

The Economic Impact of Restoring Woodland Caribou Habitat in the Bistcho and Yates Ranges in Northwestern Alberta



Photo: John Marriott

by

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About This Study:

Alberta Wilderness Association contacted the independent natural resource consultancy, Power Consulting Incorporated, located in Missoula, Montana, to review reports on the likely regional economic impacts associated with caribou conservation efforts in northwest Alberta. Power Consulting is entirely responsible for the design, analysis, and conclusions of their study. Similarly, the conclusions reached by Power Consulting are their own and not necessarily those of the organizations that commissioned and/or funded this study.

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Executive Summary

Introduction

Woodland Caribou in Alberta are a threatened species under Alberta's *Wildlife Act* and Canada's *Species at Risk Act*. According to the Alberta government, "Caribou recovery in each caribou range depends on addressing habitat-related factors that result in both the loss of caribou habitats and increased predation rates on caribou populations."¹ Residents and municipalities of northwest Alberta are concerned that efforts to protect caribou habitat will limit or halt current commercial extractive activities on which communities depend for household income and revenues to maintain public services. However, much of the Bistcho and Yates caribou ranges in northwest Alberta² are covered with legacy seismic lines and are on land that has not been leased by either oil and gas companies nor has it been leased by timber companies.

This report looks closely at those concerns that protecting caribou will do serious damage to the region's existing economic base and reaches a much more optimistic conclusion: In fact, when analyzing alternative patterns of land use with optimizing models that include conservation as well as commercial extractive objectives, the 65 percent or more undisturbed caribou habitat threshold that is required by the federal government³ can be met with almost no displacement of industrial activity currently taking place on the Bistcho and Yates ranges. Caribou conservation and continuation of existing economic activities in these caribou ranges are *not* mutually exclusive. If the analysis does not begin with the unjustified initial assumption that caribou protection is incompatible with continuation of commercial activity on those ranges, the feared high local economic costs of caribou habitat conservation decline dramatically to near zero. More generally, this report supports the use of optimizing models to identify the best choices to realize both habitat and economic goals in caribou ranges.

I. The Projection of Large Economic Losses Due to Protection of Caribou Range Lands

In northwest Alberta, a group of six municipalities formed the Northwest Species at Risk Committee, NWSAR, to explore and mitigate potential negative economic impacts associated with protecting caribou habitat.⁴ NWSAR organized a regional effort to identify the parts of their current economy that might be harmed by caribou conservation. The result was an economic report that provided "Recommendations for Boreal Woodland Caribou Population Recovery in Northwest Alberta" to the Government of Alberta.⁵

That NWSAR economic report assumed that no extractive commercial activity would be allowed in caribou habitat and estimated very large negative socioeconomic impacts from caribou conservation. Given the incompatibility assumption about caribou conservation and commercial extractive activities, the NWSAR economic report projected that forestry and oil and gas activities would have to be shut down in all five of the caribou ranges in the NWSAR study area. The report calculated that 660 jobs could be lost, \$1.1 billion in forest products revenue could be lost annually, and as much as \$2.8 billion in cumulative revenues could be lost in the oil and gas industry using today's prices and technology. Looking forward many decades, NWSAR projected economic losses in the *trillions* of dollars.

¹ Draft Provincial Woodland Caribou Range Plan, Government of Alberta, 2017. p. 7.

² See Figure 1 for a map of Alberta caribou ranges including the Bistcho and Yates ranges.

³ The federal boreal caribou recovery strategy says that caribou ranges must achieve and maintain a minimum of 65 percent undisturbed habitat in order for populations to have a 60 percent likelihood of maintaining self-sustaining levels. See Draft Provincial Woodland Caribou Range Plan, Government of Alberta, 2017, p. 27

⁴ The NWSAR member municipalities are: Mackenzie County, County of Northern Lights, Clear Hills County, Town of High Level, Town of Manning and the Town of Rainbow Lake.

⁵ The first draft was submitted to Alberta Environment and Parks in June 2017. The final version was submitted September 1, 2017, to Alberta Environment and Parks and Alberta Agriculture and Forestry.

