENT OBJECTIVES

We no longer need to collect data for Unit 21B population estimates; therefore, GSPE population estimation surveys are not needed. In the past, GSPE surveys were done infrequently and their use was limited because of this. Although Unit 21B has a positive intensive management finding, any options to improve recruitment in the moose population to achieve the IM objective (C2) are precluded by federal landownership. Aside from using a unitwide population estimate for all of Unit 21 to assess objective C2, the benefits of conducting a survey are outweighed by the cost to do so. Therefore, the existing management objectives will be changed to the following:

- M1. Provide for harvest of ≥ 25 bull moose.

REVIEW OF MANAGEMENT ACTIVITIES

1. Population Status and Trend

ACTIVITY 1.1. Monitor USFWS trend count data for information on age-sex composition. (M1)

Data Needs

Harvest levels will be adjusted by changing numbers of drawing permits and changing registration permit seasons and hunt conditions based on composition data from TCAs along with annual harvest data.

2. Mortality–Harvest Monitoring

ACTIVITY 2.1. Monitor annual reported harvest. (C1, C2, M1)

ACTIVITY 2.2. Monitor hunter activity by reviewing summaries of the Nowitna River hunter checkstation operated by USFWS. (C1, C2, M1)

Data Needs

No change from report.

Methods

No change from report.

3. Habitat Assessment–Enhancement

Data Needs

We have no need for habitat monitoring because the moose population does not appear to be nutritionally limited, so we do not plan on assessing habitat or conducting habitat enhancements in Unit 21B for moose.

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

None.

Data Recording and Archiving

No change from report.

Agreements

None.

Permitting

ADF&G Collecting Permit (Nate Pamperin #09-042).

ADF&G Collecting Permit (Glenn Stout #99-014).

References Cited

- ADF&G (Alaska Department of Fish and Game). 1976. Alaska wildlife management plans: Western Alaska (draft proposal; subsequently approved by the Alaska Board of Game). Division of Game, Federal Aid in Wildlife Restoration Project W-17-R, Juneau.
- Boggs, K., T. V. Boucher, T. T. Kuo, D. Fehring, and S. Guyer. 2012. Vegetation map and classification: Northern, western and Interior Alaska. Alaska Natural Heritage Program, University of Alaska Anchorage.
- Nowacki, G., P. Spencer, T. Brock, M. Fleming, and T. Jorgenson. 2001. Narrative descriptions for the ecoregions of Alaska and neighboring territories. Final Draft 6-1-00. U.S. Geological Survey, Reston, Virginia. <https://agdc.usgs.gov/data/projects/fhm/> (Accessed December 2017).
- Osborne, T. O. 1990. Unit 21B moose. Pages 324–336 [In] S. O. Morgan, editor. Annual report of survey-inventory activities 1 July 1988–30 June 1989. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Study 1.0, Juneau.

- Pamperin, N. J. 2012. Unit 21B moose. Pages 463–482 [*In*] P. Harper, editor. Moose management report of survey-inventory activities 1 July 2009–30 June 2011. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2012-5, Juneau.
- Pamperin, N. J. 2014. Unit 21B moose. Chapter 28, Pages 28-1 through 28-18 [*In*] P. Harper and L. A. McCarthy, editors. Moose management report of survey-inventory activities 1 July 2011–30 June 2013. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2014-6, Juneau.
- Stout, G. W. 2006. Unit 21B moose. Pages 442–460 [*In*] P. Harper, editor. Moose management report of survey-inventory activities 1 July 2003–30 June 2005. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid in Wildlife Restoration Project 1.0, Juneau.



