ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 115526
Juneau, AK 99811-5526

Alaska Department of Fish and Game
Wildlife Restoration Grant

GRANT NUMBER: AKW-B-R1-2020

PROJECT NUMBER: 1.70

PROJECT TITLE: Moose population dynamics in southeastern Alaska

PERIOD OF PERFORMANCE: 1 July 2019–30 June 2021

PERFORMANCE YEAR: 1 July 2019–30 June 2020

REPORT DUE DATE: 1 September 2020

PRINCIPAL INVESTIGATOR: Kevin S. White

COOPERATORS: Glacier Bay National Park

I. PROGRESS ON PROJECT OBJECTIVES DURING PERFORMANCE YEAR

OBJECTIVE 1A: Estimate reproductive performance of radio-marked adult female moose

ACCOMPLISHMENTS: We monitored pregnancy rates by collecting blood serum samples from radio-marked adult female moose in Gustavus during March 2020. Blood serum analyzed for pregnancy-specific protein B (PSPB; Biotracking, Moscow, ID) to determine pregnancy status. Overall, we determined that 100% (8/8) of radio-collared adult female moose in Gustavus, and 100% (5/5) in Berners Bay were pregnant during the 2019/2020 biological year. During May-June 2020, we conducted aerial (Gustavus, n = 2; Berners Bay, n = 2) surveys to determine calf status of radio-marked adult female moose. Ground-based surveys were not conducted in Gustavus due to Covid-19 considerations. We determined that 77% (24/31) of radio-marked female moose in Gustavus had calves at heel during the late-May parturition season; 29% of parous females had twins. In Berners Bay, 43% (10/23) of adult females had calves. Of the 13 calves observed in Berners Bay, 30% were twins. We successfully accomplished all activities associated with this objective that were planned for this reporting period.

OBJECTIVE 1b: Estimate survival of radio-marked adult female moose.

ACCOMPLISHMENTS: We monitored survival of radio-marked adult female moose (Gustavus, n = 34; Berners Bay, n = 29) each month via ground- or air-based radio- telemetry surveys, weather permitting. During 2019–2020, we investigated 17 mortality events involving radio-marked moose (Gustavus, n = 7; Berners Bay, n = 10). Estimated annual survival for adult

female moose in Gustavus during the 2018/2019 biological year was low (annual survival, 2019/20 = 0.80±0.06, n = 34), relative to the long-term average (annual survival, 2003-2020 = 0.88±0.01, n = 593; Table 1). In Berners Bay, annual survival of adult females during 2019/2020 was very low (annual survival, 2019/20 = 0.67±0.07, n = 29), relative to the long-term average (annual survival, 2006-2020 = 0.87±0.02, n = 436; Table 1). We attribute the low adult female survival rates during 2019/2020 to severe late-winter snow conditions; predation (wolf and bear) and population age structure may also be important factors. We successfully accomplished all activities associated with this objective that were planned for this reporting period.

OBJECTIVE 1c: Estimate survival of calves associated with radio-marked adult female moose

ACCOMPLISHMENTS: We monitored survival of calves associated with radio-marked adult female moose (Gustavus, n = 33; Berners Bay, n = 19) during May–June 2019, November 2019 and April 2020 via ground- or air-based radio-telemetry surveys. Estimated annual survival for calves in Gustavus during 2019/2020 was similar (annual survival, 2019 = 0.24±0.07, n = 33) to the long-term average (annual survival, 2004-2020 = 0.27±0.02, n = 408; Table 2). In Berners Bay, annual survival of calves during 2019/2020 (annual survival, 2019 = 0.05±0.05, n = 19) was substantially lower than long-term estimates (annual survival, 2007-2020 = 0.27±0.02, n = 289; Table 2); most calf mortality occurred during summer yet causes are unknown. In March 2019, we deployed 12 time-lapse cameras on radio-marked adult females in Gustavus to validate calf status determinations. Of the 12 cameras deployed, 11 were recovered and yielded photographs suitable for determining status of attendant calves. We successfully accomplished all activities associated with this objective that were planned for this reporting period.

OBJECTIVE 1d: Estimate moose population size and composition.

