**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-4 Wildlife Restoration FY2015

**Project Number:** 13.01

**Project Title:** Elk movements and habitat use, Unit 3

**Project Duration**: 1 July 2010 to 30 June 2015

**Report Period:** 1 July 2014 to 30 June 2015

**Report Due Date:** 1 September 2015

**Cooperator:** Rocky Mountain Elk Foundation

**PRINCIPAL INVESTIGATOR:** Richard E. Lowell, David P. Gregovich, and LaVern B. Beier

**WORK LOCATION:** Etolin and Zarembo islands in Alaska, GMU 3

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**I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH** In 1985 the Alaska Legislature passed a law that required the introduction of 50 elk to Etolin Island. In spring of 1987, 33 Roosevelt elk (*Cervus elaphus roosevelti*) from Jewell Meadows Wildlife Management Area and 17 Rocky Mountain elk (*C. e. nelsoni*) from the Elkhorn Wildlife Management Area in Oregon were translocated to Southeast Alaska in Game Management Unit (GMU) 3. Roosevelt elk were released at Dewey Anchorage on the southwest side of Etolin Island and Rocky Mountain elk were released just north of Johnson Cove on the northwest shore of Etolin Island. Twenty-eight of the transplanted elk (all cows) were fitted with radio collars to monitor their survival, productivity, and movements. Initial losses were high, and about two-thirds of the elk died from predation, starvation, and accidents within 18 months of release. Following initial losses, the population stabilized, and eventually began increasing. By 1994, when the last radio collar failed, the population had increased to estimated 100–125 animals and elk had successfully dispersed to neighboring islands, establishing a second breeding population on Zarembo Island.

By 1996 the elk population was estimated to be 250 elk, and the Alaska Board of Game approved a limited hunting season. Elk were first hunted on Etolin Island during fall 1997 under drawing permits issued for a 1-month, 1-bull season in October (Paul 2009). There are currently 3 separate drawing permit hunts and a late-November registration permit hunt each fall on Etolin island. Since 1997, a total of 1,312 hunters have taken 158 bulls (12% success), including 125 (79%) harvested on Etolin Island and 33 (21%) harvested on Zarembo Island.

Precise population estimates for elk on Etolin and Zarembo islands are not available and are difficult to obtain due to problems in sightability, rough terrain, dense vegetation, and elusive behavior. As a result, the current distribution, status, and trend of elk populations in the unit remain unclear. Dave Person (personnel commination, ADF&G biologist) developed a model to predict elk population size in Southeastern Alaska that used demographic information for elk in other areas to provide preliminary parameters, and incorporated a simple logistic population growth model that includes effects from harvest. This model estimated that a reasonable upper limit of elk populations on Etolin and Zarembo islands was approximately 450 animals in 2000 (Elk Technical Committee 2000). However, Person (personnel commination, ADF&G biologist) thought this estimate to be high, as the model did not include population decreases due to predation, dispersal, competition with deer, and other factors.

Members of the public have reported seeing elk on Mitkof, Wrangell, Prince of Wales, Deer, Bushy, Shrubby, and Kupreanof Islands, and on portions of the Unit 1A and 1B mainland; however these reports remain largely unverified. Numbers of elk on islands other than the Etolin and Zarembo island complex are thought to be low (Lowell 2010).

Initial fears that the elk population, once established, would begin to grow exponentially now appear unfounded. Although the current population trend is unknown, we are concerned that the elk population may have stabilized at a low level relative to habitat capability, primarily due to predation by wolves and bears.

The goal of this project was to gather information to be used to refine our elk management strategy, provide for hunter harvest and allow for continued growth of the GMU 3 elk herd. Because it is difficult to find and see elk in the region's rugged terrain and dense vegetation, we determined the best way of achieving these research goals was through capture and radiocollaring of a sample of elk throughout their current range.

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

In 2008 the Alaska Department of Fish and Game (ADF&G) initiated a pilot study to assess the feasibility and practicality of capturing elk to obtain baseline information on the elk population by attaching remote-download GPS collars. During 2008-2009, initial investigations showed that elk could be successfully captured and radiocollared on Etolin and Zarembo islands by helicopter darting (R. Lowell, pers. comm.). Subsequently, over 16,000 successful locations have been collected from 7 GPS-collared elk, including 1 elk on Zarembo Island and 6 elk on Etolin Island. Monitoring efforts included quarterly data download flights to retrieve GPS location data from collared elk.

