ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
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Alaska Department of Fish and Game
Wildlife Restoration Grant

Grant Number: AKW-4 Wildlife Restoration FY2015

Project Number: 2.15

Project Title: Movement patterns, home range, and habitat use by Sitka black-tailed deer on Chichagof Island, Southeast Alaska

Project Duration: 1 July 2008–30 June 2015

Report Period: 1 July 2014–30 June 2015

Report Due Date: 1 September 2015

Cooperator: U.S. Forest Service

Principal Investigator: Karin R. McCoy, David P. Gregovich, Philip W. Mooney, Neil L. Barten

Work Location: Northeast Chichagof Island, Southeast Alaska

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) was selected for a management indicator species by U.S. Forest Service (USFS) in the Tongass Land Management Plan due to their strong association with productive old-growth forest (POG) habitat (USFS 1997, 2008). Our knowledge of deer movement patterns and habitat use in Southeast Alaska has stemmed primarily from a handful of telemetry studies (Schoen and Kirchhoff 1985, Schoen and Kirchhoff 1990, Yeo and Peek 1992, Chang et al. 1995, Doerr et al. 2005, and Farmer et al. 2006). Schoen and Kirchhoff (1985) and Schoen and Kirchhoff (1990) are the only deer studies that occurred in the northern region of Southeast Alaska where winters are more severe. These studies used traditional VHF telemetry techniques to approximate animal locations. Also, these locations were mostly collected only in daylight at intervals once per week or less. Therefore, fine-scale, daily patterns of deer movement and habitat use have not been collected.

Sitka black-tailed deer have long been considered an important species in Southeast Alaska due to their status as the primary ungulate hunted for sport and subsistence. On average, approximately 7,000 hunters kill about 10,000 deer each hunting season in Southeast Alaska (Harper 2011).

Winter severity is the primary factor regulating deer numbers in Southeast Alaska (Klein and Olsen 1960). The winter of 2006–2007 was one of the most severe on record in northern Southeast Alaska, with the highest level of cumulative winter snowfall ever recorded at the Juneau airport (McCoy 2008, Mooney 2011). The following winter was above average, and another severe winter occurred in 2008–2009. This series of severe winters caused population declines and slowed deer recovery (Mooney 2011). Deer harvest in 2006–2007 was the highest recorded since 1994, likely due to deer congregating on beaches in early winter after deep snowfall (Mooney 2011). While this deer harvest was likely compensatory, concerns remained for population recovery in areas close to population centers (Mooney 2011). As a result, management measures such as hunting season restrictions were instituted on northeast Chichagof Island. This situation increased the needs for information on deer populations, movements, and habitat use. In recent years, global positioning system (GPS) radio collars have used to gather location data on various wildlife species, e.g. brown bears (*Ursus arctos*, Flynn et al. 2012), moose (*Alces alces*, White et al. 2012a), and mountain goats (*Oreamnos americanus*, White et al. 2012b), only older course-scale data was available for deer, most of which came from southern Southeast Alaska where winters are milder.

As a result, we determined that movement data at finer temporal and spatial scales using GPS technologies were needed to provide a better understanding of deer movements among habitat patches and elevation zones. Also, we wanted to identify important travel and migration corridors, compare seasonal and diel patterns of habitat use, and more accurately define home range size. This information would be analyzed to determine fine-scale deer movement patterns in time and space as they relate to seasons, habitat, and landscape features. This project will increase our understanding of deer ecology and enhance our ability to manage deer populations.

We selected a portion of northeast Chichagof Island, the Freshwater Bay area, located in Game Management Unit (GMU) 4 in Southeast Alaska as a study area. This area was studied during1993 and 1995 as part of an ecosystem analysis by the USFS. This area received the highest overall habitat rating of all watersheds on northeast Chichagof Island for the location of the large Habitat Conservation Area (later known as a large Old Growth Reserve; USFS 1997). The existing road system within the area provided a reasonable logistical access and offered the only remaining road access to elevations to 400 m. The area consists of river valleys and rugged mountainous terrain that extend from the beach to 1,200 m. Temperate rainforest dominated by western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*) and Alaska-yellow cedar (*Callitropsis nootkatensis*) interspersed with muskeg bogs characterizes areas below 800 m, while subalpine and alpine vegetation can be found at higher elevations. On northeast Chichagof Island, clearcut logging has replaced productive old-growth forests with seral scrub and second-growth forests of varying ages. While deer populations were believed to be moderately high across GMU 4, the 2006–2009 winters reduced deer populations in this area.

