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Division of Wildlife Conservation
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Impacts of Heavy Hunting Pressure on the Density and Demographics of Brown Bear Populations in Southcentral Alaska

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FEDERAL AID
FINAL RESEARCH REPORT

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
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PROJECT TITLE: Impacts of heavy hunting pressure on the density and demographics of brown bear populations in Southcentral Alaska

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COOPERATORS: None

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PROJECT NUMBER.: 4.26

WORK LOCATION: Southcentral Alaska, Game Management Unit 13

STATE: Alaska

PERIOD: July 1, 1995 – June 30, 2003

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

Beginning in 1995 the Alaska Board of Game adopted liberal bear hunting rules in Unit 13. These new regulations were intended to reduce bear numbers, which, it was hoped, would cause a commensurate increase in the moose population.

The Board identified a minimum population of brown bears in GMU 13 to be around 350 bears. This project began initially to document bear abundance and trends in the bear population. The last portion of the study was designed to identify changes in body composition of brown bears as they emerged from their dens and foraged on both vegetation and ungulates.

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

Density-dependent changes in productivity of bear populations have been widely discussed but remain poorly documented (Miller 1990c, Taylor 1994, McLellan 1994, Reynolds 1995). Identification of potential density-dependent effects associated with harvest are current objectives of bear studies in the Northcentral Alaska Range (Reynolds 1995), of baseline studies conducted in GMU 13 since 1980 (Miller 1993), and of studies on the Alaska Peninsula (Sellers et al. 1993). Some simulation models of bear populations have included increased survivorship of offspring as a function of reduced abundance of male bears caused by heavy hunting, but this effect has yet to be demonstrated. It is also possible that mean age of first litters, intervals

between litters, or sex ratio of offspring may be related to bear density. If so, these effects could compensate for or exacerbate effects of excessive harvests. The planned reduction in bear density in GMU 13 provides an opportunity to evaluate how bear populations respond to excessive harvests. These results will assist management of harvested bear populations elsewhere as well as in GMU 13.

Considerable research on this project was conducted by, and summarized in Miller (1990, 1993, 1995, 1997), Miller et al. (1997), Miller et al. (2003), and Testa et al. (1999).

The nutritional constraints acting upon bear populations have never been quantified, but it is clear that food quality and quantity have direct effects on bear population productivity (Hilderbrand et al. 1999). The nutritional value that bears can derive from moose and caribou calves and adults is unknown. Our current understanding of bears and their prey is limited to recognizing that bears eat moose and caribou, however no coefficients describing actual intake rates have been determined. Part of this research will determine intake rates and measure the nutritive value of calves vs. adults and moose vs. caribou to brown bears.

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

OBJECTIVE 1: The purpose of this work is to document bear density in a portion of Game Management 13A and to provide a baseline from which to measure changes in bear density that are anticipated to occur in this area as a consequence of significantly liberalized bear hunting regulations. The liberalized bear hunting regulations are designed to cause reductions in bear abundance. Documentation on bear abundance and changes in abundance are essential to correctly interpret responses of the moose population under simultaneous study to the designed changes in bear abundance. Another purpose for this work is to document changes in reproductive and survivorship parameters of the bear population that may occur as a consequence of heavy hunting. This last objective is complementary to similar studies occurring elsewhere in Alaska.

H1. The brown bear population density in the 13A study area is the same as in the remote Su-hydro area in 13E studied in 1985 and 1995.

Preliminary indications are that habitat conditions for brown bears are generally similar in both areas so that differences found can be attributed to harvests. There may be differences in habitat conditions that will only become evident following the bear studies. Preliminary indications, however, are that salmon appear to have a minor impact on bear density in both areas although possibly more salmon are available in 13E from Prairie Creek. Moose appear to have similar densities in both areas. The 13A study area is closer to the traditional calving grounds of the Nelchina caribou herd and it is possible that predation on caribou calves is more important to bears in this area than in 13E This will be determined by monitoring movements of radiomarked bears.

H2. Density of the brown bear population in the 13A study area is the same in 1998 as during subsequent studies.

This study will provide baseline data that can be used to document changes in density that occur in the study area through replication of the same technique. The time of subsequent studies to determine changes in density will depend on harvest density and other harvest patterns in the study area which lead to a conclusion that density has likely changed sufficiently to demonstrate a significant decline.

H3. The adult sex ratio and age structure of the brown bear population in the 13A study area is the same as in the remote Su-hydro study area.

Sex ratio and age structure will be measured using the same standardized measures employed in earlier studies in GMU 13. This measure derives from individuals documented to be in the density estimation study area at least once during the density estimation period. Because of the larger home ranges of males, this measure exaggerates the proportion of males actually present in the population but provides a useful index for comparisons between areas. An adult sex ratio with reduced proportion of males is a direct index to level of harvest because males are more vulnerable to harvest than females.

H4. Productivity of moose populations is independent of changes in bear density.