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

**OBJECTIVE 1:** Determine movement patterns of radiocollared elk on Etolin and Zarembo islands.

**Approaches:** We captured elk on Zarembo and Etolin Island to radiocollar them with GPS collars. Adult cows were targeted to obtain information on calving areas. Captures

were attempted on beaches, estuaries, and beach-fringe muskegs during the winter months, when herds are most discrete, using helicopter-darting protocols that were developed for elk in the Kodiak Archipelago, or by ground-darting. Because most GMU 3 elk reside within the South Etolin Wilderness where helicopter landings are heavily regulated, our capture efforts on southern Etolin were largely restricted to state tidelands (below mean high tide) and a relatively small state in-holding at McHenry Anchorage from 2008 to early 2011. As a result, elk capture efforts required considerable care and thoughtful planning in regard to helicopter approach vectors, terrain configuration and capture team safety. Radio transmitter darts were used to facilitate locating elk that ran into dense forest cover after having been darted and to locate and recover any darts that missed their targets. Elk captures were conducted during late-March and early-mid April when elk occupy low elevation winter range, temperatures were milder, and daylight hours were increasing. Upon locating one or more elk near the shoreline, the capture helicopter would veer away so as not to alarm the elk and land a safe distance away where the helicopter and equipment were prepared for capture attempts.

In August 2011, ADF&G received authorization from the USFS for a limited number of elk research related helicopter landings within the South Etolin Wilderness Area. South Etolin elk tend to congregate in open supalpine and alpine habitats during the summer months where it was possible to maximize capture opportunites and effeciency.

All darting was conducted using a Palmer Cap-Chur rifle and Palmer brand internal-charge 3 cc darts with 19 mm or 30.5 mm barbed needles (Cap-Chur, Douglasville, GA) and green or brown charges. In 2008 elk were immobilized with a combination of carfentanil (1.7 cc; 5.1 mg) and xylazine (1.3 cc; 130 mg) administered intramuscular from a dart. Naltrexone (10 cc; 500 mg) was used as the antagonist for carfentanil and 1-2mg/kg of tolazoline was administered to reverse the xylazine. In 2009, we reduced both the carfentanil dosage (1.3 cc; 3.9 mg) and the xylazine dosage (1.0 cc; 100 mg). In 2011, at the direction of the department veterinarian, we returned the carfentanil dosage to 1.7 cc (5.1 mg) while maintaining the xylazine dosage at (1.0 cc; 100 mg). Capture methods were approved by the ADF&G Animal Care and Use Committee (ACUC #07-012).

We attached numbered visual collars and remote-download GPS radio collars (Telonics TGW-3690, Telonics, Mesa, AZ) to each captured elk, with the exception of 1 adult cow captured in 2011 whose neck circumference was too large for the available collar. During 2008, we attached visual collars to the GPS collars, and they were jettisoned when GPS collars released automatically after 2-years. Since 2009, elk visual collars have been attached separately from GPS collars in order to allow long-term (permanent) identification of previously radiocollared animals. In addition to numbered visual collars and GPS radio collars, beginning in 2011; we simultaneously deployed lightweight secondary VHF radio transmitters (Model 336 MK 9, Telonics, Mesa, AZ) on each animal to enable long-term monitoring of elk for an additional 3 years after GPS collars release. GPS radio collars were programmed to collect location data at 4-hour intervals (collar lifespan: 2 years). GPS location data-sets were remotely downloaded (via fixed or rotor wing aircraft 3-4 times a year (pre-programmed download “windows” occur 2 days weekly). GPS radio collars were programmed to release automatically after 2-years, either on 1 April, or 1 January depending on the deployment date. Collar release

mechanisms (Telonics Model CR-2a) were pre-programmed to release while elk were on low-elevation winter range to increase the likelihood that collars could be retrieved on foot from the shoreline, thereby minimizing the need for helicopter landings in the South Etolin Wilderness.

After we downloaded GPS location data for each elk, we analyzed the locations using ArcGIS (ArcGIS 10, ESRI, Redlands, CA) software. We plotted the elk GPS locations on habitat maps to identify habitat categories that were seasonally important to elk. Using GIS, we measured the distance to shore (m), elevation (m), slope (°), and aspect (°) for each GPS location, and then we computed these parameters for each elk by month. We averaged across the elk by month.