II. REVIEW OF PRIOR RESEARCH AND STUDIES IN PROGRESS ON THE PROBLEM OR NEED

While much is known about the general ecology of Sitka black-tailed deer (Klein and Olson 1960, Klein 1965, Olson 1979, Hanley 1984), our knowledge of deer movement and habitat use in Southeast Alaska has been provided by a handful of telemetry studies (Schoen and Kirchhoff 1985, Schoen and Kirchhoff 1990, Yeo and Peek 1992, Chang et al. 1995, Doerr et al. 2005, Farmer et al. 2006), only one of which occurred in the northern segment of the region, where winters are more severe. All of these studies relied on locations collected at course intervals of either approximately once per day or once per week, and used traditional VHF telemetry techniques to approximate animal locations. Therefore, analyses of fine-scale daily patterns of deer movement and habitat use had not been conducted.

III. APPROACHES USED AND FINDINGS RELATED TO THE OBJECTIVES AND TO PROBLEM OR NEED

Objective 1: Use GPS collars to collect fine-scale deer movement data that will allow us to identify important travel routes used by deer during different seasons, as well as to detect differences in movement patterns, home range, and habitat use between different seasons and in relation to the level of forest fragmentation.

Approach: We captured deer on northeast Chichagof Island by ground darting in summer and early fall. Also, we captured deer by net gunning using helicopters in alpine habitats during late summer. After a deer was successfully captured, we attached a GPS radio collar.

Deer were classified by sex (male/female) and age group (adult yearling or adults). We delineated seasons as follows: 1 January–31 March (winter, 90 days), 1 April–21 June (spring, 82 days), 22 June–21 September (summer, 92 days), 22 September–31 December (fall, 101 days). We calculated seasonal minimum convex polygons (100% MCP) and fixed-kernel density estimation (KDE) home ranges for each animal by year (annual seasonal home range) and for all years combined (overall seasonal home range). We calculated 100% MCPs, so we could compare seasonal deer home ranges with Schoen and Kirchhoff (1985). MCPs were calculated using the ET Geowizards tool “features to convex polygons”. Kernel home ranges were calculated using the KDE and ISOPLETH commands in Geospatial Modelling Environment (GME) (Beyer 2012).

Schoen and Kirchhoff (1985) classified deer as resident if winter and summer MCP home ranges overlapped, or migratory if these ranges were non-overlapping. We evaluated home range overlap between summer and winter using both MCP and KDE overall and yearly seasonal home ranges. We believed that deer captures in the alpine on summer range would be migratory and deer captured at low elevations on summer range would be resident. We evaluated seasonal home ranges with the previous criterion. After we examined the movement data, we derived different categories.

If deer clearly migrated from one area on the coast to another inland area (in contrast with deer that migrate to the alpine), we called these low-elevation migrants. Some deer made brief excursions during early summer back to their winter ranges before settling into their summer ranges for the duration of August and September. We classify these deer as high-elevation migrants despite overlapping home ranges based on the bi-modal nature of these summer ranges and the primary use of high elevation zones during this time period. In addition, we called any deer that migrates at least once between a high elevation summer range and low elevation winter range a high-elevation migrant.

If deer were captured in the alpine and wintered at high elevations and their summer and winter ranges overlapped, we called them high-elevation residents. If deer were captured at low elevations during the summer season and had overlapping summer and winter ranges, we called the deer low-elevation residents.

