Woodland Caribou Response to a Natural-Pattern Inspired Disturbance Plan

A Forest Resource Improvement Association of Alberta
Open Funds Project

Final Report

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On behalf of

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INTRODUCTION

Woodland caribou (*Rangifer tarandus caribou*) is well recognized as being as one of the least adaptable large ungulates in North America. Their preferred habitat of large patches of contiguous, older, conifer-dominated forest is becoming a rare commodity.

Woodland caribou is listed as a *rare* species within Canada, but they are *endangered* within Alberta (Hunter *et al.* 2004). The population levels of most of the documented caribou herds in Alberta are declining. Although the reasons for these decreasing population levels are many, increased predation (particularly of the young) is thought to be the primary cause. We are somewhat more confident that herd population levels are inversely related to disturbance rates and types (Hebblewhite and Merrill 2008). Older, contiguous, undisturbed and unroaded forest areas offer caribou abundant food sources and exclusivity in terms of habitat, which translates into protection from predators (James *et al*. 2004). One of the more prevalent theories of their decline is as follows: 1) Disturbances encourages local increases in deer, elk, and/or moose. 2) This explosion of potential prey causes an increase in local wolf population levels. 3) Woodland caribou, the young in particular, are less able to escape from, or defend against, wolves. 4) Local woodland caribou population levels decline locally.

One of the key elements of this problem is the perceived inability of woodland caribou to migrate in response to a change in local conditions – including the risk of predation. For example, woodland caribou are well known to inhabit recently burned areas, which would seem to be to their detriment since recent burns attract both moose and deer, and thus wolves as well. However, the fact is that woodland caribou exist today within landscapes that we know have a highly dynamic disturbance history. The average interval between forest fires on foothills landscapes in Alberta is somewhere between 80-150 years (Andison 2002). This means that the present location of the woodland caribou herds in Alberta today was likely not the location of these animals 80 to 150 years ago because these areas would have been young forest, and thus unsuitable habitat. This suggests that woodland caribou must have some form of a migratory mechanism(s), although it may be atypical. Thus, the question that this research was originally meant to address was*:* ***Why, how, at what cost, and over what period of time do woodland caribou historically respond to (the increased risk posed by) disturbance events?***

Given what we now know, this would seem to be ***the*** most important question as relates to woodland caribou survival in Alberta over the long term. In the absence of short-term protectionist strategies (such as predator control, habitat fortification, and breeding programs), the only viable long-term solution for the survival of woodland caribou is to understand, respect, and take advantage of their natural evolutionary tendencies.

Unfortunately, we are unlikely to answer this question, or provide for any insights for long-term, regional-scale management opportunities by the current practice of limiting harvesting activities to the perimeter of known woodland caribou habitat. In fact, over time, such avoidance policies potentially create an increasingly isolated and shrinking island of caribou habitat surrounded by an increasing area of habitat that unsuitable for caribou travel. So even if caribou wanted to migrate to new habitat in response to disturbance, in most cases their options for doing so have been severely compromised. In the end, despite our best intentions, we may be inadvertently sealing the fate of woodland caribou by seeking to protect them over the short term based on an incomplete understanding of their evolutionary migratory habits.

We are far more likely to discover the key to the evolutionary strategy of woodland caribou if we can closely monitor the reaction of animals where we deliberately emulate natural disturbance phenomena within a landscape that has an abundance of high quality caribou habitat. Unlocking this key could provide the ultimate management tool for managing woodland caribou over the long term.

THE RESEARCH OPPORTUNITY

The Hwy40 North Demonstration Project is a test case to evaluate the use of a natural-pattern inspired operational plan to provide viable options for most, if not all, management objectives. The idea was to start every operational planning decision with the question "*what would Mother Nature do*?". The hope was that this would create a unified *disturbance plan* between the various partners that would provide some baseline management solutions for all other landscape values.

This is admittedly a bold hypotheses, but one that we had a reasonable hope of demonstrating. Natural patterns have already proven convergent with the needs of social values (aesthetics), economic values (harvesting costs), and ecological values (small mammals and songbirds) in a similar experiment in Saskatchewan (Andison 2004, Van Wilgenburg and Hobson 2008). The Hwy40 project represents a tremendous opportunity to learn even more, which is why the key partners involved committed to an adaptive monitoring program for several key values (*sensu* Walters and Holling 1990). Accordingly, the monitoring strategy was to pose hypothesis, predict outcomes, measure the outcomes, and critically compare outcomes with the predictions.

The project presented an ideal opportunity to pursue adaptive management ideals with respect to the migratory dynamics of woodland caribou;

- The study area overlaps with a portion of the current home range of the A la Peche woodland caribou herd, although it includes only 30-40 of the estimated 200 animals in the herd.
- The A la Peche herd is one of the few in Alberta that is not declining.
- Previous GPS collar data suggest that some animals in the herd are capable of annual migration.
- It is one of the only areas in Alberta where the animals are only using a small portion of the potential habitat. Habitat modelling by the provincial government suggests that while the entire Hwy40 study area ranks as high woodland caribou habitat potential, most of the area remains unused by animals.
- The planned Hwy40 disturbance activities over the next decade (see Figure 2 ahead) represent only a small percentage of the existing habitat, and a much smaller portion of the potential habitat.

In summary, the Hwy40 project area is one of the few places in Alberta where the potential for understanding the dynamics of movement through an adaptive disturbance experiment is realistic. From a scientific perspective, it is perhaps the only location in Canada where we have the opportunity to gain new knowledge of woodland caribou spatial dynamics in a low-risk situation. No other woodland caribou study in Canada has tested such a hypotheses, and only a very small number could do so if they wanted to. It does not get much better than this as an adaptive learning scenario.

GOALS AND OBJECTIVES

The project has evolved over the last four years in response to shifting priorities and conditions. While the original goals and objectives are perhaps even more relevant today than when they were written five years ago, we have added some new objectives in response to changing circumstances.

Original Goals and Objectives

The original goal the study is to *learn if, how, why, and when woodland caribou move to other parts of the landscape in response to a natural pattern inspired disturbance plan.*

The ultimate goal of this project is to *develop more robust and sustainable management guidelines / models for woodland caribou within and beyond Alberta.*

The objectives of this project are:

- To evaluate and improve upon the predictive capabilities of existing fine-filter models for woodland caribou, and/or create new, more robust models.
- To better understand how caribou collectively respond to specific disturbance activities over both time and space.
- To evaluate the ability of a natural-pattern inspired operational plan to meet the management objectives for caribou.

Original Competing Adaptive Hypotheses

One of the most appealing aspects of this project is that it functions as both 1) responsible monitoring of a unique management scenario, and 2) adaptive research towards generating new knowledge of a critical ecological issue in Alberta. The potential for this project to address multiple, relevant caribou issues is tremendous, and fall into three general categories, each with multiple competing hypotheses:

1) CARIBOU MOVEMENT. There are several possible explanations of the mechanisms by which caribou respond to disturbance:

1) They do not move at all.
2) Only (some or all of) the offspring move.
3) All (or most) of them move over X years.
4) Only a small number of “rogues” move as a group, along with their offspring.
5) Some or all individuals move, but only on an annual (migratory) basis.

2) NEW LOCATION(s). Assuming all or some existing animals and/or their offspring choose to move in this case, there are several options:

1) More east or south into large tracts of suitable old forest habitat conditions.
2) More west into the Willmore Wilderness Area into large, suitable old forest habitat conditions to join the main (larger) herd.
3) Move temporarily into any other areas (either during harvesting and burning operations, or as part of an annual migration), after which they return (either annually or permanently).

3) LOCAL AND NON-LOCAL POPULATION DYNAMICS. Assuming some or all animals remain in the disturbed area, several sub-population dynamic responses are possible. Remember that the proposed treatment in this case attempts to emulate fire, but cannot mimic fire. So it represents a unique treatment never previously tested, and an outlier for existing prediction models.

1) Local mortality rates will increase / decrease (track by cause).
2) Local birth rates will increase / decrease.
3) Local mortality and birth rates will change (as per 1 and 2) for a period of X years, after which they will return to pre-treatment and/or stable levels.
4) Annual migration to the Willmore will increase (see hypotheses 2.3).

In addition to testing these hypotheses, the project will attempt to develop and test a resource selection function (RSF) model for woodland caribou using these data (Johnson 1980, Manly *et al*. 1993).

New Objectives

Soon after the initiation of this project in 2006, circumstances have changed considerably. First and foremost, the perceived MPB threat for the study area shifted from being *negligible* to *high*. The province has since directed forestry companies along the eastern slopes of the Rockies to develop and submit "beetle plans" designed to mitigate both the local impact and future spread of MPB to other areas of the province. Second, the global economic downturn hit the forestry sector particularly hard starting in 2007, which translated into a shift in harvesting priorities away from areas with marginal wood value and/or areas far from processing mills. At the same time, pressure to preserve all existing areas of woodland caribou habitat was increasing, resulting in the withdrawal of support for the final disturbance plan (as shown here) from one of the key Hwy40 partners.