This report looks closely at the assumptions behind NWSAR's very high estimated costs of protecting caribou habitat and its failure to discuss the benefits associated with conserving and restoring caribou habitat. While NWSAR included five caribou ranges in its analysis, this report looks at a smaller study area in northwest Alberta that includes only two caribou ranges: Bistcho and Yates. This allows us to look in more detail at the range of choices that land managers have when planning to protect caribou habitat.

NWSAR's conclusion about the high costs of trying to constrain disturbance in caribou ranges to a maximum of 35 percent of the area is tied to Mediator Eric Denhoff's recommendations that two Forest Management Units (FMUs) not under lease for timber production and with relatively low density of gas leases be managed primarily for caribou habitat. In contrast to NWSAR's conclusions that this would undermine the economic base of northwest Alberta, Denhoff concluded that committing those two FMUs to caribou conservation

“...will achieve permanent protection of...61% of the Bistcho range, 72% of the Caribou Mountains range and 72% of the Yates range--immediately. It does not require displacement of any existing forestry tenure and existing oil and natural gas leases can be grandfathered in.”⁶

In fact, analyzing alternative patterns of land use with optimizing models that include conservation as well as commercial extractive objectives, which will be discussed below, the 65 percent or more undisturbed caribou habitat threshold that is required by the federal government can be met with almost no displacement of industrial activity currently taking place on the Bistcho and Yates ranges. Caribou conservation and continuation of existing economic activities in these caribou ranges are *not* mutually exclusive. Without NWSAR's initial assumption of the incompatibility of caribou protection and the continuation of commercial activity on those ranges, NWSAR's estimated high local economic cost of caribou habitat conservation declines dramatically to near zero.

In addition to the initial assumption about the incompatibility of caribou conservation with continued commercial activity in caribou ranges, it appears that NWSAR also began its estimate of the size and importance of the forest products manufacturing industry in northwest Alberta with an overestimate of the annual forest products sales revenues there. NWSAR then proceeded with an estimate of the *cumulative* forest products sales revenues that could be lost well *into the distant future* (100 to 200 years from now) if the timber harvest in northwest Alberta is reduced by efforts to support caribou recovery. A century in the future, the cumulative lost forest products manufacturing sales revenue according to NWSAR would be about *one trillion dollars*. Two hundred years into the future, NWSAR's projected lost forest products revenue would total almost *\$36 trillion*. For reference the total value of output for the entire Canadian economy in 2017 was *\$1.7 trillion dollars*. The estimated value for the total output of the Alberta economy in 2017 was *\$316.5 billion dollars*. Assumed economic damages that reach 100 and 200 years into the future and dwarf the size of the entire Canadian and provincial economies are neither plausible nor helpful in developing productive public policy that accounts for the needs of the caribou and the economic cost of meeting that need so that sustainable caribou populations can be maintained.

These NWSAR projections, two hundred years in the future, assume that the local economy will be frozen in time for two centuries with the same economic dependence on timber harvest and oil and gas production that exists today. Changes in technology that reduce per unit employment levels, changes in climate that may make the area hotter and drier and more or less productive for timber, changes in the importance of natural systems and wildlife in determining local quality of life, the cumulative impact of the volatility of both forest products and energy markets, etc. are all assumed away by NWSAR as the frozen economic

⁶ Setting Alberta on the Path to Caribou Recovery, Eric Denhoff, mediator, report to the Government of Alberta, May 30, 2016.

present is assumed to become the perpetual future.

Our conclusion is that caribou range protection and restoration will not cause the stark economic decline that is predicted by the NWSAR report. Instead it is very likely that the minimum 65 percent threshold of undisturbed habitat can be met without displacing, or negatively impacting in a meaningful way, the current commercial extractive industries that are taking place on the Bistcho and Yates ranges. This positive economic impact result is due to the existence of two FMUs on the Bistcho and Yates caribou ranges that have not been open to forestry leasing and the fact that oil and gas activity was not concentrated in caribou habitat adjacent to each of the FMUs. In other locations where such *widely* varied land use is not found and where the density of oil and gas development is higher, the economic costs of caribou protection can be expected to be higher. However, by optimizing for both conservation and commercial economic values, the best land use choices to support both goals can be identified in other caribou ranges too.