We divided the calendar into seasons for this analysis; winter = 22 December–21 March; spring = 22 March–21 June; summer = 22 June–21 September; and fall = 22 September–21 December. Because we had only 1 male, we didn't separate the animal by sex. We calculated the area of seasonal home ranges using 100% convex polygons (100% CP). Also, we computed the elevation for the same seasons.

**Findings:** From 2008–2012, we successfully captured and collared a total of 17 elk including 16 on Etolin Island (1 male and 15 females), and 1 female on Zarembo Island). These captures included the following: 2008 = 2 females; 2009 = 4 females; 2010 = 0; 2011 = 1 yearling male and 3 females; and 2012 = 7 female elk.

From 2008 to 2014, we obtained over 56,000 individual GPS relocations from 16 elk (1 male and 15 females). The number of relocations for individual elk ranged from 766 to 5,289. Excluding the Zarembo Island elk, we recorded 15,082 summer locations and 11,696 winter locations.

On Etolin Island, the elk shifted home range use areas by season as reflected by elevational changes. In summer, the mean location elevation was greater (504±24.7 m (±SE)) compared with winter (53.5±3.7 m, *t*-test $P > 0.01$). We didn't find any difference in mean home range area between summer (31.2±4.4) and winter (39.1±4.5, *t*-test $P = 0.2$).

**OBJECTIVE 2:** Identify habitats that are important to elk.

**Approaches:** We plotted the elk GPS locations on habitat maps to identify habitat categories that were seasonally important to elk. Using GIS, we measured the distance to shore (m), elevation (m), slope (°), and aspect (°) for each GPS location, and then we computed these parameters for each elk by month. We averaged across the elk by month.

**Findings:** In winter, the elk stayed closer to the ocean shore in winter (aveage distance in March = 778 m) then during summer (aveage distance in June = 3,793 m (Table 1). Also, the elk were located at lower elevations in late winter (average elevation in March = 47 m) compared to summer (average elevation in August = 546.9 m). (Table 1). The elk used habitats with lower slopes winter (December slopes avearged = 5.3°) than in summer (August slopes avearged = 21.2°).

We will include more analysis of these data in a future technical report.

**OBJECTIVE 3:** Facilitate locating herds for minimum population estimates and composition counts.

**Approaches:** The radiocollared elk were aerially located and counted.

**Findings:** A sample of radiocollared elk on southern Etolin and Zarembo islands has made it possible to more efficiently locate elk herds for minimum population and herd composition counts. We collected age and sex composition for the elk population by counting elk during the summer months when elk tend to congregate in open subalpine and alpine areas. To date, the greatest number of elk observed on Zarembo Island occurred on 16 August 2004 when a single herd comprised of 36 individuals was observed south of Baht Harbor. The greatest number of elk observed on Etolin Island occurred on 13 July 2010 when 163 elk were observed in 3 individual herds in the vicinity of Mt Etolin and Mt Shakes. An unknown number of elk are also known to inhabit the western portion of Etolin Island. The current estimate of the GMU 3 elk population was approximately 250–350 animals with most occurring on Etolin Island.

Subalpine habitat is extremely limited on Zarembo Island and the island's elk herd is not known to use what little subalpine does exist. Therefore, the best information on herd size and age/sex composition on Zarembo comes from opportunistic sightings of elk in open muskegs, grassy fens, clearcuts or open shoreline areas. In the aftermath of the 2005 emergency closure of the elk season on Zarembo Island, and prior to the start of the 2006 season, a decision was made not to reopen the elk season on Zarembo Island until the population increased. In January 2012, the Alaska Board of Game adopted a department sponsored proposal to close Zarembo, Bushy, Shrubby and the Kashevarof islands to elk hunting. This action was taken in response to the declining elk population, and low bull: cow ratios on Zarembo, and concerns that elk were being illegally harvested on Zarembo and reported as having been harvested during the general season hunt on Bushy and Shrubby islands. Based on recent observations by biologists and members of the public, we now believe the Zarembo elk population has declined to about 20 animals.

## IV. MANAGEMENT IMPLICATIONS

A key goal of this project was long-term monitoring of population size and trend, and herd composition. In this regard, consistent monitoring of marked animals at regular time intervals needs to continue. Acquisition of these data will be crucial for monitoring the population and devising appropriate management strategies.