The net result of these factors was an indefinite postponement of harvesting activities in most areas of the Hwy40 area. Accordingly, we developed some new project objectives:

- Initiate baseline monitoring of woodland caribou prior to Mountain Pine Beetle (MPB) infestation and/or control measures.
- Seek collaborations to strengthen our original objectives, and support other research and management objectives.
- Contribute to species at risk recovery efforts.

PROJECT LOCATION

The Hwy40 study site includes 20,000 hectares each from the Alberta Newsprint and Hinton Wood Products Forest Management Agreement Areas (FMAs), and the Foothills Forest Products quota area, and 10,000 hectares from the Willmore Wilderness Area (Figure 1). The size and boundaries were specifically chosen to represent a large operational area with ecological, economic, and social relevance (across a range of values). It is bisected by Highway 40, but remains otherwise relatively undeveloped

Ecologically, it has a relatively large proportion of conifer-dominated forest older than 120 years of age. According to a habitat model from the Fish and Wildlife Branch of Alberta Sustainable Resource Development, the entire study area is high to very high woodland caribou habitat potential (see the shaded green areas in Figure 2).

The inset of Figure 2 also shows the final area of the proposed disturbance event in the Hwy40 study area. Note also this event includes significant areas of undisturbed retention (shown in green). The number and area of these residuals is consistent with those found in natural wildfires, and it was our intention to arrange them spatially to provide a network of movement corridors and stepping stones for wildlife. It is important to understand that the "disturbance event" outlined in Figure 2 denotes the coordinated harvesting, prescribed burning, and road and well site construction activities over the next decade.

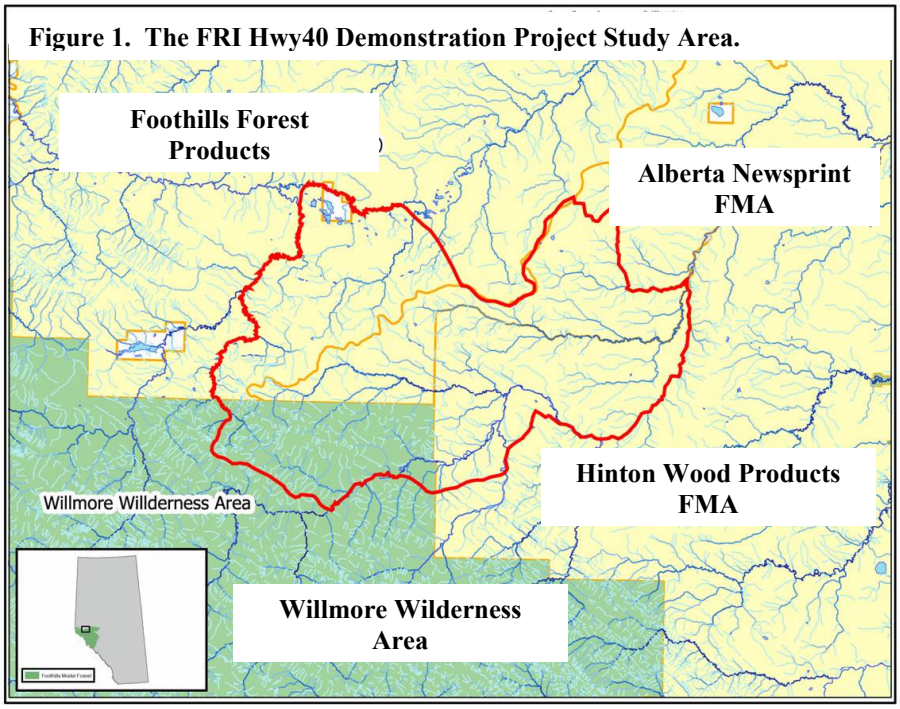
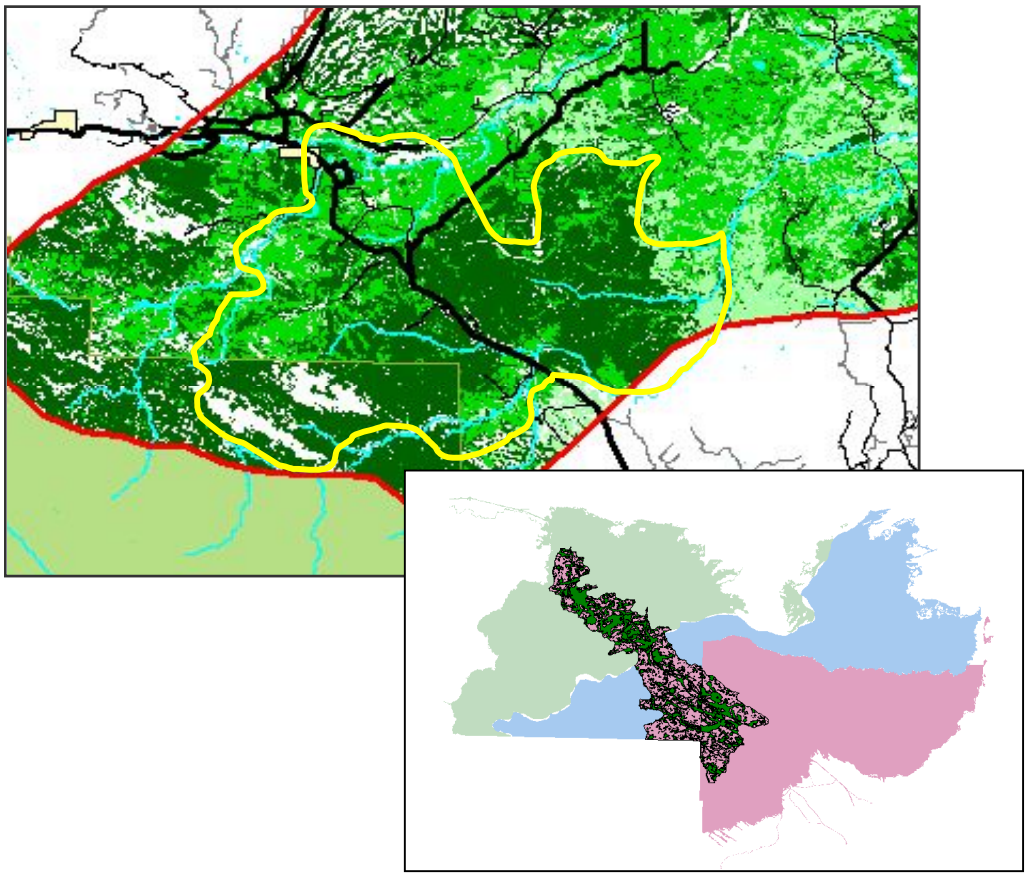


Figure 2. Caribou Habitat Model Projection for the Hwy40 Demo Study Area and the proposed 10-year Disturbance Event Location (inset).



METHODS

The project involved technical, scientific, and communications objectives. The methods involved were thus many and varied.

Project Management

The project was initiated by Dr. David Andison, who also coordinated all of the project activities until July 2006, and remains as the project manager today. As of July 2006 however, Dr. Matthew Wheatley was retained as a consultant to oversee the technical and administrative aspects of the project. In December of 2008, Dr. Wheatley accepted a job with Alberta Tourism, Parks and Recreation as a wildlife biologist. As part of his new duties, he kindly agreed to continue to oversee the management of the data and collars for the Hwy40 project. Also in December of 2008, the de facto principle investigator for the project became Dr. Mark Hebblewhite of the University of Montana.

Support and Partnerships

In terms of funding, formal proposals were prepared and submitted to several agencies, including the Foothills Research Institute, Hinton Wood Products (HWP), Alberta Newsprint Co. (ANC), the Parks Canada SARA fund, Jasper National Park, Alberta Sustainable Resource Development, and Petroleum Technology Alliance Canada (PTAC). We were successful in obtaining significant funding from HWP, ANC SARA, and ASRD.

Given both the extensive and expensive nature of woodland caribou research, we recognized the importance of forming a research-oriented partnership with one or more agencies. Towards this, we pursued collaborate with provincially led research efforts under the auspices of either/or the West-Central, or Alberta Caribou Committees. Unfortunately, the timing was such that neither group was yet able or willing to deal with the coordination of research partnerships. Fortunately, early in 2007, we were able to form an informal relationship with a Parks Canada / University of Montana woodland caribou research group. Since then, we have coordinated our capture /collar and data download requirements with them, and openly shared raw data.