II. Rational Choice among Alternatives: Optimizing Models with Conservation Objectives

The economic cost of protecting caribou habitat can be reduced by taking an economic view of the landscape. Every part of the landscape is not of equal value to the different parties' interests. By attaching weight to areas that have high conservation value for the caribou and areas that have high value to the extractive industry (oil/gas and forestry), we can prioritize areas for specific different uses within the ranges.⁷ Remember that the target that we are aiming for is a minimum of 65 percent undisturbed habitat in each range and not 100 percent. This target does not have to be reached only by reducing extractive commercial activity in caribou habitat. Changes in forestry and energy practices to reduce their ecological footprint and reclamation of previously disturbed lands such as legacy seismic lines, will also play important roles without the need for broad prohibitions on commercial use across entire caribou ranges.

By taking this economic view of the ranges and building it into an optimizing model that analyzes alternatives and excludes those that are unnecessarily costly or fail to meet basic constraints, one can generate superior alternatives from which an "optimal" solution can be chosen based on stakeholders' values. Applying such optimizing models to northwest Alberta lands suggests that existing industrial activity and caribou conservation on the Yates and Bistcho ranges can coexist.

Academic researchers like Schneider and Hebblewhite have urged careful use of such optimizing models to find least cost land use allocations. Analysts must carefully consider the different weights and filters that are used so that the largest number of stakeholders can endorse the results. By taking into account the value of different parts of the caribou ranges for a number of different objectives, the optimized solution that is presented allows for the different stakeholders' concerns to be reflected in the analysis. These optimization models are not new and have been used to optimize timber harvest programs for some time.⁸ What is new is placing value on the caribou habitat with a constraint that at least 65 percent caribou habitat be undisturbed. The end result is that industrial activity is prioritized on some of the lands most productive for it and the caribou can be assigned some areas of particular value to them so that the pre-designated minimum 65 percent of undisturbed range land constraint is realized.

The Government of Alberta, through its use of the Integrated Land Management approach, and the conservation model Patchworks, is working to come up with such an optimized solution that considers various stakeholders' concerns. One of the discussion scenarios in the Government of Alberta Indigenous and Multi-stakeholder Working Sessions, in March of 2018, included a scenario proposing development areas where the commercial extractive industry has the highest priority and proposing conservation areas where caribou have the highest priority and where there are essentially no extractive industry leases. This scenario reaches

⁷ Later in section II we present a much more nuanced version of this concept that includes indigenous rights and values as well as habitat quality and the inevitable overlap of all of the different uses for the land. It is the presence of these different diverse land values that warrants the use of a conservation model to identify superior patterns of use.

⁸ Here we are specifically talking about the Patchworks forest management optimization model now being used for caribou range scenario modeling by the Government of Alberta, which was developed 20 years ago. Other optimization models, such as Marxan, will be discussed in section II of this report.

the minimum 65 percent threshold without assuming that all of the Forest Management Units in caribou ranges are set off limits to industrial activity as NWSAR assumed would be necessary. These more nuanced solutions, that avoid “all or nothing,” or “one-or-the-other,” zero-sum reasoning, reach the minimum required caribou habitat threshold while allowing virtually all of the existing industrial activity currently taking place in the Bistcho and Yates ranges to continue.

The use of optimized land use modeling reduces the cost of meeting conservation objectives. Even so, some economic cost of protecting caribou habitat is likely. However, those costs are not a sign of failed analysis or an indication that protecting caribou habitat is irrational. In some settings, where the caribou habitat is highly valued and where governments have a responsibility to recover species at risk, even high economic costs may be justified to protect that habitat. Within the non-market, non-commercial, realm, high valued outcomes can justify high levels of investment and cost, just as they do in the commercial realm.

III. Positive Economic Impacts of Reducing Caribou Range Disturbance: Seismic Line Restoration

In the discussion thus far, it has been assumed that caribou habitat protection will always involve the displacement of some commercial extractive activity. Using an optimization approach, it may be possible to dramatically reduce the loss in commercial business activity in some situations to very low levels, but the assumption has been that there is always a conflict between caribou conservation and commercial business activity. That is not necessarily the case. Restoration activity aimed at undoing the legacy damage associated with *past* exploration and development activity, on land that is not leased by either oil and gas or timber companies, is unlikely to interfere with existing commercial extractive activity. In fact, because that *past* disturbance threatens caribou survival by undermining natural processes that are important to many species and environmental services important to human beings, such as maintaining and storing clean water or carbon, these legacy disturbances can be a drag on the future Alberta economy. Repairing that disturbance and restoring caribou ranges can also stimulate the local economies, creating valuable long-term jobs.

