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 4.44 FY2015** **Segment Number: 1**

Project Number:

Project Title: Use of AIMS-Thermal Sensor system to detect and identify bears in south-central Alaska (GMU16B)

Project Duration: 1 July 2013 – 30 June 2015

Report Period: 1 July 2014 – 30 June 2015

Report Due Date: September 29, 2015

Cooperator: Dr. Thomas Millette Mt. Holyoke College

PRINCIPAL INVESTIGATOR: Vacant

WORK LOCATION: GMU 16B

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

This is a demonstration project to see whether the AIMS-T system is capable of detecting brown and black bears under early spring conditions in south-central Alaska, at a level beyond simple aerial visual surveys. Additionally DWC wanted to test whether the resultant images are of sufficient resolution to differentiate between brown and black bears.

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

Estimates of bear populations in Alaska usually involve mark/resight, tetracycline or DNA-based mark/recapture, or developing line transect based estimators. These techniques are limited in terms of spatial scale of applicability, costs, and the need for multiple resight or recapture (M/R) surveys. Estimates or indices of bear population status suitable at small spatial scales (e.g., sub-GMU) are lacking or require multiple surveys of marked populations (i.e., M/R), yet response to management strategies may occur primarily at the sub-GMU level where population size is frequently very small. For example, Intensive Management actions in smaller areas such as the Brown Bear Control Area of GMU 16B presume control of bear populations at a relatively small (< 400 mile2) scale. Based on current estimates of population size, up to 50% of Uniform Coding Units (UCUs) in the BBCA area had >17% brown bear harvest (approximately double estimated sustainable rates) – with harvest rates in some individual UCUs up to 55% – without any apparent decrease in harvest of bears (Research files, AKDFG, Region IV). Consequently, small areas characterized by small population sizes require

novel, rapid methods to index population status that do not depend upon presence of marked individuals.

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

Thermal imaging technology is a potentially useful tool for detecting large mammals during aerial or ground surveys. Recently, infrared and high-resolution natural color images have been used in combination for aerial line-transect surveys for a variety of large mammals. These surveys have achieved detection rates of 0–100% depending upon size of object, degree of vegetative cover, and other environmental characteristics; species and sex identification rates were comparable or slightly lower. In contrast to prior infrared-only surveys using earlier generation thermal imagers, detection during surveys was less dependent upon ambient temperatures and snowcover, and was more related to temperature contrast between animals and the environment. These later factors vary with individual species daily patterns of body temperature (for example, body temperature of cervids is typically lowest during early morning and highest during midday) and cloud cover. For example, recent work in Europe found that best results were achieved during mid-day hours (because of increased body temperature of surveyed species) under overcast conditions (because of decreased solar heating of rocks, stumps, and other background material); time of year was unimportant other than for decreased leaf coverage during dormant periods.

An airborne imaging multispectral sensor thermal (AIMS-T) system has been successfully demonstrated on moose and deer populations as well as other natural resources uses. This system integrates a radiometric microbolometer-based thermal camera (16-bit radiometric depth, 8–14 micrometer spectral range), 21.1 megapixal 8-bit natural collar CCD with a 5616 X 3744 detector array, and associated GPS, LIDAR altimetry, and avionics instruments for use on a light aircraft. Additionally, associated software automates georegistration and orthorectification of imagery to allow analysis in GIS and image processing environments AIMS-T has successfully detected moose at near 100% detection probabilities under a variety of habitat conditions at reasonable cost from non-replicated aerial surveys. Similarly, the high resolution color images from the AIMS-T system have successfully differentiated moose from white-tailed deer, and sex and age classes within the species. Thus, the high detection rates of the new radiometric thermal camera in combination with high resolution color images provides a potentially useful tool to index or estimate bear populations at essentially any spatial scale by complete coverage of areas at small scales and spatial sub-sampling of larger areas. Additionally, these results indicate that the past limitations of thermal imaging surveys – primarily unreliable species identification and results dependent upon the skill of the infrared camera operator – have largely been overcome by advances in technology, post-survey concurrent review of infrared and color images, and use of predefined survey routes with fixed cameras in lieu of actively searching for targeted species.

IV. MANAGEMENT IMPLICATIONS

The study will assess the efficacy of using a AIMS-T imaging system to detect black and brown bears for the purpose of estimating population sizes. If successful this methodology will result in improved estimates at lower cost.

V. SUMMARY OF WORK COMPLETED ON JOBS

FROM PROJECT STATEMENT:

Objective 1: Determine whether the AIMS-T imaging system can detect brown and black bears beyond visual survey levels.

Job/activity 1a: Fly transects and collect imagery

Surveys involve flying transects at ~305 m AGL and 90 km/h in Cessna 172/206 or similar platform in early (1–15) May, following den emergence but prior to leaf-out. Width of transect coverage is variable depending upon camera lenses, etc., but transects average approximately 200 m in width. Simultaneous thermal IR and high resolution color camera sensors are continuously record survey path with overlapping high resolution TIF/JPEG images. All images are spatially and temporally referenced as is relevant telemetry from aircraft.

Accomplishments: This project was postponed and later cut when the principal investigator left the division.

Job/activity 1b: Fly visual observation transects

Concurrent with imagery flights, a follow-up survey in a fixed-wing PA-18 will follow the same transect line, with observers in the aircraft noting locations and species of each bear seen.

Accomplishments: This project was postponed and later cut when the principal investigator left the division.

Job/activity 1c: Image review and analysis

Post-flight analyses include viewing scroll-linked thermal images to identify thermal hits ("hot spots") then cross referencing thermal images with high resolution color JPEGS to identify the source of the thermal hit. Numbers of bears detected by species will be determined for the study area, and contrasted with minimum observer counts from concurrently aerial visual surveys to determine whether more bears are detected during

AIMS-T surveys. All bears detected during surveys will be classed as "seen" or "not seen" by each survey platform and compared using Fischer's exact test.

Accomplishments: This project was postponed and later cut when the principal investigator left the division.

Objective 2: Determine whether the AIMS-T imaging system can differentiate between brown and black bears.

Job/activity 2a: Species differentiation assessment

Individuals detected through thermal images will be cross-referenced with natural color images to determine whether individual targets can be accurately attributed to species. Previous work has shown that most species identification is accomplished through evaluation of overall size, shape of the head, and presence or absence of antlers. Characteristics of bears that make this process less certain include (1) substantial overlap in body size among species and (2) resting behavior that does not expose the head and neck to the degree seen in ungulates. To test this, color images will be evaluated by ≥ 3 independent assessor, who will rate species identification of detection as either certain, likely, or uncertain. Results of these categorical assessments will be contrasted among observers using Fisher' exact test. This will (1) determine likelihood of successful species identification and (2) consistency of species identification among individual observers.

Accomplishments: This project was postponed and later cut when the principal investigator left the division.

VI. PUBLICATIONS

None

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

N/A

PREPARED BY:

Nathan Soboleff – Federal Aid Coordinator for DWC

DATE: 12 December 22, 2015