

**DETECTING GENETICS, ECOLOGY AND THEIR CORRELATION OF CARIBOU
IN YUKON FOR MANAGEMENT AND CONSERVATION PRACTICES
FINAL REPORT (YEAR 2017), YF&WET PROJECT**



Picture of Mark Bradley

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PROJECT ACTIVITIES

Introduction

Ecological genomics is a new discipline that integrates molecular and ecological data to

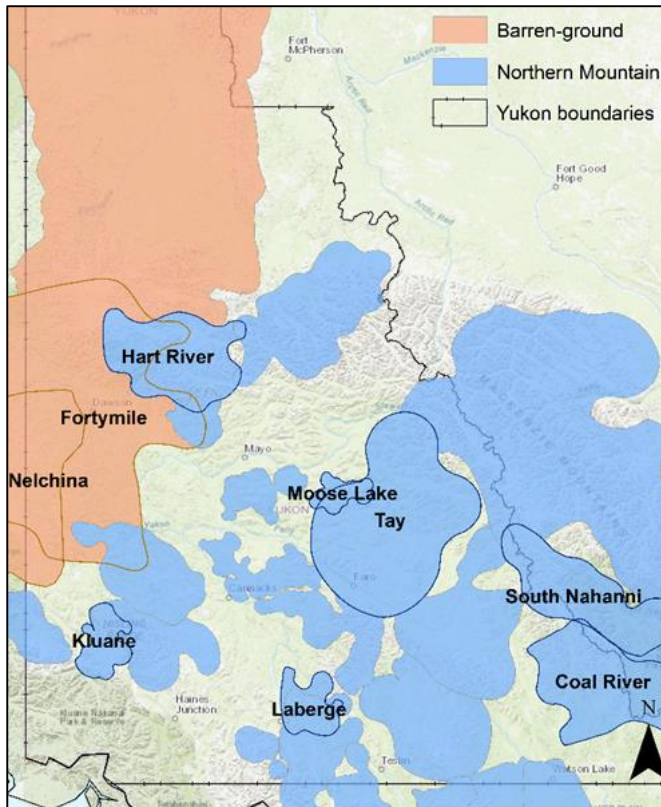


Figure 1. Distribution of caribou herds in Yukon. Herd ranges in blue are of the Northern Mountain ecotype (Woodland caribou) and ranges in red are of Barren-ground (Alaskan caribou). Names of herds for which we have genomic and behavioral/ecological data are visible in bold.

understand genes and genome function in the natural environment. It is revealing to be important in conservation matters as the analyses of interaction between ecological and genetic datasets can answer important questions for conservation applications. For example, it can provide insights on understanding animal movements, hybridization and determining adaptive divergence among populations (e.g. the evolution of different genetic traits in response to different habitat). In turn, this information could be used to delineate Conservation Units (CUs) that, in simple words, could be seen as groups of individuals (within species level) with similar and discrete (distinguishable from other groups) genetic and ecological characteristics. Our research group, formed by a collaboration between Dr. Marco Musiani's Lab (University of Calgary) and Dr. vonHoldt's Lab (Princeton University), is applying an ecological genomics approach to study caribou individuals and herds in Yukon with the aim to contribute to their delineation in CUs.

Activities completed and objectives achieved (conducted as planned)

During year 2017, we collaborated with the Environment Yukon Fish and Wildlife Branch to collect samples and telemetry locations of 71 individuals of 9 herds in Yukon (fig 1). We also conducted DNA extractions and sequencing of blood samples in Dr. vonHoldt Lab and we collected layers (e.g. altitude, vegetation and land cover) necessary for ecological analyses.

We are now in the process of analyzing both genomic and ecological data. We filtered and checked quality of the genomic data and we identified SNPs. Preliminary results indicate the presence of about 10,000 SNPs in our dataset. We also screened, filtered and normalized telemetry information to obtain a consistent one location per day per animal. Each animal is now being classified as either sedentary or migratory (see example case in fig. 2).