This report demonstrates that the goals of caribou conservation can be achieved without a major negative impact on industrial activity in the Bistcho and Yates caribou range areas. But the economic outlook for the area with successful caribou conservation is even more positive than that. The restoration activities, themselves, will also employ a significant workforce and generate substantial payrolls for almost two decades.

Academic, industry, provincial and federal experts all have been studying legacy seismic line restoration. What is clear is that without human intervention, many of the legacy seismic lines in Alberta will not return themselves to undisturbed status. After 35 years, more than 60 percent of the seismic lines in Alberta “showed little or no recovery back to a forested state.”⁹ In the Bistcho and Yates ranges alone, we estimate there are about 43,000 km of the total 67,000 km of seismic lines that need to be restored before the minimum 65 percent undisturbed threshold can be met. In percentage terms this is about 65 percent of the legacy seismic lines that exist on the two ranges.

Although there is a tremendous amount of current and ongoing research on seismic line restoration, there is currently no standard method of estimating the cost and effectiveness of seismic line restoration that has been adopted by the Government of Alberta, academia, or industry. However, using a host of different studies, we can approximate the cost of seismic line recovery as \$10,000 per km. We calculate that with twenty five-person teams (100 total jobs), the restoration for the Bistcho and Yates ranges could be carried out in a little less than 20 years at a cost of about \$24 million per year. A major cost component associated with this restoration activity is wages and salaries for workers, a stimulus to the local economy. With a total cost over those 18 years of about \$434 million (undiscounted) dollars, the restoration activity itself begins

⁹Dabros, A., Pyper, M., Castilla, G. Seismic lines in the boreal and arctic ecosystems of North America: environmental impacts, challenges, and opportunities. *NRC Research Press*. 2018.

to rival the size of some of the existing major industrial activities on the caribou ranges.

While this restoration economy is not as large as the largest extractive industries that are currently in the region, it has other benefits that should not be overlooked. Caribou are an umbrella species whose protection will help to protect many other species as their habitat is restored and will allow Alberta to enjoy more intact foothills and boreal forests, supporting climate remediation and water retention. The potential boost in the recreation and tourist economy of the area and the indirect benefits associated with the restoration work (workers and restoration companies spending money in the local area) should also be recognized. The Alberta pilot restoration projects have demonstrated the potential to contract indigenous-owned and operated businesses to provide significant caribou habitat restoration services.

Our conclusions are that there will be a significant boost to the local economy in the form of almost 20 years of seismic line restoration jobs for more than 100 workers, which in turn will bring other substantial benefits. When looking at the positive and negative economic impacts of caribou protection, these positive economic impacts of restoration activities should be included in the analysis.

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Part I: The NWSAR Estimated Economic Losses Due to Protection of Caribou Range Lands

1. Introduction and Summary

Woodland Caribou in Alberta are a threatened species under Alberta's *Wildlife Act* and Canada's *Species at Risk Act*. According to the Alberta government, "Caribou recovery in each caribou range depends on addressing habitat-related factors that result in both the loss of caribou habitats and increased predation rates on caribou populations."¹⁰

In northwest Alberta, the Alberta Northwest Species at Risk committee (NWSAR)¹¹ has expressed a high level of concern about caribou range conservation proposals that could limit or prohibit existing commercial activities in those caribou ranges.¹² Those commercial extractive activities provide wood fiber that supports regional wood and paper products manufacturing facilities as well as employment in logging, log transport, and reforestation. Oil and gas production on those caribou range lands also provide employment, payroll, and government revenues that support basic public infrastructure services. For that reason, those natural resource extractive activities are considered by NWSAR as the core of their regional economy. When it is suggested that an important part of caribou protection necessarily involves banning such commercial activities from caribou ranges, as the NWSAR report does, it is understandable that businesses, municipalities, and citizens in northwestern Alberta would be concerned that their local economy may be damaged by policies that seek to protect the caribou ranges.

