Alaska Department of Fish and Game
Division of Wildlife Conservation
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Kuiu Island Black Bear Population Estimation Using Biomarking and DNA

Elizabeth Peacock

Research Final Performance Report
Federal Aid in Wildlife Restoration
1 July 2003–30 June 2004
Grant W-33-2, Study 17.7

FEDERAL AID
FINAL RESEARCH REPORT

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 25526
Juneau, AK 99802-5526

PROJECT TITLE: Kuiu black bear population estimation

PRINCIPAL INVESTIGATOR: Elizabeth Peacock

COOPERATORS: University of Nevada Reno

FEDERAL AID GRANT PROGRAM: Wildlife Restoration

GRANT AND SEGMENT NR: W-33-2

PROJECT NUMBER: 17.7

WORK LOCATION: Southeast Alaska

STATE: Alaska

PERIOD: 1 July 2003–30 June 2004

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

Black bear harvest has increased substantially over the past decade across Southeast Alaska and there are concerns that about overharvest in some areas. Kuiu Island is one area that has gained popularity for hunting because of the island's high bear density bear population. The bear harvest there increased from an average of 80 bears per year from 1990 – 1992 to an average of 163 bears per year from 1997 – 1999. It was unknown whether this increased harvest was sustainable, so a harvest guideline of 120 bears per year was instituted through regulation, not knowing the efficacy of this value. Beyond the immediate need to better manage the Kuiu Island black bear population, hunter harvest and general public interest in black bears increased across all of Southeast Alaska during the 1990s. We were in need of approaches to estimate black bear numbers and understand their movement among islands, barriers to dispersal and a better definition of populations for management purposes. The Kuiu Island black bear research project was designed to meet these needs.

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

Black bears are a well-studied species across much of their range, yet they have not been well studied in Alaska and there are no population or demographic studies in Southeast Alaska. Prior studies of black bears in Alaska have largely focused on the Kenai Peninsula. Estimating black bear numbers is a challenge to many state fish and game agencies. One approach gaining recognition is the use of tetracycline biomarking as a noninvasive method

to estimate black bear numbers. If employed under the right circumstances, the approach can be cost effective and accurate enough for management application. Another approach is the use of new DNA methods to identify individual bears and estimate various population parameters and movements (in generation time) from the genetic information. We combined these two approaches to estimate black bear population size and estimation, movements and other demographic parameters.

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

OBJECTIVE 1: Develop and maintain cooperative agreements and foster interagency and university logistics to conduct field and laboratory studies.

We developed and maintained two important agreements to execute this study. The first agreement was to have K. Titus ensure that the USDA Forest Service would cooperate on logistics and staffing in support of the project. This interagency arrangement used the existing Master Memorandum of Understanding between the Alaska Department of Fish and Game and the Alaska Region of the USDA Forest Service. More informal agreements were made between the Petersburg Ranger District that maintains and controls the facilities and lands on Kuiu Island and the Region I – Division of Wildlife Conservation. Kuiu Island is a remote island in Southeast Alaska and the study would not have been possible without this arrangement. The Forest Service provided housing, access to vehicles, other maintenance facilities, and staff support for the tetracycline biomarking project. The second agreement was a formal cooperative agreement between ADF&G and the University of Nevada Reno. This institution was equipped to handle the conservation genetic aspects of the project. A less informal agreement included consultation with Dr. Dave Garshelis of the Minnesota Department of Natural Resources. Overall, this objective was met well by combining the skills, logistics and staffing among ADG&G, the Forest Service, staff from another state fish and game agency and an academic institution.

OBJECTIVE 2: Conduct a Kuiu Island-wide tetracycline biomarking field project in the spring of 2002. This will be a follow-up to the biomarking field project that took place on part of Kuiu Island in 2000. Population estimates will be made from hunter samples provided in the fall of 2002 (if a hunting season takes place) and the spring of 2003.

This objective was met in a modified manner. The 2000 estimate was conducted along the roads and beaches on the northern portion of Kuiu Island. As a result, there may have been bias in the population estimate because the marking took place in a biased manner. For 2002, we did not conduct an island-wide population estimate after carefully considering the difficulty and logistics of working across a much larger area some of which would have included federally-designated wilderness areas. We conducted the biomarking project in 2002 in the same area as in 2000, except that the sampling was unbiased because samples were distributed systematically across the entire study area using a grid-based approach. Mark-recapture methods were used to estimate population size for both years using the

samples collected from black bear hunters from the fall of 2000 through the fall of 2003. Results can be found in the dissertation of Elizabeth Peacock.

OBJECTIVE 3: Estimate black bear use of salmon spawning streams using DNA methods.