Rejection of this null hypothesis will indicate support for the H_A which is the outcome anticipated by the new bear hunting regulations: Moose productivity is enhanced by reductions in bear density. Moose productivity will be measured during simultaneous moose studies in the same area (Testa 1995). Large reductions in bear density will ultimately yield higher survivorship of moose calves measured in fall. Ultimately, however, productivity must be measured in terms of recruitment to the age cohorts susceptible to harvest by hunters.

H5. Reproductive parameters for bears in the 13A study area are the same in the 13A study area as in the remote Su-hydro (13E) area studied between 1980 and 1995.

Reproductive parameters of radiomarked brown bears were studied in a remote portion of Subunit 13E for 15 years. Studies conducted in 1985 and 1995 indicated that bear density was unchanged in this area so it provides good baseline data for contrasting differences that may occur as a consequence of hunter-induced reductions in bear abundance. Parameters that will be investigated include: Age at first litter production, interval between litters, sex ratio of litters, and survivorship of offspring and subadults.

H6. Nutritional value of moose and caribou (calves and adults) to foraging brown bears.

Recently developed techniques for determining body composition (stable isotope and Bioelectrical Impedance Analysis), for assessing diet (stable isotope ratios of diet vs. blood) will be employed to track changes in body composition of Unit 13 brown bears from spring to fall.

IV. MANAGEMENT IMPLICATIONS

In order to measure the effect of intensive management in Unit 13 it was important to establish a baseline for grizzly bear population size. This work identified population size in a portion of Subunit 13A. Continued refinement of census procedures and techniques are needed, and it needs to be determined if the methods used in this project can be directly compared to bear density estimates determined from other methods (i.e., line transect).

Patterns in seasonal body composition changes of Unit 13 grizzly bears show that increasing body mass can not be assumed to represent increasing body fat. Seasonal fluctuations in body composition, between lean body mass and fat mass, need to be paired with matched isotope values of prey species. Seasonal gains in lean body mass and fat stores have different costs associated with acquisition and deposition, thus additional analysis will make it possible to assign relative nutritional value of terrestrial meat and vegetation (e.g., berries) to unit 13 grizzly bears. These results would then provide realistic estimates of intake coefficients for modeling of predator-prey dynamics in Unit 13.

Current management focus is on reduction of predators in unit 13. The Department of Fish and Game has a professional obligation to not allow the population of grizzly bears to fall below sustainable size, however that obligation must be balanced against the directives from the Board of Game. Research should be instituted to determine the productivity and recruitment of grizzly bears in unit 13, and those results should be paired with additional population census work from the line transect methodology.

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

JOB 1. Estimate brown bear density in an approximate 700 mi^2 portion of Subunit 13A centered in the area of intensive moose studies (Testa 1994).
No work was done on this job in this time period. This work was accomplished in 1997 – 1998.

JOB 2. Estimate sex ratio and age structure of the brown bear population in the 13A study area and compare to composition of population in 13E study areas and to composition of harvested bears.
No work was done on this job in this time period. This work was accomplished in 1997 – 1998.

JOB 3. Estimate changes in bear productivity and survivorship that may occur in response to heavy hunting pressure.
No work was done on this job in this time period.

JOB 4. Document movements and habitat use of radio-marked bears throughout the period of den emergence during 1996, 1997, and 1998.
No work was done on this job in this time period.

JOB 5. Contrast predation rates on neonatal moose calves by radio-marked brown bears with previous results at lower moose densities.
No work was done on this job in this time period.

JOB 6. Evaluate prevalence of consumption of moose and of caribou by bears through analysis of prey specific fatty acids identified in bears.
Lipid biopsies that had been collected from adult bears, moose, and caribou during prior captures were stored at -20C in chloroform-methanol mixtures. Analysis of samples has not begun.

JOB 7. Determine body composition changes and diet switching by bears.
Blood samples were sublimated to capture water for deuterium analysis. Tissue and blood samples were freeze-dried, ground in liquid nitrogen, and then transferred to tin boats for stable isotope analysis. After beginning this project published work indicated that isotopes of sulfur would be useful in determining predator-prey relationships. Thus, we added Eschka sulfur extractions to our laboratory preparations for Unit 13 prey samples. Equipment and chemical purchases included muffle furnace, ceramic dishes for ashing, tongs, dry ice, 100% ethanol, tin boats, liquid nitrogen, and misc. chemicals.

Additional lab work included approximately 2 months of lab time. Samples have been loaded into tin boats, but not yet run on the mass spec.

Deuterium analysis for body composition has shown that Unit 13 grizzly bears have a mean fall mass of 182.5kg and a mean body fat of approximately 30%. At den emergence the mean body mass is 119 kg and the mean body fat content is 9.3%. Prior to early July the bears will have increased body mass by 15%, but the mean body fat content had continued to decline to approximately 5.5%. Body fat content is gained during July and August. Final laboratory analysis of isotope data is continuing.

JOB 8. Preparation of annual reports and publications.
No peer-reviewed publications have been written yet. Data have been presented in several public forums, and a manuscript on seasonal fluctuations in body composition of unit 13 grizzly bears is being prepared.