In many cases, the deer movement data collected by the GPS collars did not span the entire date range of a season during the calendar year due to the timing of captures and collar release. Preliminary analyses indicated that truncating the date range of a season could affect home range size of that season for some deer. For this reason, home range data pooled for all years was used to calculate overall seasonal home range sizes. When at least 90% of the number of days within a seasonal range was not available for a given animal, that animal was excluded from home range size analyses. Home range size was calculated using the Arctoolbox add geometry attributes" function.

Schoen and Kirchhoff (1985) considered deer to have used the same seasonal home range if ranges in consecutive years overlapped. Annual seasonal home ranges were evaluated in ArcGIS to determine home range overlap. Centroids were created using ET geowizards "polygon to point – centroid inside" function. Distances between annual seasonal home range centroids were calculated using the "point distances" command in GME.

However, to analyze distance between summer and winter home ranges, we only used their non-overlapping summer and winter home ranges to calculate a mean distance between summer and winter ranges for this group.

We calculated the mean elevation of deer within seasonal home ranges by month. In addition, for each deer with overlapping annual summer or winter home ranges, we calculated the distance between overall summer and overall winter MCP home ranges for each animal. Centroids for each overall seasonal MCP home range were created using ET geowizards "polygon to point – centroid inside" function. Distances between seasonal home range centroids were calculated using the "point distances" command in GME.

We compiled the GIS location data and location data were attributed with elevation, slope, aspect, and USFS landcover type (Southeast Alaska GIS Library 2015). The USFS size-density habitat layer is part of the landcover type.

Findings: We captured 28 deer (8 males and 20 females) from August 2009–August 2012 (Table 1). Of these deer, 19 were considered adults and 9 yearlings. Twelve deer (2 males and 10 females) were ground darted; 16 deer (6 males and 10 females) were net gunned in the alpine during late August 2010. We attached GPS radiocollars to these deer.

Deer classification was more complex due to much variation among anticipated groupings (Table 2). Three deer (HD06, HD35, and HD40) with non-overlapping summer and winter MCP and/or KDE home ranges did not have locations in alpine habitats. To distinguish them from deer that migrated to the alpine, we called these deer low-elevation migrants. Three deer (HD16, HD29, and HD30) were captured in the alpine during summer, but had summer and winter ranges that overlapped. Two deer (HD10 and HD41) were captured at low elevation during the summer and migrated to the alpine. These 5 deer seemed to have summer ranges characterized by use of a completely different alpine areas not used during winter. However, during early summer, they made brief excursions back to their winter ranges before settling in to their summer ranges for the duration of August and September. We classified these deer as high-elevation migrants. One deer (HD26) stayed at higher elevations in winter 2011, but migrated to a distinct low elevation winter range during the more severe winter snowfall in 2012. As a result, Deer HD26's summer ranges overlapped in 2010 and 2011 and overlapped winter 2011, but did not overlap with winter 2012. We called Deer HD26 a high-elevation migrant. We did have two deer (HD22 and HD25) that were captured in the alpine and did indeed migrate to distinct low-elevation winter ranges in both 2011 and 2012. These deer were grouped as high-elevation migrants. We suspect that 2 other deer (HD21 and HD28) that were captured in the alpine and wintered at high elevations in 2011 are actually migrants like HD26, but since we only have one winter season for them, we do not know if they migrated in 2012. Because their summer and winter ranges overlapped, we called them high-elevation residents. Four deer (HD04, HD09, HD14 and HD42) that were captured at low elevations during the summer season and had overlapping summer and winter ranges were classified low-elevation residents.

MCP home range size in summer ranged from 57 to 1,944 ha with an average of 474 ha for all deer combined (n = 18). Winter MCP home range size ranged from 29 to 1,399 ha, with an average of 186 ha for all deer combined (n = 22).

For all deer with multiple years of summer locations (n =19; 15F, 4M), all annual summer home ranges overlapped, with the exception of HD10, a yearling male deer who dispersed from the watershed in which it was captured. Excluding HD10, the overall mean distance between summer home ranges was 0.81 km (n = 26). For deer with multiple years of winter locations (n =6, 4F, 2M), 4 winter annual home ranges overlapped, one did not. The one that did not was an adult female high-elevation migrant that did not migrate to her winter range in 2011. The mean distance between winter home ranges for this animal was the highest of all deer at 5+ km. This female was grouped separately for this analysis. The remaining deer had an overall average distance between winter annual home ranges of 1.14 km.

