FEDERAL AID FINAL RESEARCH PERFORMANCE REPORT

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 115526
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Alaska Department of Fish and Game
Wildlife Restoration Grant

PROJECT TITLE: Grizzly and black bear distribution and abundance relative to the 2004 wildfires in eastern Interior Alaska: Possible intensive management consequences

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COOPERATORS: None

FEDERAL AID GRANT PROGRAM: Wildlife Restoration

GRANT AND SEGMENT NO.: W-33-7 through W-33-12

PROJECT NO.: 4.39

WORK LOCATION: Game Management Unit 20E, Fortymile River drainage

STATE: Alaska

PERIOD: 1 July 2008–30 June 2014

I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH:

Alaska Department Fish and Game wildlife managers in Game Management Unit (GMU) 20E identified the following research objectives: 1) estimate the number of grizzly bears (*Ursus arctos*) and if possible the number of black bears (*Ursus americanus*) in the most hunter accessible area in the unit and 2) evaluate effects of the extensive wildfires of 2004 on grizzly bear density and distribution. Grizzly bears were found to be a major predator of moose calves in portions of Interior Alaska and Yukon, Canada (Gasaway et al. 1992). Meeting these objectives would help interpret results of past and ongoing intensive grizzly bear-moose-caribou management programs and would be used to design future management actions to meet moose (*Alces alces*) and caribou (*Rangifer tarandus*) population and harvest objectives.

Grizzly bears can occupy a variety of habitats resulting in almost a continuous spatial occupation of ranges, but distribution can change due to changes in habitat (Apps et al. 2004). If the severity of wildfire was such that large areas no longer offered adequate and predictable food resources, we would expect bears to avoid these areas. The spatial structure of a grizzly bear population has direct bearing on its role as a predator. During summer 2004, wildfires disturbed 31% of central GMU 20E. Large-scale wildfires may effect grizzly bear distribution and predation patterns in GMU 20E and in other areas in the Interior that are prone to wildfire. We needed to assess how population distribution and population trends of bears and moose changed relative to burns. During July 2008–June 2013, we limited our study to evaluating grizzly bear population size, distribution, and movement patterns relative to the 2004 wildfires.

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

A comprehensive predator-prey research study was conducted in central GMU 20E during the mid-1980s (Gasaway et al. 1992). As part of that study, Boertje et al. (1987; unpublished data) radiocollared 31 grizzly bears and monitored den emergence times, home range sizes, distribution and seasonal movement patterns by gender and family associations. Predation by grizzly bears was a major factor limiting moose population growth (Gasaway et al. 1992). Location data indicated that grizzly bears were distributed throughout the area and that all borders of the study area were open to grizzly bear movement (Boertje et al. 1987; unpublished data). Using the direct-count method (Reynolds and Hechtel 1984, Mace and Waller 1998) and after accounting for the lack of geographical closure, Boertje et al. (1987) estimated the minimum and most probable total bear densities to be 14 and 16 bears/1,000 km^2 for 1 May 1986. These results suggested that central GMU 20E supported one of the least dense grizzly bear populations in Interior Alaska (Reynolds and Hechtel 1984).

Since the conclusion of Boertje et al. (1987), wildfires mildly to severely burned 31% of the central GMU 20E during summer 2004 (http://fire.ak.blm.gov/predsvcs/maps.php). The wildfires burned a ≤29 km wide swath through central portion of the unit extending from the southwest to northeast sides (Fig. 1). The effect of this wildfire on grizzly bear abundance and distribution in the control area was not known.