In addition to occupying Zarembo Island and the South Etolin Island Wilderness, elk are also know to inhabit the western lobe of Etolin Island (west of Mosman Inlet), including several smaller associated islands located in Rocky Bay and Three-Way-Passage. Unlike elk on southern Etolin which utilize alpine and subalpine habitats extensively during the summer months, elk on western Etolin have limited access to this habitat type and little is known about the distribution, population size or movement patterns of this segment of the Unit 3 elk population. Therefore, future elk research efforts will focus on trying to radiocollar a sample of elk on Zarembo Island and western Etolin Island in an attempt to improve our understanding of those segments of the Unit 3 elk population.

The Minimum Requirements Decision Guide (MRDG) authorizing ADG&G to conduct a limited number of helicopter landings within the South Etolin Wilderness expired in 2015; thereby preventing future helicopter assisted capture, radiocollaring, and collar recovery efforts within the South Etolin Wilderness. As a result, we currently have no plans to radiocollar additional elk within the South Etolin Island Wilderness.

In recent years, we have become concerned about the status of the elk herd on Zarembo Island where the population appears to be declining. There are currently no radiocollared elk on Zarembo Island, and to date we have only successfully collared a single animal here. In order to monitor the population status and herd composition in this segment of the Unit 3 population, we should continue to radiocollar 1 elk on Zarembo Island.

## V. SUMMARY OF WORK COMPLETED ON JOBS .

**FROM PROJECT STATEMENT:**

**Objectives:** The primary objectives of the project are to: (1) delineate summer and winter ranges of elk and identify calving and rutting areas; (2) identify habitats that are important to elk; and (3) facilitate locating herds for minimum population estimates and composition counts.

**Objective 1:** Delineate summer and winter ranges of elk and identify calving and rutting areas.

**Job/activity 1a:** Capture and radiocollar a sample of elk on Etolin and Zarembo islands.

**Accomplishments:** From 2008 to 2012, we successfully captured and collared a total of 17 elk including 16 on Etolin Island (1 male and 15 females), and 1 female on Zarembo Island. These captures included the following: 2008 = 2 females; 2009 = 4 females; 2010 = 0; 2011 = 1 yearling male and 3 females; and 2012 = 7 female elk.

**Job/activity 1b:** Determine seasonal movement patterns of radiocollared elk on Etolin and Zarembo islands.

**Accomplishments:** From 2008 to 2014, we obtained over 56,000 individual GPS relocations from 16 elk (1 male and 15 females) successfully captured and fitted with GPS radio collars. The number of relocations for individual elk ranged from 766 to 5289. Excluding the Zarembo Island elk, we recorded 15,082 summer locations and 11,696 winter locations.

On Etolin Island, the elk shifted home range use areas by season as reflected by elevational changes. In summer, the mean location elevation was greater (504±24.7 m (±SE)) compared with winter (53.5±3.7 m, *t*-test $P > 0.01$). We didn't detect any difference in mean home range area between summer (31.2±4.4) and winter (39.1±4.5, *t*-test $P = 0.2$).

**Objective 2:** Identify habitats that are important to elk.

**Job/activity 2a:** Determine seasonal habitat selection patterns of radiocollared elk.

**Accomplishments:** These data have been collected and summarised. We have not analysized or evaulated these data completingly. We will include more analysis of these data in a future technical report.

**Objective 3:** Facilitate locating herds for minimum population estimates and composition counts.

**Job/activity 3a:**

**Accomplishments:** We were able to locate groups of elk for population estimates and composition counts. The greatest number of elk observed on Etolin Island occurred on 13 July 2010 when 163 elk were observed in 3 individual herds in the vicinity of Mt Etolin and Mt Shakes. An unknown number of elk are also known to inhabit the western portion of Etolin Island. A current subjective estimate of the Unit 3 elk population is approximately 250–350 animals, with most occurring on Etolin Island.

**Objective 4:** Prepare annual and final reports

**Job/activity 4a:**

**Accomplishments:** Federal Aid progress reports were prepared annually and a final Federal Aid report was submitted. A progress report to the Rocky Mountain Elk Foundation was completed in 2012. A technical wildlife research report will be completed in 2016.