ACCOMPLISHMENTS: We conducted two aerial surveys during fall/winter in order to estimate moose population size and composition (Gustavus, n = 1; Berners Bay, n = 1). During surveys, moose sighting probabilities were estimated using mark-resight techniques based on data collected from radio-marked adult female moose. In Gustavus, we observed 91 total moose (1 bull, 10 cows, 13 calves and 67 unclassified adults) and 37% (10/27) of the radio-collared adult females resulting in a mark-resight population estimate of 233±97 moose. Since the survey was conducted in February, after antler drop, we were unable to acquire reliable adult composition data. In Berners Bay, we were unable to conduct a complete survey in Berners Bay due to unsuitable weather conditions and resulting survey data were inadequate for deriving a population estimate. Otherwise, we successfully accomplished all activities associated with this objective that were planned for this reporting period.

OBJECTIVE 1e: Capture and radio-mark adult female moose

ACCOMPLISHMENTS: We conducted moose capture activities during this reporting period in the Gustavus and Berners Bay areas during March 2020. In Gustavus, we captured 10 moose (n = 8 adult females and 2 short yearlings) using ground-based capture methods. Camera collars were deployed on 10 of the adult females captured (Gustavus, n = 7; Berners Bay, n = 3). In Berners

Bay, we captured 5 adult females using helicopter darting methods. Camera collars are used to collected detailed and complementary information about calf status (see Objective 1c). Following capture, we collected biological samples (i.e. blood, tissue, fecal pellets, hair), recorded body condition (via ultrasonography) and morphological characteristics. Biological samples were analyzed and/or archived for this (i.e. pregnancy, age, nutrition) and other related projects (i.e. genetics, health/disease assessment). We successfully accomplished all activities associated with this objective that were planned for this reporting period.

OBJECTIVE 1f: Prepare annual reports.

ACCOMPLISHMENTS: We prepared a progress report detailing activities conducted in the Gustavus and Berners Bay areas, to satisfy ADF&G Federal Aid reporting requirements. We also presented findings, in a comparative context, at moose management public and Advisory Committee meetings.

OBJECTIVE 2a: Synthesize population-specific demographic data.

ACCOMPLISHMENTS: We synthesized annual and seasonal survival (adult female and calf) and reproductive (calving, twinning and fecundity) rates for radio-marked adult female moose and associated calves monitored in Gustavus (adult females, 2003–2020, n = 121, 593 moose years; calves, 2004–2020, n = 408) and Berners Bay (2006–2020, n = 92, 436 moose years; 2007–2020, n = 289). We also estimated reproductive rates for each population (Gustavus, 2004-2020, calving = 0.58±0.02, twinning = 0.37±0.02, fecundity = 0.80±0.02, n = 549; Berners Bay, 2007-2020, calving = 0.56±0.03, twinning = 0.48±0.03, fecundity = 0.83±0.02, n = 378). We successfully accomplished all activities associated with this objective that were planned for this reporting period.

OBJECTIVE 2b: Develop a moose population model for management applications

ACCOMPLISHMENTS: We developed and validated a 2-stage matrix population model parameterized using vital rate data summarized in Objective 2a. In 2015, the model was extended to estimate the proportion of legal (spike/fork and 3-brow tine/50 inch) and non-legal bulls in the population. In 2019-2020, in collaboration with Dan Eacker (ADFG/DWC, Douglas), we developed an integrated population model. This model builds on the existing matrix population model and involves further synthesis and explicit integration of multiple sources of demographic data. This model is completed but further computer programming is planned to more easily facilitate use for routine management applications, as well as expand its utility for other regional moose populations. Development of this model represents a promising advance in our ability to monitor moose populations and evaluate routine harvest management scenarios. We successfully accomplished all activities associated with this objective that were planned for this reporting period.

II. SUMMARY OF WORK COMPLETED ON PROJECT TO DATE.

Since 2010, we have captured and handled 235 moose in the Gustavus (n = 174) and Berners Bay (n = 61) study areas. In each area, we have annually conducted aerial surveys to derive population estimates via mark-resight analytical techniques, weather permitting. In addition, we have conducted monthly, and seasonally, monitored survival and reproduction of radio-collared moose in order to derive estimates of survival and fecundity. Vital rate estimates (i.e. survival and reproduction) along with population estimates have enabled development of population models that have been routinely used to project population trajectories into the future and evaluate harvest scenarios in management and research contexts.