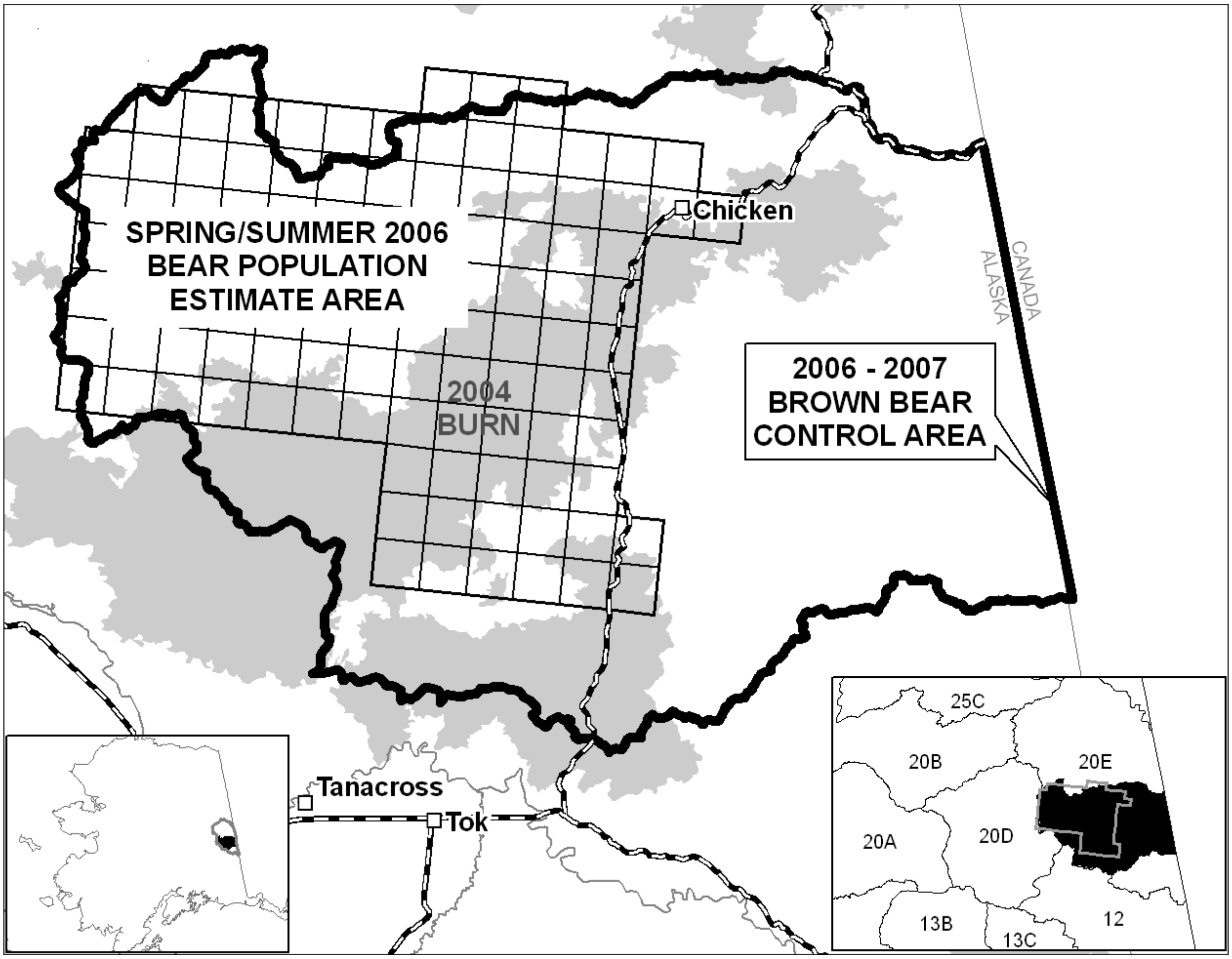

FIGURE 1. Grizzly bear control area in eastern Interior Alaska, USA, including boundary of study area divided into 106 7×7 km sample units, and the boundary of area burned by the 2004 wildfires.

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

OBJECTIVE 1: Determine the following trends relative to the 2004 wildfires in Unit 20E: 1) grizzly bear population size and distribution and possibly, predation rates on moose calves; 2) moose population size, composition, and trend; and 3) black bear population size and distribution and possibly, predation on moose calves. Develop an intensive management strategy that incorporates findings from this research.

Due to financial limitations, we limited the study to evaluating grizzly bear population size, status, and distribution relative to the 2004 wildfires. We used genetic analysis of hair samples to identify individual grizzly bears to estimate population density and distribution (Woods et al. 1999) in central GMU 20E during 21 May–19 July 2006 (Fig. 1). We further evaluated grizzly bear movement patterns and offspring survival rates by deploying 13 GPS radio collars on 9 female (3 re-collars) and 1 male and 2 VHF collars on 2 males grizzly bears during June 2008–August 2012. We discontinued collaring males after summer 2009 because 0 of 3 collars deployed on adult males lasted >1 month before radio structural failure.

DNA mark-recapture using hair traps is an effective technique to estimate grizzly bear abundance in forested habitats (Boulanger et al. 2002; Kendall et al. 2008, 2009; Ebert et al. 2010). We incorporated the mark-recapture data into spatially-explicit capture-recapture (SECR) models to estimate density (Efford 2004, Borchers and Efford 2008, Efford et al. 2009, Royle et al. 2009, Gardner et al. 2010, Obbard et al. 2010, Russell et al. 2012, Howe et al. 2013, Royle et al. 2013). Both maximum likelihood (Borchers and Efford 2008, Borchers 2012) and Bayesian (Royle et al. 2009, Gardner et al. 2010) SECR models allow for direct estimates of density, can account for biologically relevant forms of capture heterogeneity, and can yield unbiased population estimates for open systems (Blanc et al. 2013, Efford and Fewster 2013). SECR models resolve problems associated with nonspatial capture-recapture models, specifically the difficulty of defining the area sampled and capture heterogeneity caused by variation in the proximity of animals to trap locations (Royle et al. 2013). However, these models require large samples to prevent inaccurate density estimates with overstated precision (Howe et al. 2013). Limited capture data can cause heterogeneous detection probabilities to go unnoticed and the selection of inappropriate models (i.e., reduced parameter models) is possible (Howe et al. 2013). Overly simple models can cause estimates of density and its precision to be negatively biased and unsuitable for addressing difficult and controversial management decisions. Therefore, the challenge of using SECR models, especially when accounting for individual heterogeneity in low density populations, becomes the acquisition of sufficient data for unbiased and precise estimates (Obbard et al. 2010). Consequently, studies using DNA mark-recapture methods need to be designed to maximize captures relative to cost and logistical constraints.