Summer had the overall highest mean elevation (433 m). Winter had the lowest mean elevation (118 m). Summer displayed the greatest variation in elevations overall, but high elevation migrants in the fall displayed the highest variation in elevation of all groups among all seasons. Each group had their highest mean seasonal elevation during summer, with the highest peak generally in September and descending thereafter. Mean elevation by month is displayed in Figure 1.

HD10 dispersed to another watershed, resulting in over 14 km between his overall summer and winter ranges. Keeping HD10 separate, mean distance moved between overall summer and winter ranges was 3.86 km for the rest of the deer combined (n = 23). Low-elevation migrants moved the furthest followed by high-elevation migrants.

We began a preliminary analysis on seasonal habitat use using the USFS landcover habitat layer. We found this habitat layer had substantial mapping errors, so we had difficultly distinguishing among some habitat classes of interest. Thus, further analyses of habitat use were postponed until we investigate the potential of developing a more accurate habitat classification using more recent remote sensed satellite imagery.

Objective 2: Provide information for public education and outreach.

We produced annual reports and a final report.

IV. MANAGEMENT IMPLICATIONS

While this final performance report details our findings on the movement patterns and home range sizes of northern Southeast Alaska deer, we are in the process of synthesizing additional habitat use data and will provide management implications when these analyses are complete. However, deer remain one of the most important harvested species in Southeast Alaska, and our understanding of deer ecology, movement, and habitat use will be advanced by the analyses of these data. In addition, we recommend that work to develop a better habitat layer for these particular deer locations should be continued to broaden our understanding of deer habitat use.

V. SUMMARY OF WORK COMPLETED ON JOBS

FROM PROJECT STATEMENT:

Objective 1: Use GPS collars to collect fine-scale deer movement data that will allow us to identify important travel routes used by deer during different seasons, as well as to detect differences in movement patterns, home range, and habitat use between different seasons and in relation to the level of forest fragmentation.

Job/activity 1a: Order collars, purchase animal capture equipment, program collars, review literature, develop a work plan, organize and mobilize personnel.

Accomplishments: This job was completed. Four radio collars remained from this project with intact battery life for field deployment. These have been stored in "off" status. Collars were not reprogrammed for revised deployment dates, because no further captures or collaring is planned.

Job/activity 1b: Conduct ground and aerial based activities instrumental in the collaring of Sitka black-tailed deer and the retrieval of released collars.

Accomplishments: This job was completed. This study proved more challenging than anticipated, because deer populations were reduced from hard winters and hunting pressure. We encountered few deer along road systems at the study onset, making it hard to get collars deployed in a timely manner. After only getting a few collars out in 2008 and 2009, we finally brought a net gunning crew down from the interior to collar deer in the alpine, and through both that and ground-darting efforts, we were finally able to deploy 20 collars in fall 2010 (two years behind our initial schedule). Collars were deployed for 1 or 2 years on both male and female deer. More collars were deployed in 2011 and 2012 (Table 1).

In 2009, manufacturing defects in the telemetry tailpiece that allowed radiotracking of the dart (and the drugged deer) resulted in the loss of 9 darted deer. We learned from the manufacturer that an error was made in transmitter length. Upon the dart's impact, the transmitter knocked the tailpiece out of the dart cylinder leaving no mechanism to recover the darted deer.

Job/activity 1c: Monitor snow depths through nearby weather stations and by ground checks of snow conditions.

Accomplishments: Monthly snowfall was recorded for each month of each winter from nearby existing NOAA weather stations. In addition, 3 snow stakes equipped with hobo logger sensors were deployed in the Pavlof watershed at low (0–150 m), medium (150–300 m), and high (<300 m) elevations for comparison to snow depths recorded at the Hoonah and other weather stations. The hobo logger sensors on the snow stakes were retrieved in spring 2015, but the data has not yet been analyzed. Some stakes had been knocked to the ground by bears, so it may be difficult to analyze the data if the timing of this event cannot be determined. Regardless, the winter of 2014–2015 was one of the lowest snow years on record.