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

No additional federal aid-funded work was accomplished on this project.

VII. PUBLICATIONS

Information relative to these data can be found in:

Miller, S.D., R. A. Sellers, and J. A. Keay. 2003. Effects of hunting on brown bear cub survival and litter size in Alaska. Ursus 14(2):130-152.

VIII. RESEARCH EVALUATION AND RECOMMENDATIONS

Results from the technique of capture-mark-resight are difficult to use for prediction of population size beyond the borders of the area in which the procedure is applied. While this limitation holds for all methods of censusing grizzly populations, newer aerial census techniques, such as line transect, will cover large study areas and thus provide population estimates with greater applicability.

The harvest of grizzly bears in Unit 13 has been at historically high levels for several years, and questions have arisen regarding the mechanism by which the hunted area has (apparently) been able to sustain high harvest levels. Suggestions have included increased cub survival as a result of high hunting mortality of adult males and/or increased immigration of sub-adult bears from nearby areas. Miller et al. (2003) addressed the possible population level effects of adult male mortality, which is currently the focus of intense debate. The question of increased immigration of bears into Unit 13 could be determined by appropriate DNA based measures. It is possible to identify the genetic population structure of harvested bears, and then to compare those results to data collected from samples of brown bears residing near the boundaries of Unit 13, and from unharvested bears in Unit 13. The appropriate biological samples can be easily collected from harvested animals when hides and skulls are sealed, and samples from live bears can be collected by helicopter delivered biopsy darts.

IX. PROJECT COSTS FROM LAST SEGMENT PERIOD ONLY

Federal Aid share $35,124 State share $11,709 = Total $46,833

X. APPENDIX

LITERATURE CITED

HILDERBRAND, G. V., C. C. SCHWARTZ, C. T. ROBBINS, M. E. JACOBY, T. A. HANLEY, S. M. AUTHUR, AND C. SERVHEEN. 1999. The importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears. Canadian Journal of Zoology 77:132-138.

MCLELLAN, B. 1994. Density-dependent population regulation of brown bears. Pages 15-24 in M. Taylor, ed. Density-dependent population regulation in black, brown, and polar bears. Int. Conf. Bear Res. and Manage. Monogr. Series No. 3. 43pp.

MILLER, S.D. 1990. Impact of increased bear hunting on survivorship of young bears. Wildl. Soc. Bull. 18:462-467.

MILLER, S.D. 1993. Impacts of increased hunting pressure on the density, structure and dynamics of brown bear populations in Alaska's Game Management Unit 13. Fed. Aid. in Wildl. Restor. Res. Final Rep. Projects W-22-6, W-23-1, W-23-2, W-23-3, W-23-4, and W-23-5. Study 4.21. 182pp.

———. 1995. Impacts of heavy hunting pressure on the density and demographics of brown bear populations in southcentral Alaska. Federal Aid In Wildlife Restoration Research Progress Report W-24-3, Study 4.26, Alaska Department of Fish and Game, Juneau, AK.

———. 1997. Impacts of heavy hunting pressure on the density and demographics of brown bear populations in southcentral Alaska. Federal Aid in Wildlife Restoration Research Progress Report W-25-5, Study 4.26, Alaska Department of Fish and Game, Juneau, AK.

———, G. C. White, R. A. Sellers, H. V. Reynolds, J. W. Schoen, K. Titus, V. G. Barnes, Jr., R. B. Smith, R.R. Nelson, W. B. Ballard, and C.C. Schwartz. 1997. Brown and black bear density estimation in Alaska using radiotelemetry and replicated mark-resight techniques. Wildlife Monographs 133: 1–55.

MILLER, S.D., R. A. SELLERS, AND J. A. KEAY. 2003. Effects of hunting on brown bear cub survival and litter size in Alaska. Ursus 14(2):130-152.

REYNOLDS, H. V. 1995. Effects of harvest on grizzly bear population dynamics in the northcentral Alaska Range. Fed. Aid in Wildl. Restor. Res. Prog. Rep. Grant W-24-3, Study 4.25. 27pp.

SELLERS, R. A., S. D. MILLER, T. S. SMITH, AND R. POTTS. 1993. Population dynamics and habitat partitioning of a naturally regulated brown bear population on the coast of Katmai National Park. 1993 Annual Progress Report. Alaska Dep. Fish and Game, Juneau. 35pp.

TAYLOR, M., ED. 1994. Density-dependent population regulation in black, brown, and polar bears. Int. Conf. Bear Res. and Manage. Monogr. Series No. 3. 43pp.

TESTA, J. W., W. P. TAYLOR, AND S. D. MILLER. 1999. Impacts of heavy hunting pressure on the density and demographics of brown bear populations in southcentral Alaska. Federal Aid in Wildlife Restoration Research Progress Report W-27-2, Study 4.26, Alaska Department of Fish and Game, Juneau, AK.

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