III. SIGNIFICANT DEVELOPMENT REPORTS AND/OR AMENDMENTS.

PCN 11-2253 was moved to headquarters, reduce allocation to actuals. Moved $38.2K in Line 1000 to head Headquarters grant. Travel was significantly reduced due to COVID 19 and because PCN 11-2253 was no longer involved with this project.

IV. PUBLICATIONS

None.

V. RECOMMENDATIONS FOR THIS PROJECT

This project should be continued as described in the study plan and project statement.

Prepared by: Kevin White

Date: 1 September 2020

Table 1. Estimated annual survival for radio-collared adult female moose in Berners Bay and Gustavus, Alaska during 2003-2020. "At Risk" sample sizes reflect maximum number of animals monitored during the period of interest. Staggered-entry statistical design includes animals that were not monitored the entire year for annual estimates.

	Summer Survival				Winter Survival				Annual Survival			
Year	At Risk[1]	Died	Ŝ	SE	At Risk	Died	Ŝ	SE	At Risk	Died	Ŝ	SE
Berners												
2006	--	--	--	--	33	5	0.85	0.06	--	--	--	--
2007	30	2	0.93	0.05	33	4	0.87	0.06	33	6	0.81	0.06
2008	28	1	0.96	0.04	33	2	0.94	0.04	33	3	0.91	0.05
2009	31	0	1.00	0.00	37	2	0.94	0.04	37	2	0.94	0.04
2010	33	2	0.94	0.04	32	4	0.88	0.06	33	6	0.82	0.06
2011	25	1	0.96	0.04	30	0	1.00	0.00	30	1	0.96	0.04
2012	29	1	0.97	0.03	28	2	0.93	0.05	29	3	0.90	0.06
2013	27	0	1.00	0.00	35	4	0.89	0.05	35	4	0.89	0.05
2014	30	1	0.97	0.03	29	2	0.93	0.05	30	3	0.90	0.05
2015	27	0	1.00	0.00	31	3	0.90	0.05	31	3	0.90	0.05
2016	29	2	0.93	0.05	27	1	0.96	0.04	29	3	0.90	0.06
2017	26	1	0.96	0.04	31	1	0.97	0.03	31	2	0.93	0.04
2018	30	0	1.00	0.00	30	3	0.90	0.05	30	3	0.90	0.05
2019	27	1	0.96	0.04	29	9	0.70	0.07	29	10	0.67	0.07
Last 3 Years	83	2	0.98	0.02	89	13	0.85	0.03	89	15	0.83	0.04
All Years	372	13	0.97	0.01	436	41	0.91	0.01	436	54	0.87	0.02
Gustavus												
2003	--	--	--	--	21	0	1.00	0.00	--	--	--	--
2004	21	0	1.00	0.00	26	0	1.00	0.00	26	0	1.00	0.00
2005	27	0	0.98	0.02	39	3	0.93	0.04	39	3	0.91	0.05
2006	37	0	1.00	0.00	37	6	0.84	0.06	37	6	0.84	0.06
2007	34	1	0.97	0.03	37	3	0.91	0.05	37	4	0.88	0.05
2008	36	2	0.94	0.04	44	5	0.89	0.05	44	7	0.84	0.05
2009	40	0	1.00	0.00	42	3	0.93	0.04	42	3	0.93	0.04
2010	40	2	0.95	0.03	38	2	0.95	0.04	40	4	0.90	0.05
2011	35	3	0.91	0.05	35	0	1.00	0.00	35	3	0.91	0.05
2012	40	1	0.98	0.02	39	4	0.90	0.05	40	5	0.88	0.05
2013	36	3	0.92	0.05	36	2	0.94	0.04	36	5	0.87	0.05
2014	35	1	0.97	0.03	37	3	0.92	0.04	37	4	0.89	0.05
2015	36	2	0.94	0.04	39	1	0.97	0.02	39	3	0.92	0.04
2016	42	2	0.95	0.03	40	3	0.93	0.04	42	5	0.88	0.05
2017	40	1	0.98	0.02	39	3	0.92	0.04	40	4	0.90	0.05
2018	40	5	0.88	0.05	36	4	0.89	0.05	40	9	0.78	0.06
2019	34	5	0.85	0.06	34	2	0.94	0.04	34	7	0.80	0.06
Last 3 Years	114	11	0.91	0.03	108	9	0.92	0.03	114	20	0.83	0.03
All Years	538	23	0.96	0.01	560	42	0.92	0.01	560	65	0.88	0.01

Table 2. Estimated annual survival for calves associated with radio-collared adult female moose moose in Berners Bay and Gustavus, Alaska during 2003-2020. "At Risk" sample sizes reflect maximum number of animals monitored during the period of interest. Staggered-entry statistical design includes animals that were not monitored the entire year for annual estimates.