Capture and Collar

During the fall of 2005, Dr. Andison, with advice from the FRI Grizzly Bear Program and ASRD Fish and Wildlife Branch, developed specs for, and ordered 12 Lotek GPS collars. The priority was to ensure not only reliability, but also compatibility with existing parallel caribou studies. In February ’06 the collars arrived and were readied for collaring.

After acquiring the necessary permits, in the late winter of 2006 we managed to capture and collar only one animal using aerial net guns. For animal health reasons, the acceptable capture criteria based on minimum snow levels and maximum temperatures is quite narrow. The late winter of 2006 not only offered few such windows of opportunity, but when they did, a) there were other higher priority caribou capture projects, and b) when they were able to look, aerial reconnaissance was unable to find suitable Hwy40 animals.

After acquiring new capture permits, in December 2006, we collared seven animals just east of the highway in the centre of the A la Peche caribou winter range (Figure 3). In February 2007, an additional five collars were deployed under a collaborative capture permit with our collaborators. These five collars were deployed within north Jasper National Park and the Willmore Wilderness area, adjacent to the Hwy40 Project area (Figure 3).

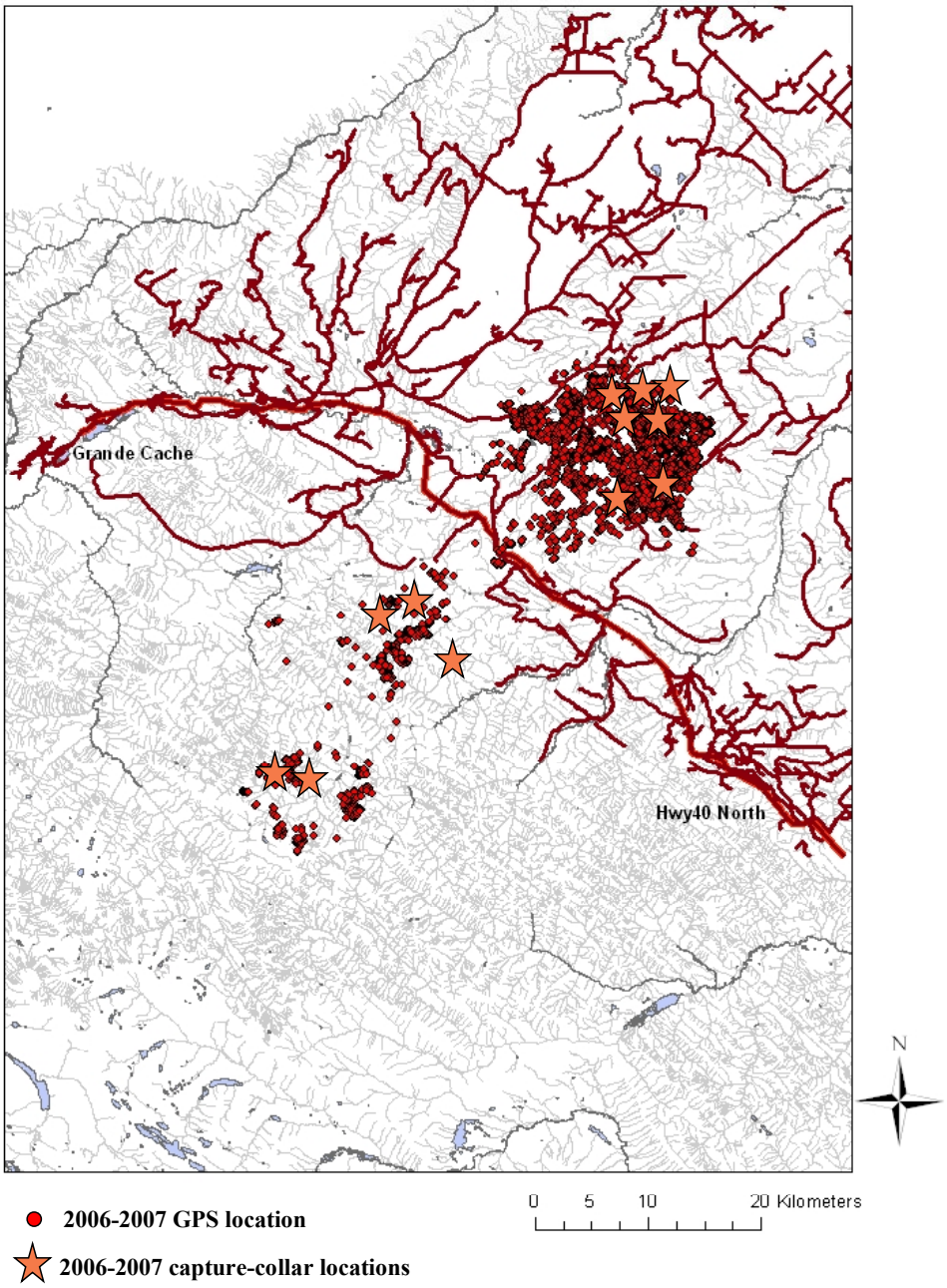


Figure 3. Caribou capture locations (orange stars) with scatter plot of downloaded GPS data from 2006-2007. *Note, Figure does not distinguish GPS data among animals and cannot be used to imply habitat use as-is.*

For most of the past four years, the project gathered location data. Data-collection flights (to download collar data remotely) were completed at least once monthly. Raw data are stored in a common database housed in Jasper (Resource Conservation Offices, Parks Canada).

Since 2006, the collars have been recovered and redeployed several times. One collar was retrieved in July 2007 after transmitting a mortality signal, and two more animals died later in the same year. One of the three recovered collars was destroyed by a vehicle, and the remaining two collars were refurbished in preparation of redeployment. In December of 2008, three refurbished collars were re-deployed on animals in the Willmore, but we lost the signal on three others due to malfunction. Two more collars were recovered and replaced in January of 2009. So in summary, as of September 2009, of the 12 original collars we purchased:

- Three are lost.
- One was destroyed.
- Two were re-deployed on animals in Feb. '09 in the Hwy40 area
- Three were re-deployed on new animals in Dec. '08 in the Willmore
- Four others have recently been recovered from the field, one of which is currently in good condition and will be redeployed as soon as conditions allow.

Results

Examples of (raw) GPS collar data are shown in Figures 4-17 for each of our collared animals. As planned, less than half of the collared animals actually use any part of the area within the planned disturbance event, and of those that do, most do so for migrating from east to west. (Note that we are not suggesting that most of the A la Peche herd does not use the disturbance event area, but rather that we deliberately chose a mixture of animals with different location preferences. This would have provided us with some control data during and after the disturbance treatment).

At this point, no part of the Hwy40 disturbance event has been installed, and it is unlikely that this will happen in the near future. This means we have been unable to test any of the specific hypotheses originally outlined on pages 3 and 4 concerning caribou movement in response to disturbance. Furthermore, none of our data have been analysed alone since there was no experiment to test.

Anecdotally, it is worth noting that the GPS locations of the collared animals are all inconsistent with the original caribou habitat suitability map. The dark green (high potential habitat area) of Figure 2 includes virtually no visits from the collared animals in Figures 4-17. Ironically, there is no empirical evidence to suggest that any members of the A la Peche herd currently reside in the south-eastern portion of the study area. More importantly, this confirms the limitations of habitat suitability maps alone as decision-support tools for woodland caribou, and reinforces the value of collar data.

We had considerably greater success in accomplishing the new objectives outlined on page 4 in terms of contributing to baseline conditions and developing collaborations. For example, the collared Hwy40 animals are all directly in the path of one of the more worrying mountain pine beetle (MPB) 'spillways' from the west. We began tracking animals in 2006, which means we not only have all-important pre-disturbance data, but we continue to capture and collar animals throughout the outbreak. This project is well

positioned to uniquely contribute to questions that are now arising about the impact of MPB on woodland caribou and their habitat.

In the bigger picture, all of our animal data has, and continues to be used by several different agencies associated with woodland caribou research and management. In recognition of the importance of SARA species recovery efforts, all data collected in the Hwy40 project area are sent to the Alberta Caribou Committee and made available to biologists involved in the provincial caribou recovery plan and associated activities. The Hwy40 contingent of collared caribou represents a significant portion of the region's sample size for woodland caribou.

In spring 2007, we were successful in acquiring a collaborative federal Species at Risk grant to combine data for north Jasper and Hwy40 caribou, and to coordinate our monitoring efforts accordingly. A common database now exists for the A la Peche (Jasper and Hwy40) and the Little Smokey herds. We also agreed in 2007 to fold our work in with the University of Montana's Ungulate Ecology lab run by Dr. Mark Hebblewhite. The research focus of this group is quite broad, and includes predator-prey interactions, migratory behaviour, the impacts of forestry and fire, and impacts of human development. The team is using data from the ACC, which includes all of our animals.

