University of Nevada, Reno

Population, Genetic and Behavioral Studies of Black Bears *Ursus americanus* in Southeast Alaska

A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in Ecology, Evolution and Conservation Biology

by

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December 2004

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ABSTRACT

I studied population, genetic and behavioral aspects of black bear (*Ursus americanus*) in the temperate rainforest of Southeast Alaska. At a landscape level, I used population genetics to investigate black bear movement in the Alexander Archipelago and mainland of Southeast Alaska. I found that geographic structure defined by salt water and glaciers curtails black bear movement, to the extent that most regions have significantly genetically differentiated black bear populations. I found that black bears in Southeast Alaska cluster into seven genetic types. I also found that two larger, nuclear genetic clusters of black bears in Southeast Alaska correspond, geographically, to the two ancient mitochondrial lineages of black bears. This perhaps indicates that the nuclear genome retains a genetic signature of the secondary contact of these two lineages. I also studied black bear vagility on a much smaller scale – at the level of riparian areas of salmon spawning streams. I used genetic tagging to demonstrate that the group of bears using these streams is in demographic flux throughout the course of the salmon stream, and that a high number of individual bears use these streams. The persistence of intact salmon streams in Southeast Alaska likely contributes to high black bear population density. In a final aspect of my dissertation research, I used tetracycline biomarking to estimate the population size of black bears on Kuiu Island to be 1.5 bears/km^2. This estimate is among the highest recorded bear densities.

ACKNOWLEDGEMENTS

My dissertation research was made possible by kind and generous support of my community of family, friends and colleagues.

The project was funded and supported logistically by the Alaska Department of Fish and Game, Division of Wildlife Conservation, Southeast Alaska Region. I am indebted to Kim Titus who gave me the opportunity to pursue this project. Kim had faith in my abilities to succeed with this research from the beginning, and I thank him for this opportunity and his support, advice and conversations about bears for the last five years. I also thank Matt Kirchoff for good conversations about the Kuiu Island bears and conservation and biology on the Tongass, and for advice throughout my research. It was upon Matt's excellent suggestion, that I pursued the Kuiu Island black bear project. I thank the staff of ADF&G throughout the region for advice and field help, especially Neil Barten, Boyd Porter, Polly Hessing, Dave Person and Kevin White. I am especially grateful to Rich Lowell – regional biologist – and Mary Meucci – program technician – at ADF&G in Petersburg for their coordination of *all* field logistics, and the data collection and outreach for the tetracycline biomarking project. This project would have been impossible without Mary and Rich's support!

I would like to thank Ranger Patty Grantham at the Petersburg Ranger District, United States Forest Service (USFS) for her support of the Kuiu Island black bear project and the collaboration with ADF&G. Without the support of the district (not only in-kind support

such as use of the facilities at Rowan Bay and vehicles, but support of the project in spirit), this project would not have been possible. I also would like to thank employees of USFS who helped in the field (Steffen Merten, Erik Duerkup, Rosalie Grant), with special thanks to Petersburg Ranger District biologists Jim Brainerd and Glen Ith, and Eric Larsen and Rachel Weaver.

This project required a tremendous amount of assistance in the field. I would like to thank those who spent months on Kuiu Island: Elizabeth Balmin, Robert Borntraeger, J.D. Conaway, Al DeGayner, W. Scott Hampton (UNR employee), Ben Fanson, Melissa Helfrich, Peter Herbster, Claire Lucas, Cory VanStratt and Connie Ziehm. I also thank other volunteers who helped in the field including Nancy Fair, Dave Garshelis, Eileen Hickey, Debra Hill, my father Brian Peacock, David Reichel, Chris Rosamond, Ying Wang, Lee Webber, Brian Wright and Melinda Wright.

I thank the black bear guides and hunters on Kuiu Island for providing toe bones of their harvested bears. Over the course of the three collection years, we had 95 to 100% sample submission, which was great, especially considering the submission wasn't required!

Additional research and stipend funding was provided by the Excellence in Diversity Fellowship from the Graduate School at the University of Nevada, research grants from the Biology Department at UNR, Sigma Xi, Animal Behavior, the Explorer's Club and the lab of Mary Peacock.

Thank you to my academic committee at the University of Nevada – Reno: Jim Sedinger, Steve Jenkins and Scott Mensing. All of my committee members offered good, critical advice and I thank each of them for his contribution. I would like to especially to Guy Hoelzer for use of his laboratory and making sure that I got the genetics theory right. I thank Jim Sedinger for his very relevant advice, and I thank him for coming to UNR, contributing so much to students' success and for opening his home for so many celebrations! I would also like to thank Joel Berger, with whom I worked for three years at UNR – for the encouragement to study "anything [I] wanted to, anywhere in the world." I hadn't known that was possible! Mary Peacock has been a joy to have as a major advisor. Mary has supported my work academically and financially, and has become a good friend (and a new-found long lost distant cousin of some kind) and mentor in the process. She never stops fighting for and encouraging her students, and I thank her for taking on me and my bear project!

In the program of Ecology, Evolution and Conservation Biology, I am grateful to my cohort including Helen Neville, Hillary Robison and Cali Crampton for their friendship and their emotional and academic encouragement over the last six years.