Our study objective was to produce accurate and precise population estimates adequate for intensive management decisions. Upon completion, it was apparent our density results were most likely biased low and not adequate for sensitive grizzly bear management decisions. The main issue we could not overcome even after using the most current field and modeling methods was that our sample sizes were too low and provided insufficient information to the SECR models. Our DNA hair capture data reflected a reduced catch of family groups. Our small sample of females with offspring resulted in a lack of support for models that accommodated such heterogeneity casting uncertainty on the density and precision estimates. This is disconcerting because the methods we used are often recommended and used to estimate population size of other low density remote large carnivore populations including grizzly bears (Howe et al. 2013). Our results suggest that in low density grizzly bear populations, DNA mark-recapture hair snaring and SECR models may not be effective to estimate density reliably unless there is a secondary source of mark-recapture data (i.e., rub trees, harvest). Without a secondary data source, we strongly caution researchers and managers that density estimates in areas with low numbers of grizzly bears could be misleading.

Our hair trap and radiotelemetry data suggest there was a shift in bear distribution across central GMU 20E caused by the 2004 wildfires. Although imprecise, the estimated point densities for areas unaffected by the 2004 wildfires were about 3 times larger than the density within the burned area (Gardner et al., *In prep*). In contrast, location data collected during the 1980s (Boertje et al. 1987) as well as harvest data collected during 1970–2003 (C. Gardner, ADF&G, unpublished data) support a relatively uniform distribution of grizzly bears across the landscape prior to the 2004 wildfires. We suggest that extensive alteration of habitat caused by wildfire changed the distribution of grizzly bears in the control area. Between the mid-1980s and 2006, the grizzly bear population in the central GMU 20E did not experience substantial changes in climate, in the availability of ungulate food resources, increased harvest, or reduced survival rates (survival remained >90% for adults and 39–40% for cubs; Boertje et al. 1987; Gardner et al., *In press*). We contend that the 2004 wildfires reduced the availability and distribution of optimum foraging patches for grizzly bears increasing the competition for those patches. We found evidence that suboptimum habitat caused most females with cubs to relocate more frequently during the first 6 weeks following den emergence, thereby increasing both the risk of infanticide and energetic demands (Gardner et al., *In press*). Further we did not find evidence of philopatry in central GMU 20E even after concentrating our capture efforts to radiocollar adjacent adult females. Philopatry beyond 3 years of age is common for female grizzly bears resulting in considerable overlap of home ranges among related females (Mace and Waller 1998, Schwartz et al. 2003). We suggest the lack of philopatry was caused by the combination of poor cub survival and possibly by the dispersion of previous matrilineal assemblages due to the extensive wildfires in 2004. If the severity of wildfire was such that large areas no longer offered adequate and predictable food resources, grizzly bear distribution may have shifted and competition for optimal areas may have increased among bears, including related females.

IV. MANAGEMENT IMPLICATIONS

Bear biologists should use field and modeling methods that fit the habitat and logistical diversities of the study area and the scale and costs of the management questions (Yoccoz et al. 2001). A coefficient of variation (CV) of ≤20% is considered adequate for management decisions (Pollock et al. 2002) but in reality, for critical decisions a CV of ~20% is not adequate. Better precision requires larger sample sizes and higher capture probability. Capture probabilities ≥20% are needed when population size is ≤150 bears to meet the minimum CV recommendation (Boulanger et al. 2002). Our study found that capture probabilities of 27–33% in a population of <100 bears in an open system were insufficient to produce precision estimates informative to managers. In low density areas, we contend that precision is more dependent on overall capture numbers and adequate capture of age and family groups rather than capture probability per se. Considering the high costs necessary to conduct a DNA mark–recapture population estimate and the difficulty of obtaining the necessary number of captures to obtain a sufficiently precise estimate, we question if the traditional trapping method using a systematic trapping grid with trap spacing of ≥7 km is adequate to address management questions for low density, remote, open populations where multiple data sources are not available. For these areas, more efficient sampling schemes must be developed or it is likely that females with cubs will be undersampled causing estimates to be negative biased. In some situations, field techniques and models that do not adequately account for individual heterogeneity and result in an underestimate may be acceptable (Howe et al. 2013). However, when conducting a bear control program, accurate estimates of the number of bears is essential to ensure that the necessary number of bears are removed to benefit ungulate survival and enough bears remain for recovery.

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

JOB/ACTIVITY 1A: Conduct literature review.

We conducted biweekly literature searches for population estimate studies using DNA-based mark/recapture sampling and models. We also searched for publications on grizzly bear movement patterns, habitat use, and survival.

JOB/ACTIVITY 1G: Data analysis and reporting.

We submitted one manuscript entitled "Movement patterns and space use of maternal grizzly bears influence cub survival in Interior Alaska" to *Ursus*. We have a second paper in prep entitled "Sampling design and modeling challenges for estimating abundance and density of a remote, low density and geographically open grizzly bear population" which we will submit for publication.

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

None.

VII. PUBLICATIONS

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VIII. RESEARCH EVALUATION AND RECOMMENDATIONS

None.

IX. APPENDICES

None.

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