Most recently, this group published an article on DNA analysis of Alberta's woodland caribou. Ironically, their work suggests that some proportion of Alberta's woodland caribou is more closely related to the more migratory lineage of barren-ground caribou (*Rangifer tarandus groenlandicus)* (McDevitt *et al.* 2009). In other words, "migration" in this case may occur at the individual scale, as opposed to entire herds. In other words, our original hypotheses listed on page 3 are not only reasonable, but ahead of their time.

In the interests of caribou conservation, we have made full collaboration a primary objective through the federal SARA program. A main component of this objective is to clarify the migratory behaviour of trans-boundary caribou moving from Hwy40 into Willmore and Jasper National Park, as well as among the Little Smokey and A la Peche herds. Note that this objective is entirely consistent with our original objectives #1 and #2. The fact that we share this with others can only make the research, and the results, that much stronger.

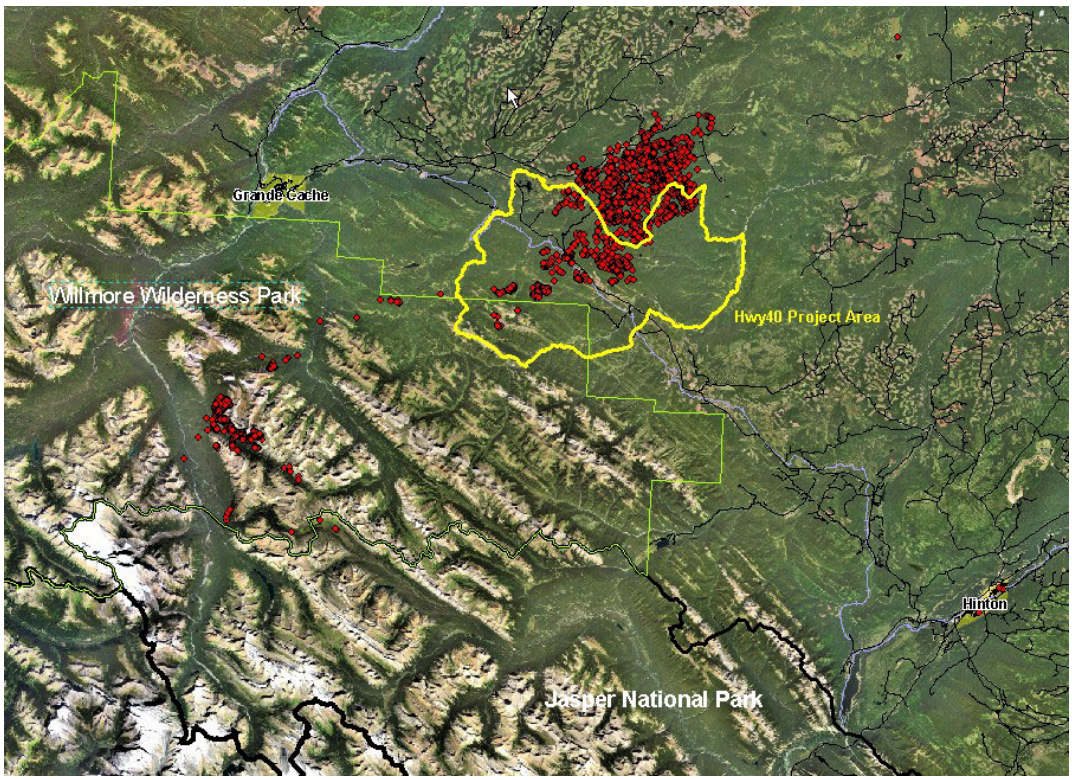


Figure 4. Caribou scatter plot of downloaded GPS data on animal #120 for 2006-08.

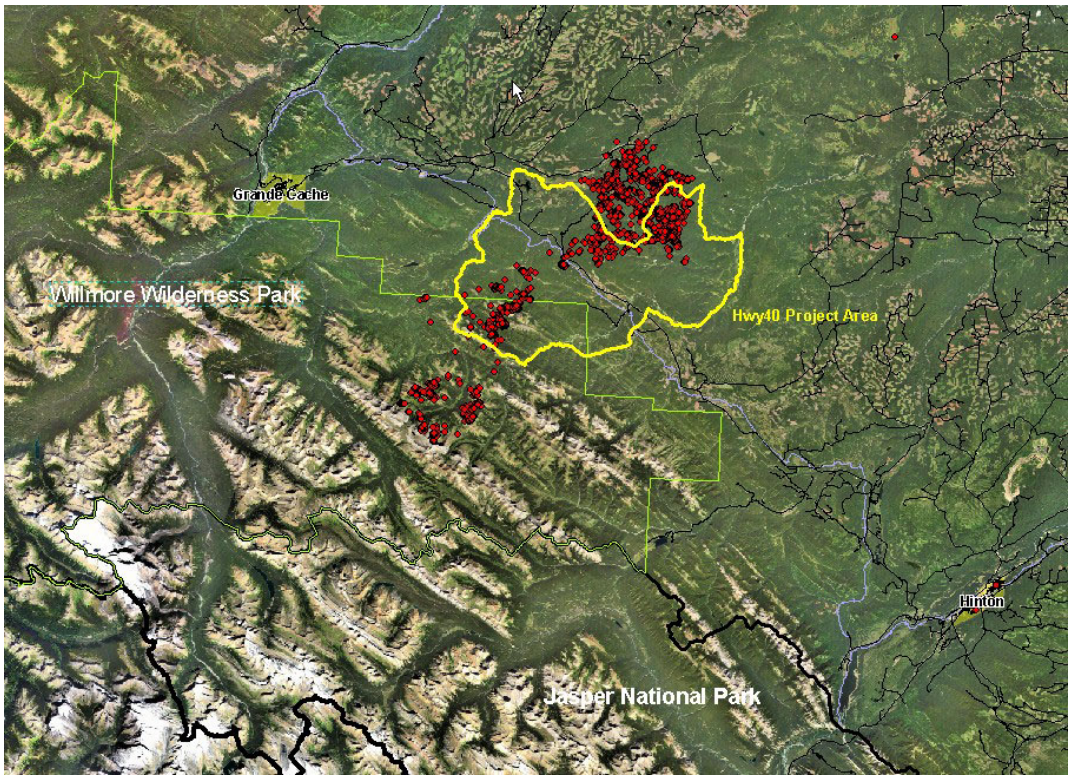


Figure 5. Caribou scatter plot of downloaded GPS data on animal #768 for 2005-06.

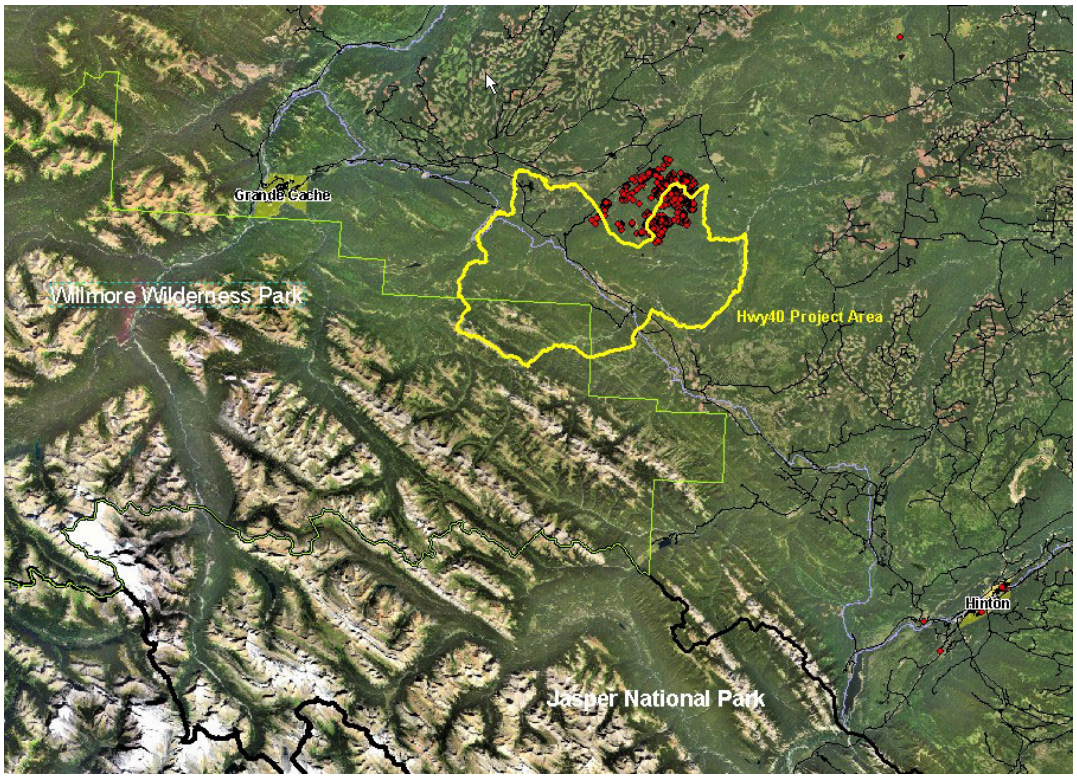


Figure 6. Caribou scatter plot of downloaded GPS data on animal #116 in 2007. (Died in July ’07).