Job/activity 1d: Identify deer home range characteristics and investigate differences in home range size.

Accomplishments: Radiocollars were recovered in August and September of 2013 and the location data were downloaded. We have analyzed home ranges patterns and reported the results in this document.

Job/activity 1e: Identify differences in deer movement and activity patterns relative to seasonal use of habitat types and level of POG forest fragmentation.

Accomplishments: Habitat use analyses were undertaken in fall 2014, but have not been completed because initial results were confounded by habitat mapping errors. We are in the process of identifying a better habitat data source to complete the analyses.

Job/activity 1f: Identify diel and seasonal patterns of deer habitat use.

Accomplishments: Analyses of these data have begun, but has not been completed. See Job/activity 1e.

Objective 2: Provide information for public education and outreach.

Job/activity 2a: Write annual reports detailing activities and accomplishments to date, including results of animal captures and collar status.

Accomplishments: Annual performance reports were prepared.

Job/activity 2b: Write final report.

Accomplishments: A final report was prepared.

Job/activity 2c: Prepare manuscript for submission.

Accomplishments: No publications were prepared and the analysis continues. We plan to publish a technical report later this year.

VI. PUBLICATIONS

We produced these annual progress reports:

McCoy, K. 2009. Movement patterns, home range, and habitat use by Sitka black-tailed deer in Southeast Alaska. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid Annual Research Performance Report 1 July 2008-30 June 2009, Federal Aid in Wildlife Restoration Project 2.15, Juneau.

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I. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT

None.

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White, K. S., D. P. Gregovich, G. W. Pendleton, N. L. Barten, R. Scott, A. Crupi and D. N. Larsen. 2012b. Mountain goat population ecology and habitat use along the Juneau Access road corridor, Alaska. Final wildlife research report. ADF&G/DWC/WRR-2012-02. Alaska Department of Fish and Game, Juneau, AK.

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Submitted by: Rodney W. Flynn, Research Coordinator

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Table 1: Captured and radiocollared deer on northeast Chichagof Island, 2009–2013, that were used for habitat or movement analyses.

Deer ID	Collar	Capture method	Capture	Sex	Age	On	Off	Days	No. locations
HD04	618563	Ground	08/07/09	F	A	08/08/09	01/25/11	535	5294
HD06	618564	Ground	08/10/09	F	Y	08/10/09	06/30/11	689	6878
HD09	622909	Ground	07/14/10	F	Y	07/15/10	07/31/11	381	9399
HD10	616625	Ground	07/15/10	M	Y	07/16/10	07/31/11	380	9315
HD14	618567	Ground	07/19/10	F	A	07/20/10	03/18/11	241	2060
HD15	618570	Netgun	08/27/10	F	A	08/28/10	03/10/11	194	1814
HD16	616648	Netgun	08/27/10	F	A	08/28/10	07/31/11	337	8898
HD17	618562	Netgun	08/27/10	M	A	08/28/10	11/12/10	76	1078
HD18	616780	Netgun	08/27/10	M	A	08/28/10	10/17/10	50	2261
HD20	616644	Netgun	08/27/10	F	A	08/28/10	07/31/11	337	9007
HD21	616789	Netgun	08/27/10	F	A	08/28/10	07/31/11	337	8802
HD23	616647	Netgun	08/28/10	F	A	08/29/10	07/31/11	336	9009
HD24	616781	Netgun	08/28/10	M	Y	08/29/10	07/31/11	336	9050
HD27	616661	Netgun	08/28/10	F	A	08/29/10	07/31/11	336	9085
HD29	616649	Netgun	08/28/10	M	A	08/29/10	06/06/11	281	7652
HD30	616624	Netgun	08/28/10	F	A	08/29/10	07/31/11	336	8948
HD31	616642	Netgun	08/28/10	F	A	08/29/10	07/31/11	336	8677
HD22	618597	Netgun	08/28/10	M	A	08/29/10	08/01/12	703	7135
HD25	618569	Netgun	08/28/10	M	A	08/29/10	08/01/12	703	6857
HD26	618572	Netgun	08/28/10	F	A	08/29/10	08/01/12	703	7158
HD28	618571	Netgun	08/28/10	F	A	08/29/10	04/25/11	239	2254
HD32	618568	Ground	09/29/10	F	Y	09/30/10	08/01/12	671	7110
HD35	615980	Ground	8/9/2011	F	A	08/10/11	08/01/12	357	8276
HD39	655431	Ground	06/19/12	F	Y	06/20/12	07/03/12	13	621
HD42	616659	Ground	08/02/12	M	Y	08/03/12	04/26/13	266	5638
HD40	655437	Ground	07/12/12	F	Y	07/13/12	08/01/13	384	11454
HD41	618562	Ground	07/11/12	F	Y	07/12/12	08/01/13	385	10948
HD43	618562	Ground	08/05/12	F	A	08/06/12	09/28/12	53	1247