The Laboratory for Ecological and Evolutionary Genetics (Julie Ellsworth and Veronica Kirchoff) and The Nevada Genomics Center were generous with their equipment, facilities and know-how. I would like to especially thank Joan Rowe for her patience with my low DNA quality samples! In the laboratory I would like to thank Tatiana Tsareva,

Jason Devlin, Jay Sao, Myra Barnes and Michelle Bogoger. I would also like to thank Eric Simandle for setting up the cluster of computers to run program MIGRATE.

I also gained priceless insight and advice from collaborators including Dave Garshelis who provided tremendous help in understanding population estimation, discussions about bears and biology and contributed with help in the field. Dave also let me use his lab in Minnesota for the analysis of all the toe bones from the tetracycline study. Mark Herzog also introduced me to programming and population modeling.

I thank my family – my mother and father, Eileen and Brian, my sisters – Caroline and Georgina and my brother Tommy for emotional and financial support, and for their encouragement and faith in my abilities. Finally, I would like to thank Alexandra Kameda, Alexis Clark Vennard and Stevie Lee Ambruzs for their encouragement and friendship throughout these years.

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INTRODUCTION TO THE DISSERTATION

The coastal rainforest of Southeast Alaska and British Columbia constitutes 25% of the world's remaining temperate rainforest. The forest in Southeast Alaska is important as it remains largely intact, and enjoys more legal protection than temperate rainforests in South America, Canada and the Pacific Northwest of the United States. Attention to conservation and wildlife management is elevated in the region, as the forest occurs on the over 1,000 islands of the Alexander Archipelago and a narrow strip of coastal mainland, where insular endemics may be more vulnerable to habitat destruction and fragmentation. Furthermore, demand for natural resources is high as consumptive and non-consumptive resource use is the keystone of the region's economic viability. Industrial logging and commercial fishing have occurred for over 50 years on the Tongass National Forest, which comprises 80% of Southeast Alaska. Recreational use including hunting, sport fishing and wildlife viewing is increasing on the Forest and other federally-managed land, which together comprise 95% of the region.

The American black bear (*Ursus americanus pugnax*) occurs on the southern islands of the Alexander Archipelago at high densities, likely due to intact anadromous Pacific salmon (*Oncorhynchus* spp.) runs and productive forests. Since the temperate rainforest of Southeast Alaska remains largely conserved, I was able to study black bears in a natural context, at different landscape and temporal scales. Most aspects of this dissertation have direct management and conservation implications for black bears on the Tongass National Forest. This work also contributes to the field of Ursid ecology, specifically, but to animal behavior in general. While I've made specific contributions to

the understanding of black bears in the salmon dominated ecosystem, in a more general light, I have examined how a solitary species behaves in the face of ephemeral, high density gatherings of conspecifics. The dissertation also contributes specifically to the phylogeography of mammalian species on the Alexander Archipelago, but also more generally to how animals navigate fragmented systems.

Two mitochondrial lineages of the black bear, which diverged at the beginning of the Pleistocene 1.8 million years ago, co-occur in Southeast Alaska. I have shown that two groups of the black bears, defined by nuclear microsatellite variation, correspond geographically to these two mitochondrial lineages. I suggest that the geographical interface of these two groups occurs near the Cleveland Peninsula on mainland, on Mitkof Island, and on Prince of Wales Island. In addition, results from several analyses suggest that there is a general, historical movement of bears southward along the coast.

I described the dispersal patterns of black bears among the islands and mainland of Southeast Alaska using nuclear, microsatellite genetic markers. I found that the geographic structure of the region curtails black bear dispersal, as geographical distance does not satisfactorily predict genetic distance. Salt water crossing distance explained a fair degree of variation in genetic distance, however other factors such as the direction of crossing may play an additional role. I detected asymmetrical movement of black bears among islands of the Alexander Archipelago, which could be possibly due to ecological differences between islands, such as differences in population density, instigating dispersal behavior. Alternatively, or in addition, directional tidal currents could have produced asymmetrical migration, by affecting the success of dispersal. Finally, large ice fields, of greater than approximately 150 km were substantial barriers to black bear

movement, and intervening salt water bays on the mainland of Southeast Alaska, mitigated, but did not prevent black bear movement.

At a smaller scale, I studied the black bears on Kuiu Island in the Alexander Archipelago. I used tetracycline biomarking to estimate the population size of black bears on Kuiu Island to establish base line data for effective wildlife management. This technique proved to be an effective tool, in terms of labor and cost, to estimate population size of a harvested, yet elusive, mammal. With two independent data sets, I estimated the population size of black bears on Kuiu Island to be roughly 1.5 bear/km^2, which is one of the highest recorded bear densities in the world.

I also estimated the number of bears that used reaches of salmon streams using genetic tagging – a form of mark-recapture using genetic identities as tags. I detected large numbers of black bears using small sections of the streams over the course of the salmon runs. However, there was high turn over in the identities of individual black bears using the salmon streams. In all data sets, I detected heterogeneity in capture probability, which is likely due to behavioral differences of the bears on salmon streams. One plausible explanation of heterogeneity in capture, could be due to male and female bears using the streams differently. I found that on most streams, females were detected on the streams less than expected. In addition, I found that females used tidal areas of streams less than upstream, forested stretches of streams. Both of these findings may suggest that there maybe sexual segregation on streams, and that not all female black bears in the population use salmon streams.