Current work (conducted as planned)

We are completing our project with the analyses of correlation between SNPs and behavioral/ecological information. We are producing matrixes of concordance between new and existing genetic, behavioral, ecological and distributional data to delineate caribou CUs.

Contribution to caribou protection

Our approach essentially augments radio-collar data with additional sources of information which is bolstering understanding of herd delineation. For herds where radio-collar data does not provide a definitive answer, looking to other sources of biological information is shedding light on addressing this critical question. Our research also provided a better understanding of the genetic basis for behavioral patterns observed in different caribou herds, such as migratory or non-migratory behavior. This type of knowledge is used by decision makers when considering the long-term management and conservation of Yukon caribou in order that the different “genetics” of caribou can be maintained on the landscape. Furthermore, as Northern Mountain caribou are currently listed as a Species of Special Concern under Canada’s *Species at Risk Act*, any information (like ours) that can be used to effectively conserve these caribou is valuable.

No significant variances to our goals, objectives or work plan occurred; no changes in project design were required. Our contribution to caribou protection is largely dependent upon communication with stakeholders of the species and of its ranges. Such plans are explained in the below section.

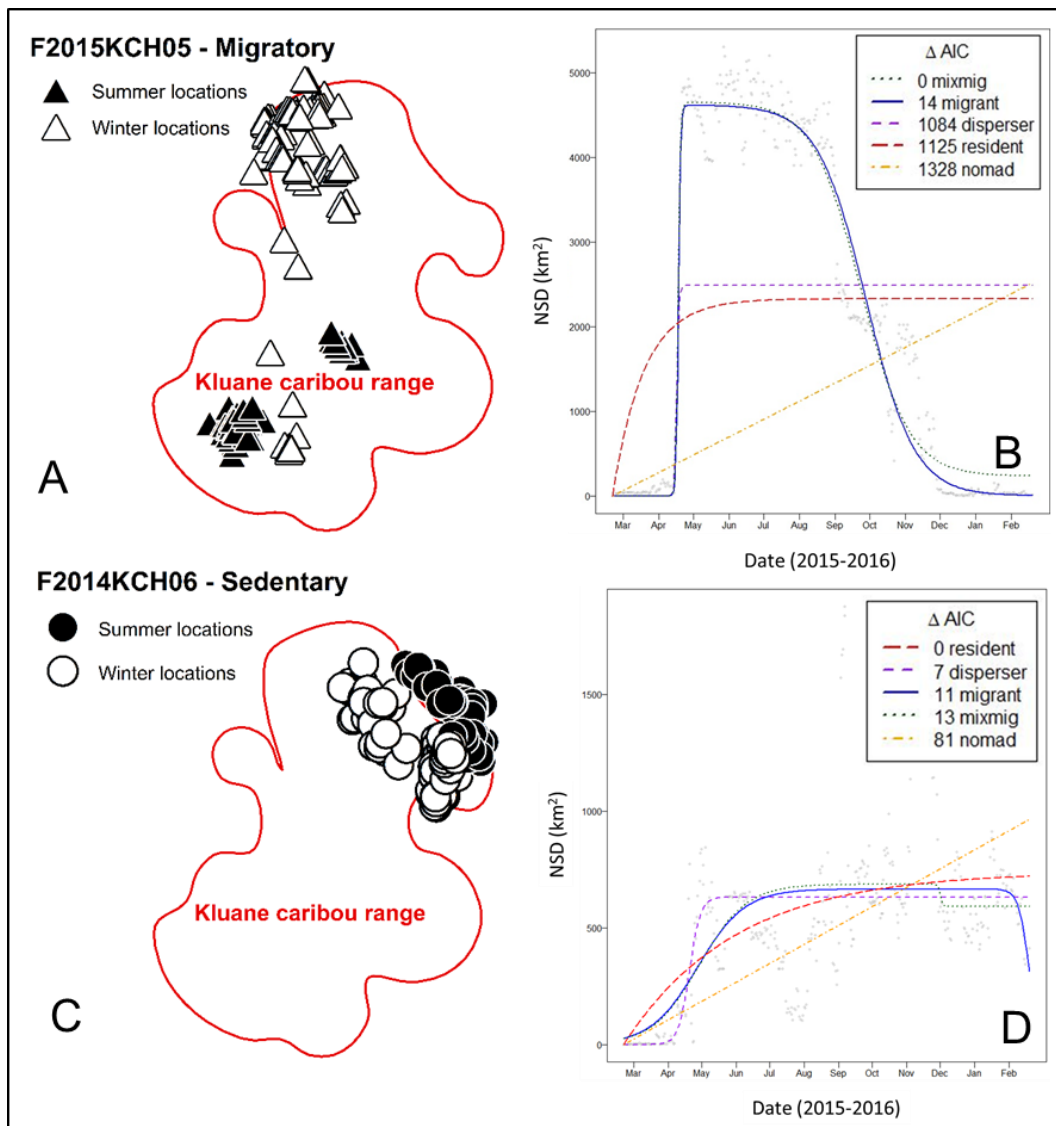


Figure 2. Sample case of one migratory (A, B) and one sedentary (C, D) animal from the same herd (Kluane). **A** and **C** Maps showing summer and winter GPS locations for the migratory and sedentary caribou (triangles and circles, respectively). **B** and **D** Analyzed trajectories of the same animals of panels A and C. Trajectories were analyzed throughout Net Square Displacement (NSD) method: telemetries for one full year were fit to NSD models and evaluated based on Akaike Information Criterion (AIC). Possible models included migrant (returning to the initial location), mixmig (mixed migrant; returning to the same geographical area but not same location), disperser (settling in a new area without returning to the initial location), nomad (random walk behaviour) and resident (remaining in a home range). Net squared displacement (NSD) is displayed in square kilometres on the y-axis and timeframe for the analysis is displayed on the x-axis.

COMMUNICATIONS