This report outlines why caribou protection will *not* have to have such negative socioeconomic impacts in northwest Alberta, focusing on the Bistcho and Yates caribou ranges. (See Figure 1 next page).¹³ Careful land use planning analysis that recognizes the different capacity of different parts of the landscape to assist in reaching both commercial and conservation goals can reduce the cost of caribou conservation. In certain situations, where landscape capacities are not as varied, there may be substantial costs in terms of lost commercial extractive industry revenues associated with caribou conservation. That outcome is not a sign of failed analysis or an indication that protecting caribou habitat is irrational. In some settings, where caribou habitat is highly valued, and where governments have a responsibility to oversee the recovery of species at risk, even high economic costs to protect especially high-valued caribou habitat may be justified.

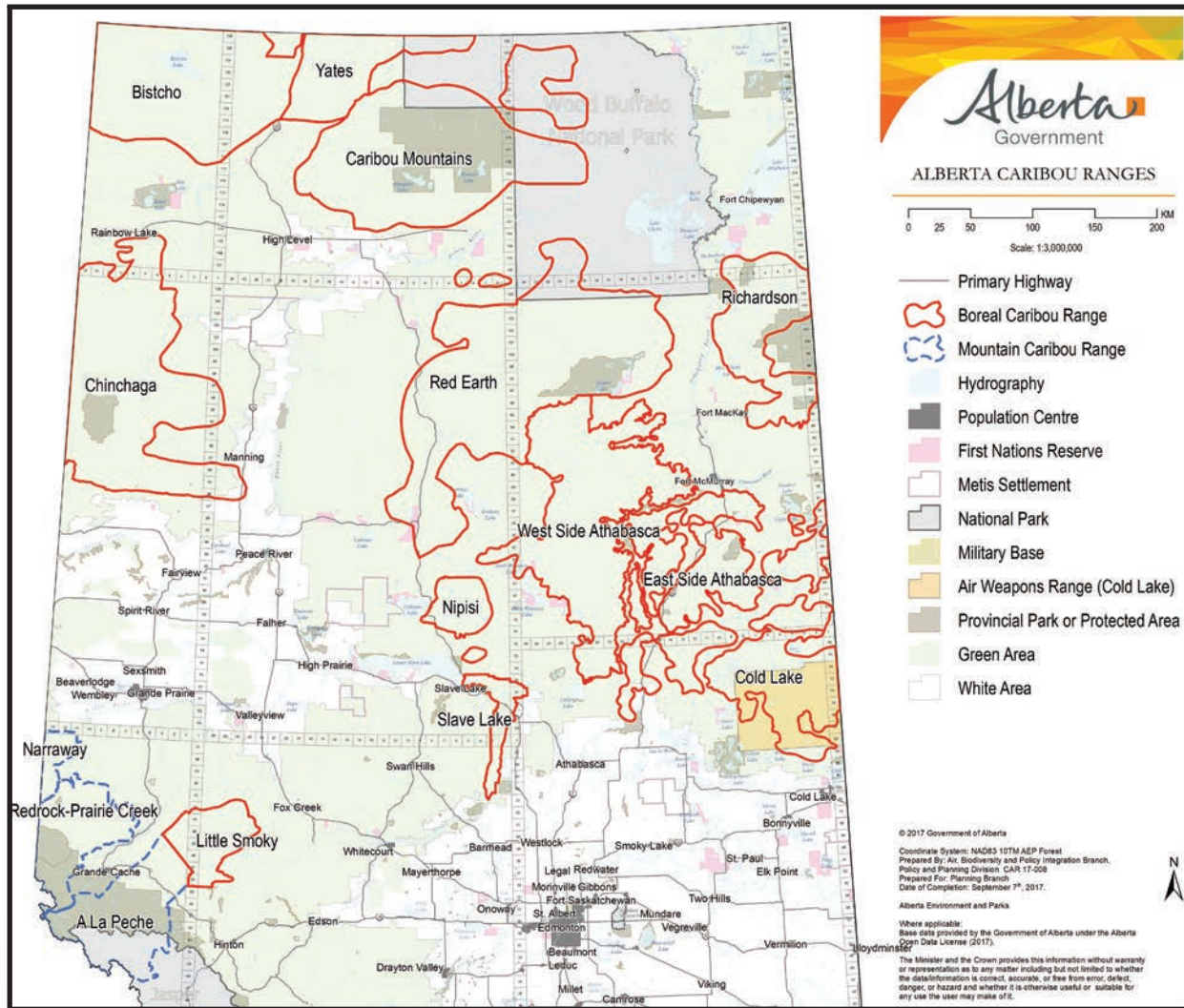
¹⁰ Draft Provincial Woodland Caribou Range Plan, Government of Alberta, 2017. p. 7.