Table 2: Residency and elevational status of deer captured on northeast Chichagof Island, 2009–2013.

Status[a]	Capture method[b]		Sex		Age		Total deer
	G	N	M	F	Y	A	
Migrant-high elevation	1	15	7	9	3	13	16
Migrant-low elevation	3	0	0	3	2	1	3
Resident-high elevation	0	2	0	2	0	2	2
Resident–low elevation	7	0	1	6	4	3	7
Totals	11	17	8	20	9	19	28

[a] Residency and elevational status are defined in the text.
[b] Capture method G = ground and N = netgun.

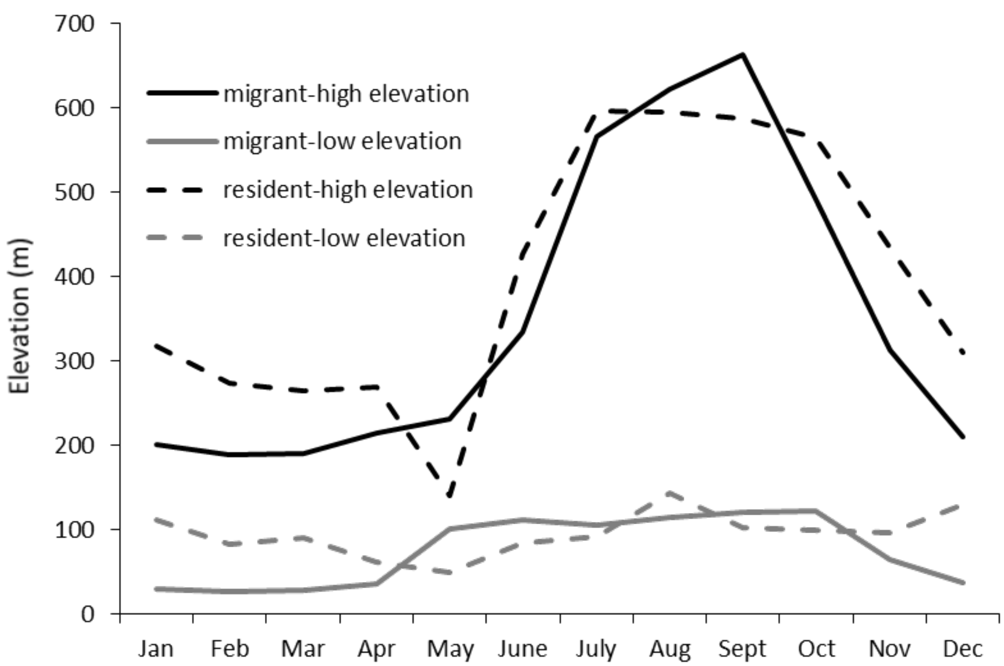

Figure 1. Mean elevation by month of each migratory group on northeast Chichagof Island, 2009–2013. Definitions of elevational and migratory status are described in the text.