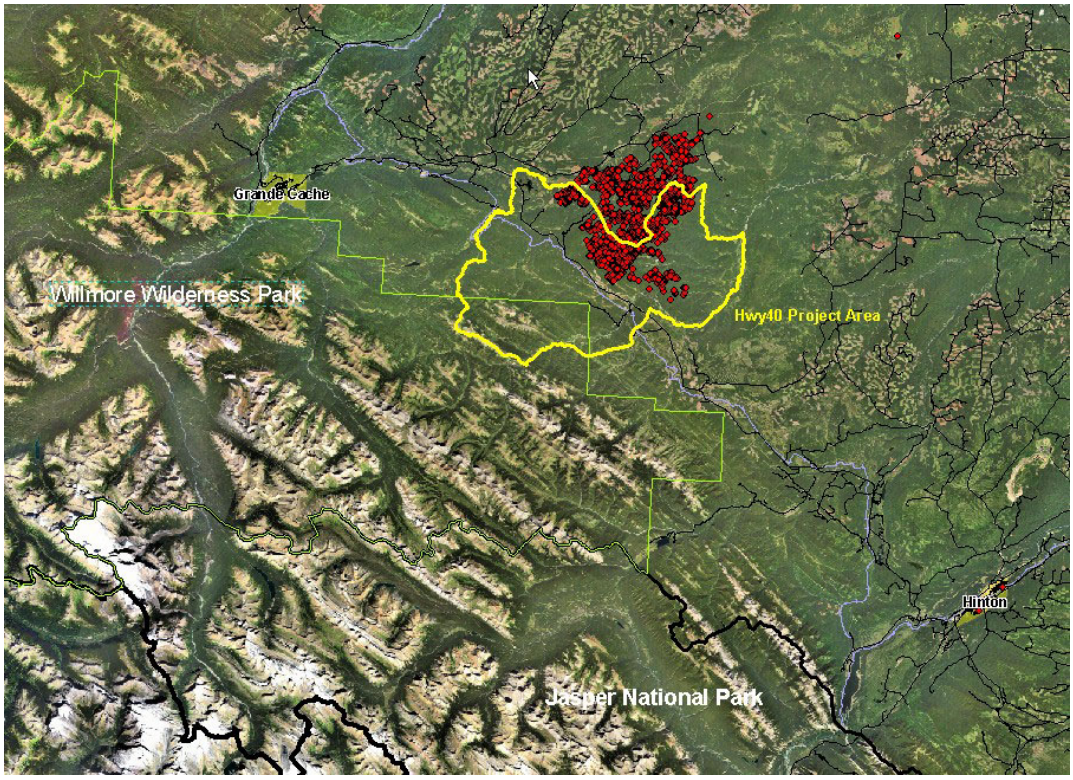


Figure 7. Caribou scatter plot of downloaded GPS data on animal #117 for 2006-08.

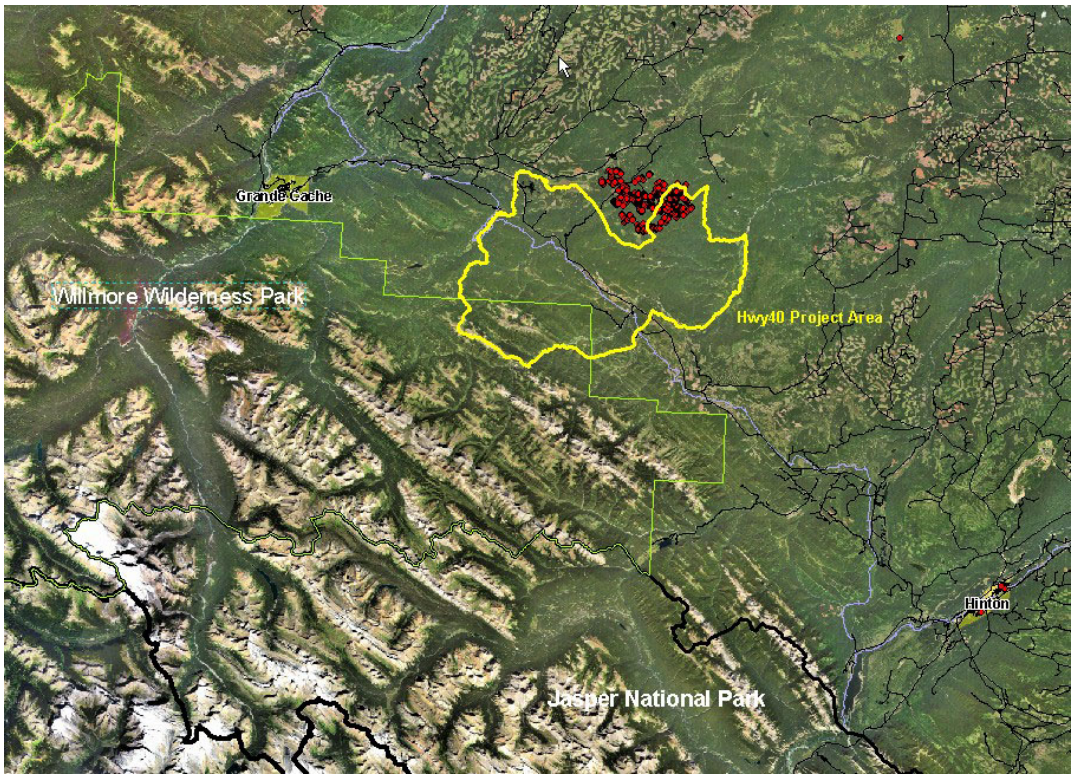


Figure 8. Caribou scatter plot of downloaded GPS data on animal #118 for 2006-07.

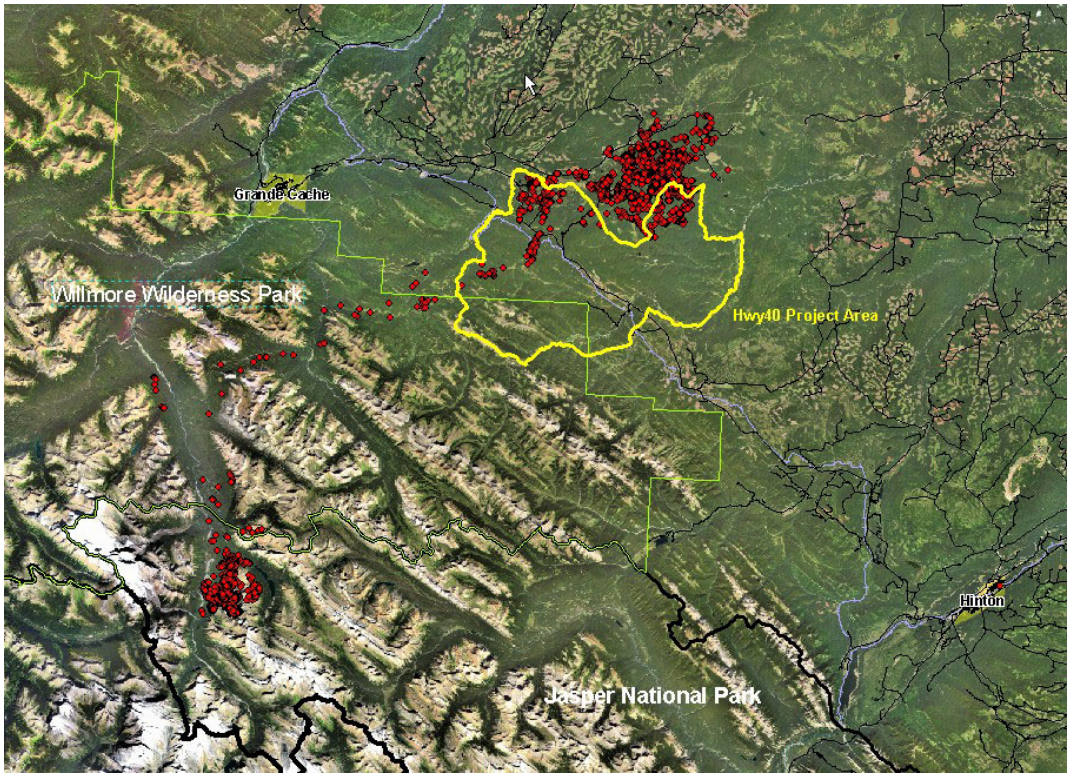


Figure 9. Caribou scatter plot of downloaded GPS data on animal #121 for 2006-08.

