Annual Report

Prepared for:

Yukon Fish and Wildlife Enhancement Trust
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PROJECT ACTIVITIES

The first stage of this research project examined the effect of large-scale, global climate on recruitment and survival patterns in Yukon woodland caribou. Data were provided by Yukon Fish and Wildlife Branch in raw form and required some "processing" in order to be used in formal analyses. Fall survey data, used to assess recruitment, was provided as groups of animals observed by herd and year. There were 5534 observations collected during the rut from 1980 – 2007. These data were summarized to provide annual recruitment estimates (calf:cow ratio) for each herd. In total, there were 198 annual recruitment estimates across the Yukon. We limited the herds which we included in the analysis to those having a minimum of 9 years of data. Thus, we used data from 10 herds (nearly half of all woodland/mountain herds in the Yukon) in the analysis which provided 165 annual recruitment estimates (Figure 1).

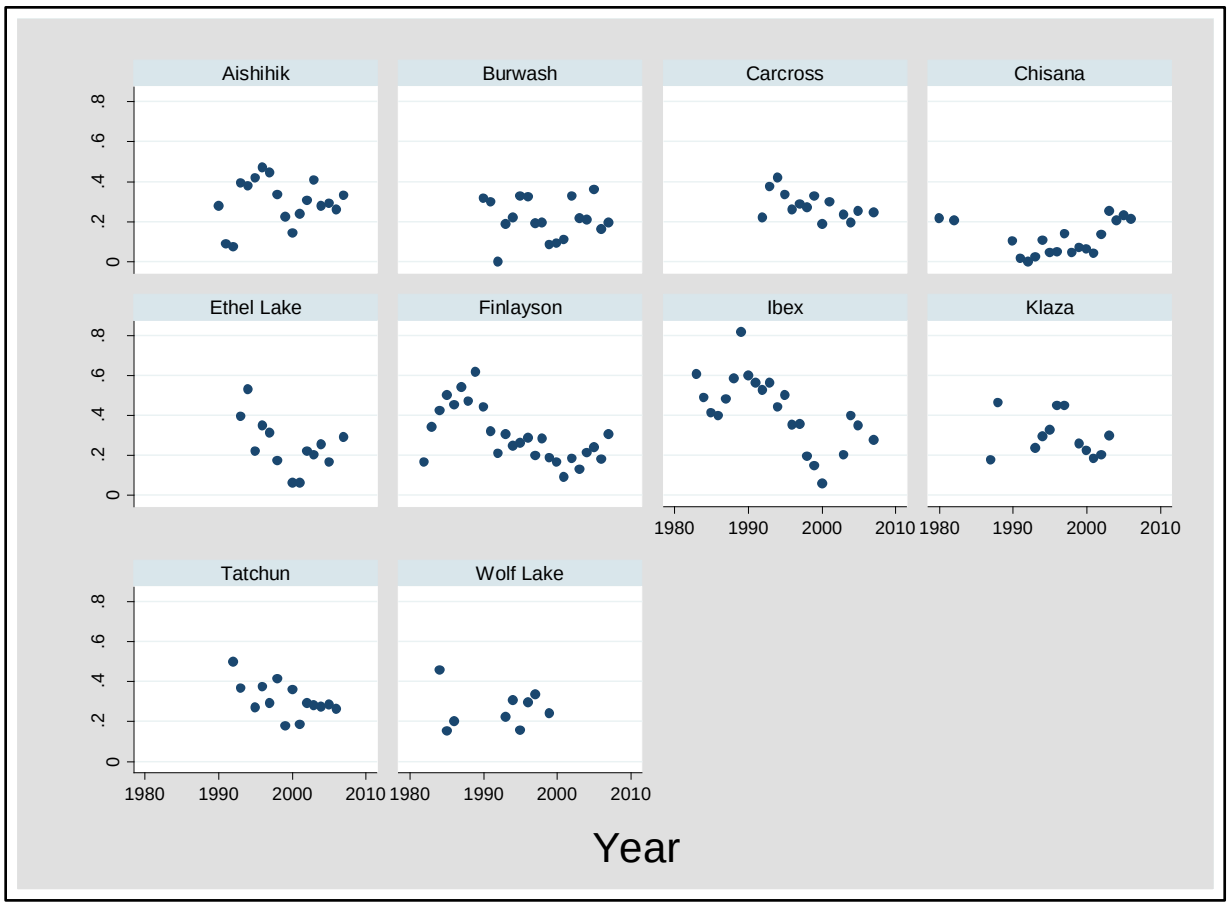

Figure 1. Annual recruitment rates (cow:calf ratio) from ten Yukon mountain-dwelling caribou herds.

The first step was to assess the relationship between these recruitment rates and global climate. We used the Pacific Decadal Oscillation (PDO) as an index of climate. The PDO is based on sea surface temperatures in the north Pacific Ocean and in the Yukon, warm (positive) phases of the PDO represent warmer temperatures, earlier snowmelt, and longer growing seasons. Dr. David Hik (University of Alberta) and his students have found a relationship between the PDO and collared pika survival in their study area in the southwest Yukon, and it has been related to such things as forest fire activity across Alaska and western Canada.

Due to issues with observational data, such as these recruitment estimates, important assumptions required by traditional statistical analyses are often not met. Therefore, we used advanced and more complex methods called random effects regression models, or mixed-models. The primary benefit of these types of models is that they can account for such things as some herds having more data than others as well as dealing with the differences between years and between herds that are virtually impossible to account for explicitly. In statistical language this is termed “unobserved heterogeneity”. Using these random effects models we can bring all the data in from multiple herds to gain more information than we could if we just looked at each herd separately.