There is little quantification of black bear use of salmon streams, despite a general knowledge that these riparian areas concentrate bears. Black bear use of salmon spawning streams is important to quantify because hunters may also concentrate their activities during the fall, because high black bear numbers probably depend on these riparian systems, Ms. Peacock used genetic tagging to estimate bear use of salmon streams on Kuiu Island. Barbed-wire snags were placed along sections of seven salmon spawning streams in 2000 and 2002. Mark-recapture models were used to estimate bear numbers and the sex ratio of bears on specific stream segments. The modeling procedure also provided information on a variety of factors that affect bear use of salmon-spawning streams and population estimation factors such as season, capture heterogeneity, and trap density.

OBJECTIVE 4: Use genetic modeling methods to evaluate effective population size.

Ms. Peacock used rapidly evolving genetic markers such as nuclear microsatellite loci to investigate relative effective population size among islands, and evaluate possible population bottlenecks. Southeast Alaska black bear populations occur on many islands and across the mainland and they are subject to varying degrees of isolation. For objectives 4 and 5 she obtained frozen tissue samples from >800 hunter-killed black bears sealed by department staff. Samples were obtained from Yakutat to Ketchikan. State of the art genetic analyses methods were used. Nei's expected heterozygosity in the sampling regions ranged from 0.55 on Kuiu Island to 0.79 for the southern mainland. A significant population bottleneck was detected for the Kuiu Island black bear population. The Yakutat region, Kupreanof, Mitkof, Prince of Wales and Revillagigedo islands had no evidence of population bottlenecks. Estimates of effective population size were made.

OBJECTIVE 5: Assess phylogeography and relative among-island movement rates of black bears using molecular genetic methods.

Ms. Peacock used the genetic markers from Objective 4 and assessed the ecological basis for the asymmetrical black bear movements among islands and across the Southeast Alaska mainland. Use of molecular genetic models will assist managers with information on the scale at which black bears should be managed and the amount of bear movement among islands. Ms. Peacock found that migration rate (migrants per generation based on genetic data) between sampling regions varied significantly. For example, rates were high between adjacent mainland sampling regions and lower between adjacent sampling regions that are separated by salt water. Ms. Peacock found that the distribution of the assignment of individuals from Kuiu, Kupreanof and Mitkof islands to the Kuiu Island complex indicates that the movement predominates from Kuiu to Kupreanof/Mitkof and not vice versa. Other indirect measures of average genetic differentiation suggest that the Southeast Alaska black

bears exhibit substantial substructure, an expected result from a region characterized by geographic insularity. Results from the genetic analyses provide information on the population units that can be used for delineating practical black bear management units across the region.

IV. MANAGEMENT IMPLICATIONS

The preliminary estimated black bear population for Kuiu Island was found to be among the highest for the species. This value is proving to be very useful for Kuiu Island black bear management suggesting that an overharvest is not occurring. The preliminary population estimate provided by Ms. Peacock is being carefully evaluated because some of the marked bears were harvested on nearby Kupreanof Island, complicating the population estimate depending on how these data are included. The fact that the tetracycline biomarking approach provided estimates with reasonable coefficients of variation suggests that the method has application for other bear management situations in Alaska. The conservation genetic aspects of the region-wide identification of discrete black bear populations will be of direct assistance to managers for regulating harvest and understanding bear movement patterns in a multi-generation context. Estimates of bear numbers on salmon-spawning streams will assist the Forest Service in riparian management as they will for the fist time have information on the importance of this habitat type for black bears.

V. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN FOR LAST SEGMENT PERIOD ONLY

Job 1: Study administration and interagency coordination

During this period K. Titus worked on interagency close-out of the cooperative agreement with the University of Nevada-Reno. K. Titus also participated in reviewing drafts of final reports, Ph.D. dissertation chapters, and other data analyses with Ms. Peacock.

Job 2: Conduct island-wide tetracycline biomarking

Activities to meet this job include 1) data analysis to estimate the Kuiu Island black bear population size with hunter-collected data through the fall of 2003 and 2) data acquisition from hunters for the spring of 2004. These 2004 data are not part of this project but are part of ADF&G management of Kuiu Island black bears and will help refine the previous estimates.

VI. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THE LAST SEGMENT PERIOD, IF NOT REPORTED PREVIOUSLY

Completion of a written Ph.D. dissertation that will serve as the basis for manuscripts on the jobs described above.

VII. PUBLICATIONS

VIII. RESEARCH EVALUATION AND RECOMMENDATIONS

IX. PROJECT COSTS FROM LAST SEGMENT PERIOD ONLY

FEDERAL AID SHARE $ 4,500 STATE SHARE $ 1,500 = TOTAL $6,000

X. APPENDIX

XI. PREPARED BY:

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