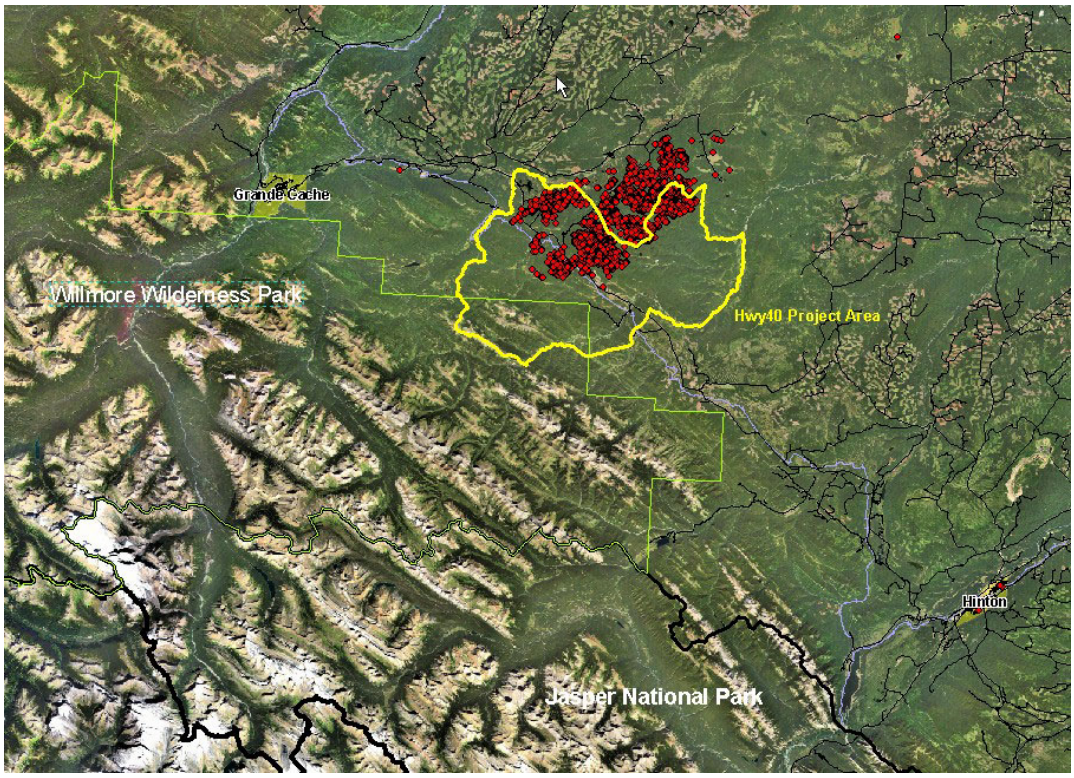


Figure 10. Caribou scatter plot of downloaded GPS data on animal #119 for 2006-07.

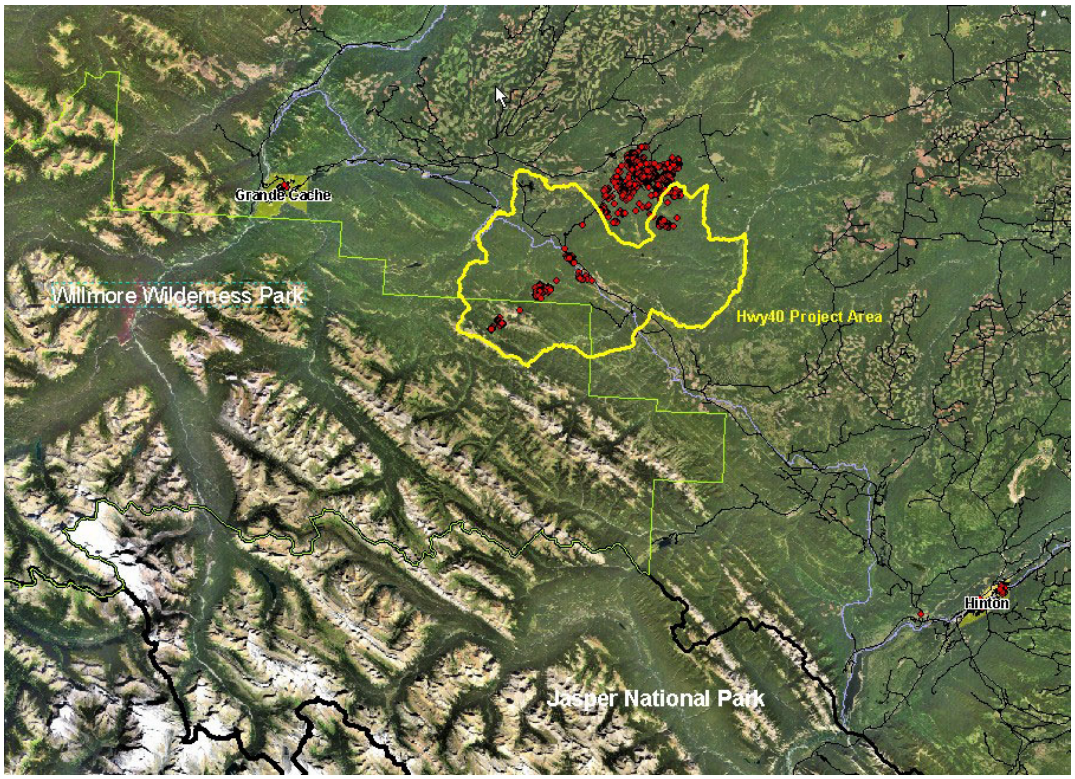


Figure 11. Caribou scatter plot of downloaded GPS data on animal #122 for 2006-08. Died Jan. '08.

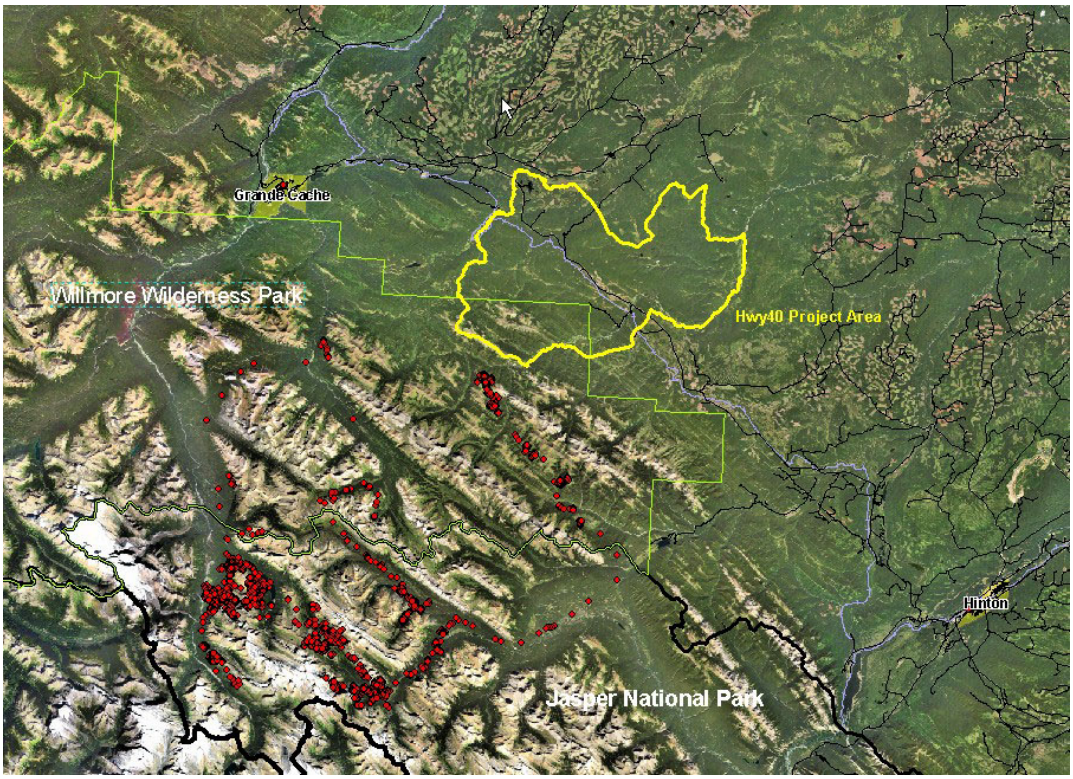


Figure 12. Caribou scatter plot of downloaded GPS data on animal #125 for 2007-08.