	Summer Survival				Winter Survival				Annual Survival			
Year	At Risk[1]	Died	Ŝ	SE	At Risk	Died	Ŝ	SE	At Risk	Died	Ŝ	SE
Berners												
2006	--	--	--	--	15	8	0.47	0.08	--	--	--	--
2007	13	8	0.39	0.08	4	1	0.75	0.19	13	9	0.29	0.12
2008	27	20	0.26	0.04	7	2	0.71	0.14	27	22	0.19	0.06
2009	24	17	0.29	0.05	7	6	0.86	0.12	24	18	0.25	0.08
2010	18	9	0.50	0.08	9	0	1.00	0.00	18	9	0.50	0.12
2011	24	16	0.33	0.06	8	1	0.88	0.11	24	17	0.29	0.09
2012	25	16	0.36	0.06	9	1	0.89	0.10	25	17	0.32	0.09
2013	16	11	0.31	0.06	5	3	0.40	0.14	16	14	0.13	0.05
2014	33	17	0.48	0.06	16	4	0.75	0.09	33	21	0.36	0.07
2015	24	15	0.38	0.06	9	1	0.89	0.10	24	16	0.33	0.09
2016	21	6	0.71	0.08	15	8	0.47	0.09	21	14	0.33	0.07
2017	24	20	0.17	0.03	4	1	0.75	0.19	24	21	0.13	0.06
2018	21	13	0.38	0.07	7	2	0.71	0.14	21	15	0.27	0.09
2019	19	18	0.05	0.01	1	0	1.00	0.00	19	18	0.05	0.05
Last 3 Years	64	51	0.20	0.02	12	3	0.75	0.11	64	54	0.15	0.04
All Years	289	186	0.36	0.02	74	14	0.81	0.04	289	211	0.27	0.02
Gustavus												
2003	--	--	--	--	7	0	1.00	0.00	--	--	--	--
2004	13	3	0.77	0.10	10	2	0.80	0.11	13	5	0.62	0.12
2005	9	5	0.44	0.11	6	2	0.67	0.16	9	7	0.30	0.10
2006	20	11	0.45	0.07	8	1	0.88	0.11	20	12	0.39	0.11
2007	21	10	0.52	0.08	10	0	1.00	0.00	21	10	0.52	0.11
2008	27	22	0.19	0.03	11	7	0.36	0.09	27	29	0.07	0.02
2009	29	21	0.28	0.04	9	3	0.67	0.13	29	24	0.18	0.06
2010	23	17	0.26	0.05	12	3	0.75	0.11	23	20	0.20	0.05
2011	30	18	0.40	0.06	12	1	0.92	0.08	30	19	0.37	0.08
2012	29	20	0.31	0.05	9	1	0.89	0.10	29	21	0.28	0.08
2013	30	21	0.30	0.05	10	3	0.70	0.12	30	24	0.21	0.06
2014	21	12	0.43	0.07	13	1	0.92	0.07	21	13	0.40	0.09
2015	30	19	0.37	0.05	10	3	0.70	0.12	30	22	0.26	0.07
2016	35	25	0.29	0.04	10	3	0.70	0.12	35	28	0.20	0.06
2017	29	22	0.24	0.04	7	0	1.00	0.00	29	22	0.24	0.08
2018	29	15	0.48	0.06	15	4	0.73	0.10	29	19	0.35	0.07
2019	33	24	0.27	0.04	8	1	0.88	0.11	33	25	0.24	0.07
Last 3 Years	91	61	0.33	0.03	30	5	0.83	0.06	91	66	0.27	0.04
All Years	408	265	0.35	0.01	127	27	0.79	0.03	408	300	0.27	0.02