## VI. PUBLICATIONS

Lowell, R. 2010. Unit 3 Elk Management Report. Pages 1-9 *in* C. Brown, editor. Management report of survey-inventory activities, 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Juneau.

Lowell, R. 2011. Elk movements and habitat use, Unit 3. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid Annual Research Performance Report 1 July 2010 to 30 June 2014, Federal Aid in Wildlife Restoration Project 13.01, Juneau.

Lowell, R., L. Beier, and C. Koch. 2012. Elk movements and habitat use in Unit 3. Progress report to the Rocky Mountain Elk Foundation. Unpublished report. Alaska Department of Fish and Game, Division of Wildlife Conservation. Petersburg, Alaska.

Lowell, R. 2013. Elk movements and habitat use, Unit 3. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid Annual Performance Research Report July 1, 2010 to June 30, 2014, Federal Aid in Wildlife Restoration Project 13.01, Juneau.

Lowell, R. E. 2014. Elk movements and habitat use, Unit 3. Alaska Department of Fish and Game, Division of Wildlife Conservation, Federal Aid Annual Research Performance Report 1 July 2010 to 30 June 2015, Federal Aid in Wildlife Restoration Project 13.01, Juneau.

## REFERENCES

ADF&G. 1999. Southeast Alaska Elk Management Plan, Division of Wildlife Conservation, Department of Fish and Game, Juneau.

Elk Technical Committee. 2000. Elk Technical Committee meeting notes. On file at ADF&G, Division of Wildlife Conservation, Ketchikan.

Lowell, R. 2010. Unit 3 Elk Management Report. Pages 1-9 in C. Brown, ed. Management report of survey-inventory activities, 1 July 2001–30 June 2003. Alaska Department of Fish and Game. Juneau.

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

Beginning in 2011, in addition to GPS collars we also fitted a smaller secondary VHF collar to captured elk to facilitate long-term monitoring of elk (up to 5 additional years) after GPS collars released. During 2011 and 2012 a total of 11 elk (10 females, and 1 male) were fitted with secondary VHF collars. Fate of those elk as of August 2015: 2 confirmed mortalities; 1 shot legally by a hunter; 1 inactive, fate unknown; 5 still alive; and 2 not located recently.

**PREPARED BY:** Richard Lowell

**SUBMITTED BY:** Rodney W. Flynn

**DATE:** 15 September 2015

Table 1. Attributes of GIS locations for elk by month in GMU 3, 2010–2014.

| Month | Distance .to shore (m) | | Elevation (m) | | Slope (°) | | Aspect (°) | |
|---|---|---|---|---|---|---|---|---|
| | x̄ | SD | x̄ | SD | x̄ | SD | x̄ | SD |
| January | 1253 | 1007 | 63.1 | 43.2 | 5.7 | 4.1 | 176.9 | 82.8 |
| February | 1339 | 1132 | 68.4 | 50.4 | 5.7 | 3.8 | 177.5 | 79.7 |
| March | 778 | 629 | 47.0 | 28.7 | 5.4 | 3.7 | 180.5 | 76.4 |
| April | 1591 | 1104 | 63.3 | 33.3 | 5.6 | 3.7 | 173.8 | 85.0 |
| May | 2720 | 1409 | 153.2 | 110.9 | 11.3 | 7.8 | 175.3 | 80.6 |
| June | 3793 | 865 | 346.8 | 149.7 | 18.7 | 8.8 | 191.0 | 85.9 |
| July | 3752 | 650 | 446.7 | 175.6 | 20.7 | 8.8 | 204.8 | 92.5 |
| August | 3756 | 750 | 546.9 | 199.1 | 21.2 | 8.7 | 204.7 | 96.7 |
| September | 3727 | 853 | 457.2 | 171.1 | 19.8 | 8.6 | 192.2 | 88.0 |
| October | 2852 | 1268 | 221.2 | 141.3 | 12.9 | 7.6 | 174.0 | 89.3 |
| November | 1751 | 1147 | 121.9 | 79.2 | 7.6 | 4. | 172.7 | 81.7 |
| December | 761 | 641 | 51.8 | 37.6 | 5.3 | 3.8 | 183.7 | 77.2 |
| Overall means | 2339 | 1223 | 215.6 | 184.6 | 11.7 | 6.7 | 183.9 | 11.6 |