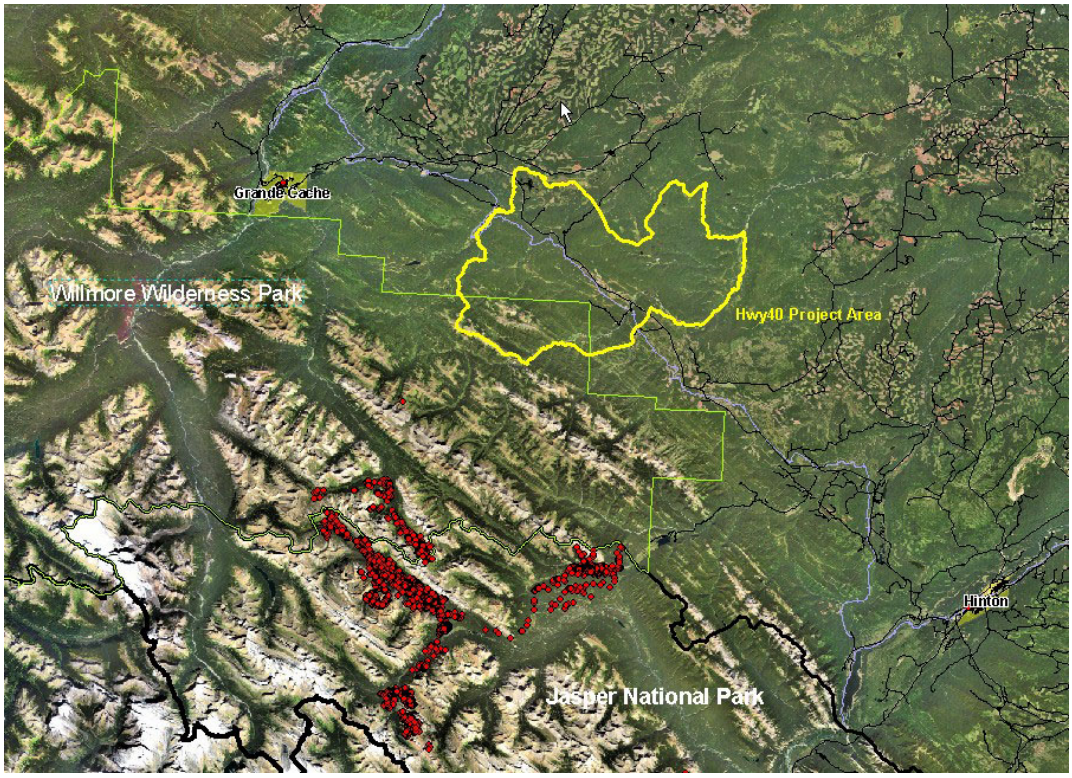


Figure 13. Caribou scatter plot of downloaded GPS data on animal #95 for 2007-08.

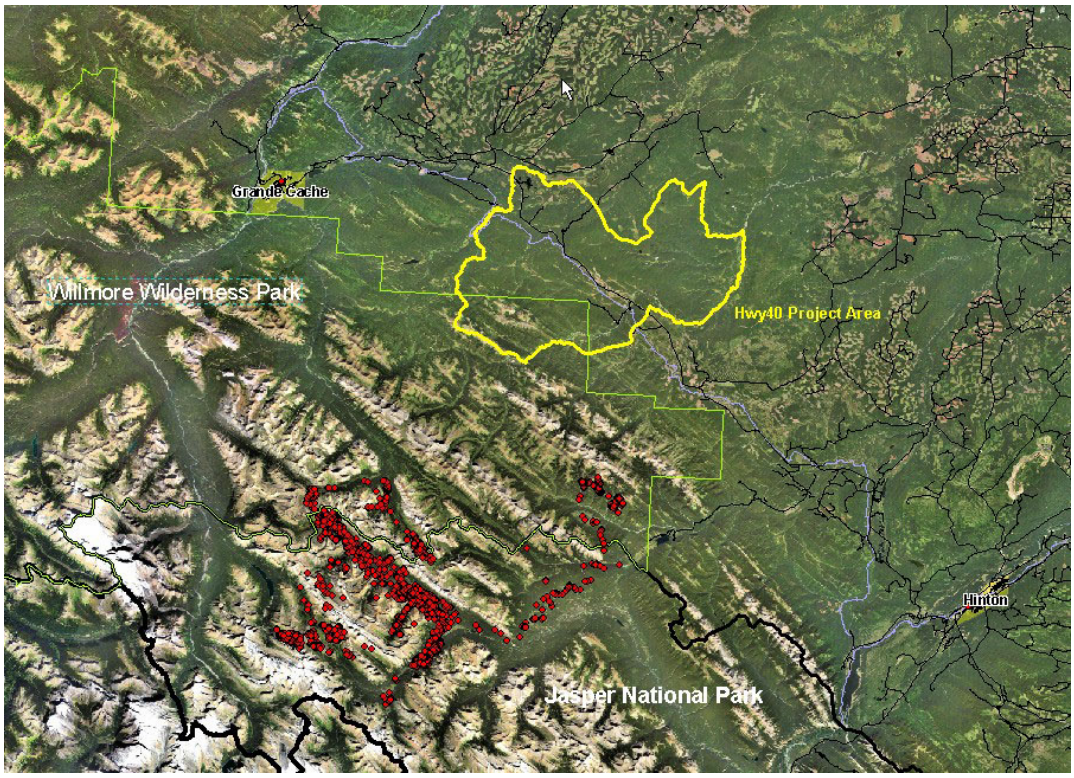


Figure 14. Caribou scatter plot of downloaded GPS data on animal #94 for 2007-08.

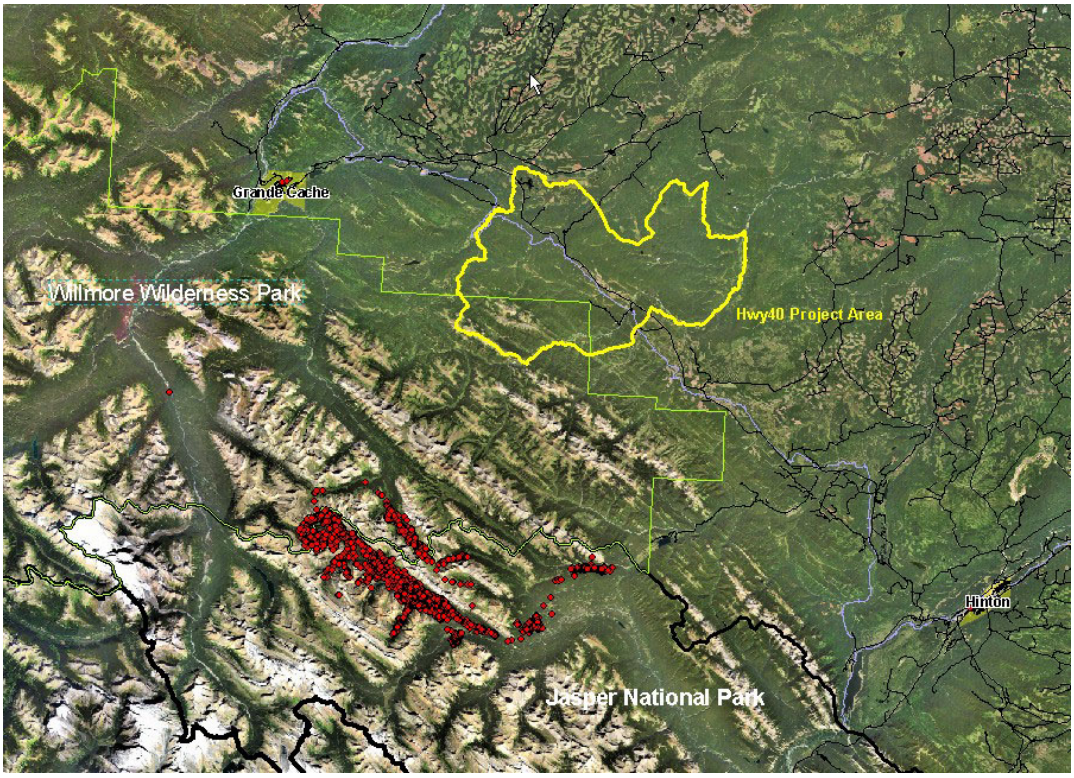


Figure 15. Caribou scatter plot of downloaded GPS data on animal #97 for 2007-08.