We examined how climate (i.e., the PDO) during different seasons influenced recruitment rates. To account for the effect of wolf control on the Aishihik, Finalyson, Burwash, and Klaza herds, we used a separate coding variable for those years because wolf control would confound the ability to investigate a climatic effect.. We anticipated that climatic conditions during calving (spring) would have the greatest effect on recruitment because of how factors such as snowdepth influence predation on newborn calves. Interestingly, we found that climatic conditions in the year prior to birth had the strongest effect on recruitment rates. Climatic conditions prior to the rut can influence female body condition which can reduce her chance of either successfully giving birth and/or reduce the survival of her calf. This does not mean that climatic conditions during spring are not important; they do have a statistically significant effect on recruitment. Rather, statistically, the influence of climate prior to the rut explained more of the

variation in observed recruitment patterns better than springtime conditions. These results suggest that female body condition is influenced sufficiently by pre-rut climate that it is influencing recruitment rates. That climate at this time plays such a strong role in recruitment is somewhat surprising because of the high rate of calf losses shortly after birth, which means female caribou in the Yukon should be in good body condition by the rut because most do not have to provide resources for calves.

Our best model of how climate influences recruitment patterns included climate from the winter prior to the rut and climate in the fall season during the rut. Poor winter conditions prior to the rut may mean the females are exiting winter in poor condition and are unable to restore their body reserves sufficiently to successfully reproduce. Good fall conditions mean that the time available for females to restore their body reserves is longer, thus enabling them to successfully reproduce. We found no effect of climatic conditions 2 years prior to the rut, which would have suggested that there is a cumulative effect of climate on reproduction which could indicate limiting forage conditions. The order seasons, with respect to their influence on recruitment patterns, when just including one season in a model was:

$$Summer_{Pre\text{-}rut} > Winter_{Pre\text{-}rut} > Fall_{Rut} > Winter_{Gestation} > Spring_{Calving}.$$

We also investigated the effect of predator removal on the influence of climate on recruitment. We used data from the Finlayson herd because it had some of the most data of any herd in the Yukon. We looked at the relationship between climate and recruitment in years with and without an effect of wolf removal. We anticipated that in years with wolf removal, the influence of spring (calving season) climate should be reduced because with such fewer wolves, things like increased snowfall should have a much less effect on calf survival. In high snowfall years when wolves are present, females have difficulty moving to higher elevations to disperse away from wolves and thus there are greater calf losses. When wolves are removed, the effect of high snowfall on recruitment, for example, should be much less. Additionally, because more calves are surviving, females must provide more energetic resources to those calves, thus preventing them from devoting their entire energetic intake to their own body reserves. This should therefore make climatic conditions prior to the rut (those which influence

female body condition) more important. Results from this analysis are very preliminary and we are currently working on interpreting them. However, we did find changes in the climatic effect on recruitment with and without wolf control.

From a management perspective these results provide information which may assist in forecasting potential effects of future climatic conditions on caribou recruitment. They also suggest the importance of summer foraging conditions, and hence summer ranges, for caribou recruitment. While winter range is often viewed as a critical factor for caribou population dynamics, summer range may also be very important. These results may also be useful for managers working to predict potential effects of changing climate on caribou populations as it specifies how different seasons affect recruitment. An important note is that results described here should be viewed tentatively. Until results and conclusion drawn from them have been peer-reviewed by either T. Hegel's doctoral supervisory committee and/or reviewers from scientific journals they should be considered preliminary.

One of the proposed objectives of this research was to compare the responses of different herds to global climate. Our assessment from the 10 herds considered here did not allow for this comparison because we found there was not a sufficient enough difference among herd responses. This could be the result of either an insufficient amount of data to examine this relationship, or that the response of herds to the PDO is relatively similar. With research projects such as this, unexpected findings, or lack thereof, are a common occurrence and should not be viewed negatively.

We are currently in the process of analyzing adult female survival data based on radio-collar data. As with recruitment, data were provided by Yukon Fish and Wildlife in raw form. Data preparation for this analysis was much more time-consuming and required the processing of over 15,000 animal observations from over 1200 radio-collared animals. This analysis is ongoing. Future research in this overall project will include examining factors relating to the degree of annual variation in recruitment rates both within and across herds. We will also be examining the synchrony in demographic rates between herds and possible factors related to it. Now that the base recruitment

and survival rates have, or will soon be, estimated, these future analyses should proceed much quicker.

COMMUNICATIONS

This project forms the basis of a doctoral dissertation being completed at the Institute of Arctic Biology, University of Alaska Fairbanks. A copy of this dissertation will be provided to the Enhancement Trust upon completion. We are currently preparing two manuscripts to submit these results and findings to international scientific journals. If published, these and any other published articles arising from this research will be provided to the Enhancement Trust. In all publications and/or presentations, the Enhancement Trust will be graciously acknowledged for their financial assistance of this project.

BUDGET

Expenditure Category	Item	Projected Cost	Actual Cost	Receipts
Wages, Contract Services	Salary for T. Hegel	$11,000	$11,000	n/a ($8800 received as of March 2008)

As identified in the original proposal for this project submitted to the Enhancement Trust, this project was primarily analytical and funds were designated as salary/stipend for the lead researcher.