Our research project is in largely conducted in collaboration with the Environment Yukon Fish and Wildlife Branch and our main goal is to provide results that can be used by wildlife managers and government personnel to enhance caribou management and protection in Yukon. However, it is our understanding that our contacts in the Government have mechanisms in place to involve other stakeholders and decision makers, ranging from indigenous groups to hunters and other users (e.g. recreationalists). All these players are exposed to the information provided by this and other projects on caribou. As a consequence, management decisions are collegial and take into consideration various aspects, also including data from this project.

We also had the chance to present our objectives, methods and results during meetings with different Labs at University of Calgary and Princeton University. Furthermore we presented in university lectures (Conservation Biology Biol 451) and we attended and presented at 2017 Canadian Society for Ecology & Evolution Meeting. Our contribution has also been accepted as oral presentation at the 2018 The North American Congress for Conservation Biology. In our presentations and written reports, Yukon Fish & Wildlife Enhancement Trust is always mentioned and visible in the Acknowledgments.

Overall, our project is benefitting protection of caribou directly and caribou habitat indirectly, and therefore we are aligned with the mandate of your Enhancement Trust. Finally, we believe that our project, relying on a new methodology that integrates molecular and ecological data (i.e. a model approach), will benefit the management and conservation of not only caribou but also other species in the future.

Note on FINANCIAL REPORT

We are working with the Accounting personnel of the University of Calgary's Research Services. We have a system for submission of receipts, payment of other items and conducting all checks of eligibility for each project. Research Services is producing a Financial Report to you, as is common practice in academia. We:

- Included all receipts and invoices from the project and ensured they matched the project work plan and the amount of funding received.
- Did not incur over expenditures or under expenditures.

Please note that there was a minor discrepancy of budget-to-actual, comparing our original budget to actual spending. This discrepancy was not on the total amounts. However, we realized that we had to invest more than planned in human resources (2 graduate students) and proportionally less in lab costs. The discrepancy is fully explained by recent changes in the research field (ecological genomics): to produce data is costing less and to analyze big datasets (in the order of gigabytes of information) is taking more time and more resources.

ACKNOWLEDGMENTS

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