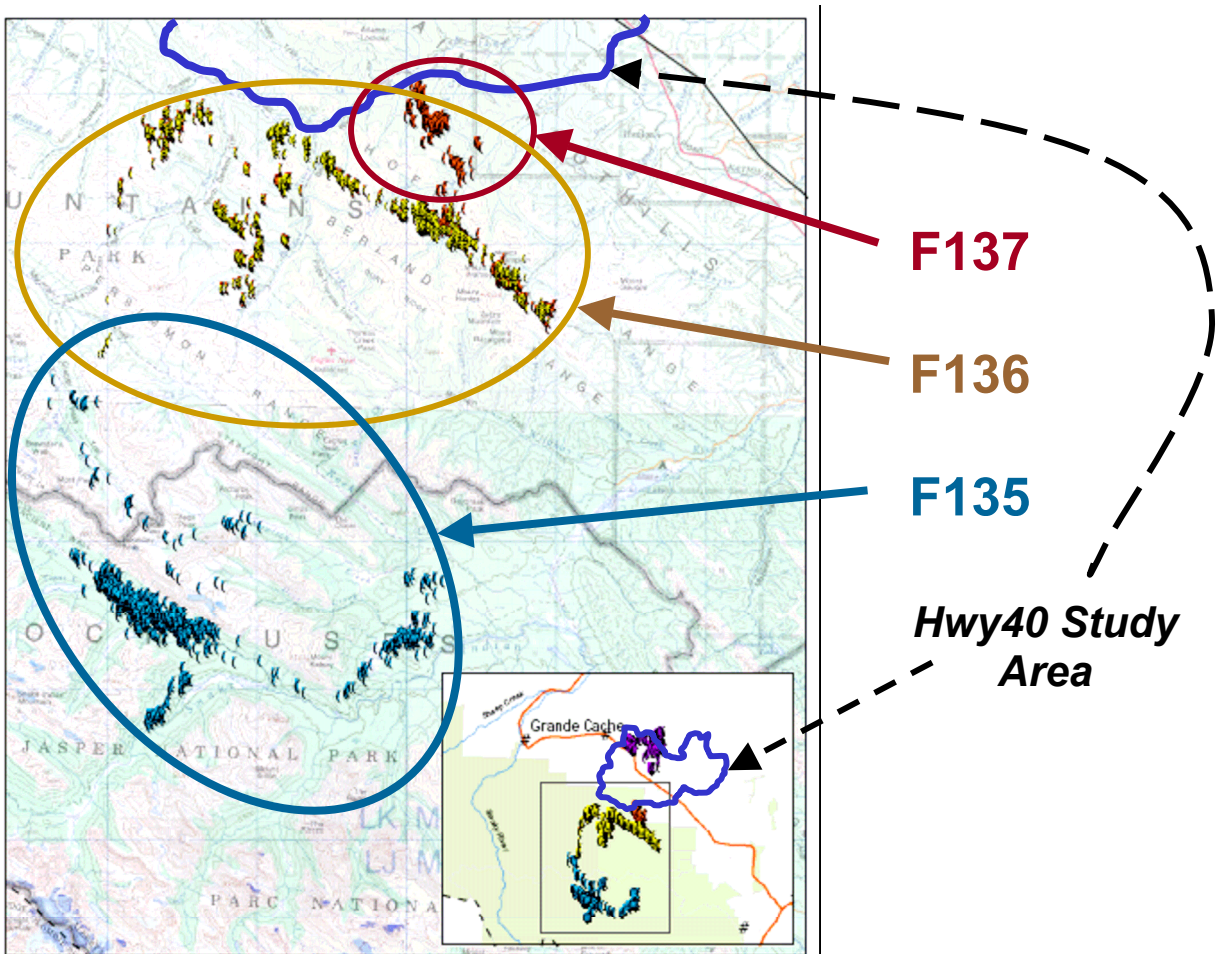


Figure 16. GPS collar locations from Feb-May 2009 for animals 135, 136, and 137.

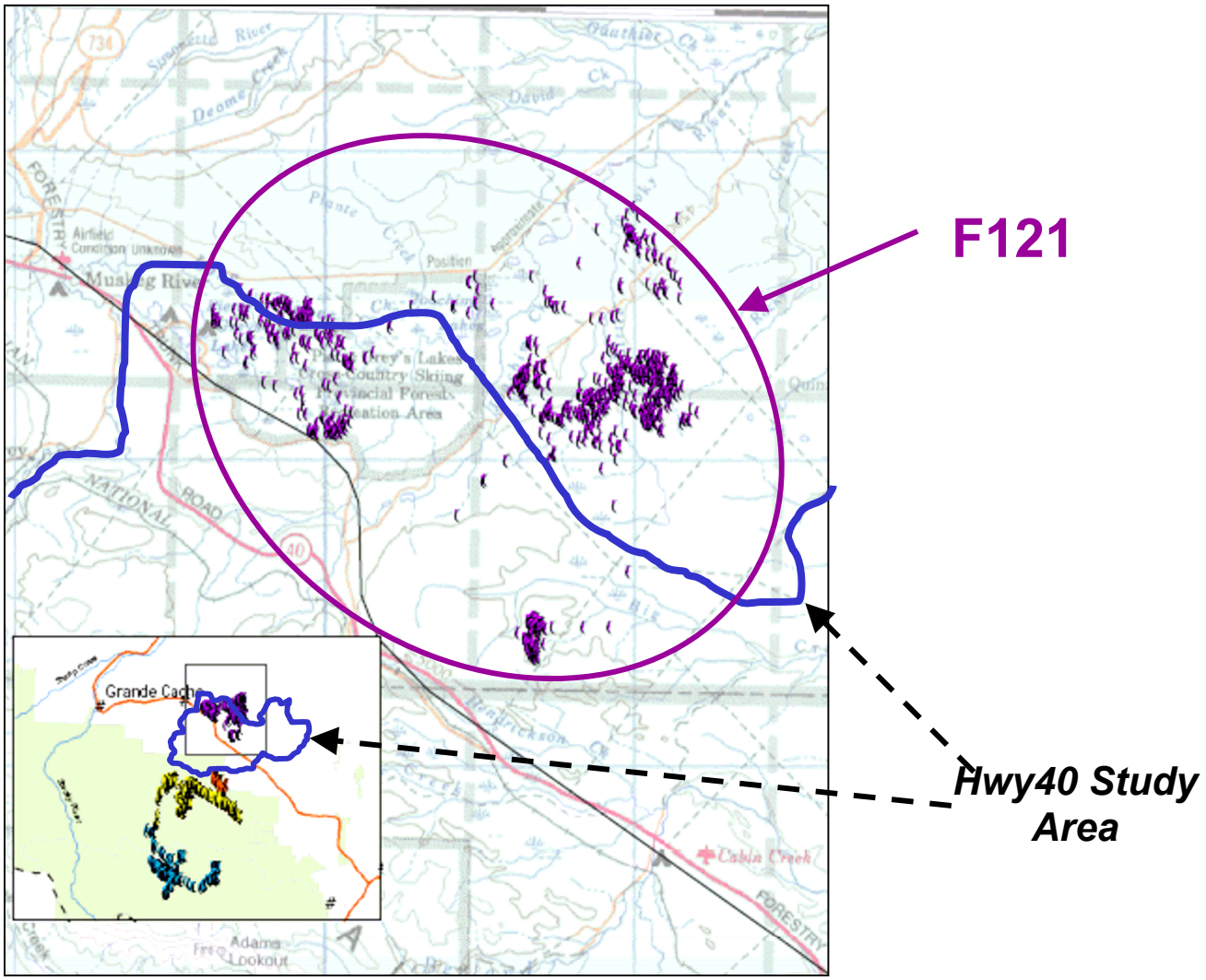


Figure 17. GPS collar locations from Feb-May 2009 for animal 121.

The Future

It is unfortunate that the Hwy40 disturbance event was never installed. Recent evidence suggests that we were on the right track with respect to our original hypotheses concerning caribou movement dynamics, and this was an ideal, low-risk opportunity for an adaptive management experiment. In fact, it may be the only such opportunity in the foothills of Alberta.

However, we are now faced with some new challenges; the impact of MPB on caribou and primary prey habitat; how we can balance wildfire threat mitigation efforts with woodland caribou needs; and the impact of continued energy sector development on habitat quality. We also have some new opportunities. For example, there is new evidence from other Natural Disturbance Program research suggesting that vast portions of the foothills may have experienced mixed-severity fires. If this is true, it suggests an entirely new type of historical habitat that may have been ideal for woodland caribou.

Overall, this is an excellent time to re-evaluate caribou-related research goals and opportunities, both within the FRI, and together with our new collaborators.

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