¹¹ The NWSAR member municipalities are: Mackenzie County, County of Northern Lights, Clear Hills County, Town of High Level, Town of Manning and the Town of Rainbow Lake.

¹² Alberta Northwest Species at Risk Committee (NWSAR): "Recommendations for Boreal Woodland Caribou Population Recovery in Northwest Alberta", submitted September 1, 2017.

¹³ It is important to point out that although this report is focused on the Bistcho and Yates caribou ranges, NWSAR's focus was on a much larger part of northern Alberta that included five caribou ranges not just the two on which we focus. As a result, the potential socioeconomic impacts calculated by NWSAR are larger than the impacts that would be calculated for just the two caribou ranges in the northwest corner of Alberta on which this report is focused.

Figure 1.



A. Using Current Commercial Extractive Activity on Caribou Ranges to Measure the Potential Economic Losses to the Local Economy caused by Protecting Those Ranges.

Given this regional concern as to how caribou protection might impact the local economy, NWSAR has released a report on the extent to which their economy relies on the commercial activities currently taking place in caribou range lands that have been leased or permitted for extractive activities such as timber harvest and oil and gas production. The estimate of this *current* level of economic activity, NWSAR believes, provides a measure of the potential negative impact to their economic base by caribou protection policies. They also believe it is an indicator of the dominant commercial activity that will occur in this region far into the future.

Although this approach may provide insight into how dependent northwest Alberta currently is on commercial extractive activities on identified caribou ranges, this approach cannot provide an accurate projection of what the socioeconomic impacts may be of efforts to protect or restore caribou habitat. In fact, focusing solely on current economic activities taking place in caribou ranges leads to a serious exaggeration of potential negative impacts while ignoring the potential positive economic impacts associated with reducing human-caused disturbances in caribou ranges.

i. Inappropriate Initial Assumptions Can Lead to Exaggerated Projections of the Socioeconomic Impact of Caribou Protection Policy

Basing projections of socioeconomic impacts of caribou protection policies on the existing commercial extractive activities currently authorized through leases and permits on provincial lands, explicitly or implicitly, makes several assumptions that assure exaggerated and misleading projections of socioeconomic impacts, negative and positive.

First, this focus on the existing commercial activity taking place on ranges that have already been leased and permitted focuses only on part of the caribou ranges. But not all identified caribou range lands are equally important to the regional economy. There are, for instance, Forest Management Units that have not been leased for timber harvest and management and where oil and gas drilling and development is quite small or non-existent. On those lands the commercial extractive loss associated with protecting that caribou habitat is likely to be very small.

Second, this approach assumes that “protection of caribou” requires that *all* of a range’s lands have to be set off limits to commercial extractive activity. Our understanding is that most proposals for “protection of caribou” do *not* propose such limits for all parts of each caribou range, although regulations governing commercial extractive activity on caribou range can be expected to limit the environmental footprint of those activities. This assumption of closing all caribou ranges to commercial activity significantly and unnecessarily increases the projected negative socioeconomic impacts of “protecting” caribou.

Third, this approach implicitly assumes that the policy objective of protecting caribou is zero disturbance across all caribou ranges. That is the implication of the assumption that all timber, oil, and gas activity that is already permitted or leased in caribou ranges must cease. But the policy target currently being used is that disturbance be limited to a maximum of 35 percent of the ranges,¹⁴ not zero percent.

Fourth, this approach assumes that management actions taken to protect caribou always have negative impacts on the regional economy because they reduce employment, payroll, and the revenue circulating within the local economy. That assumption ignores the positive impacts that a “restoration” economy aimed at caribou habitat can have and the positive impacts of restored wildlife and natural systems.

¹⁴ Disturbance includes anthropogenic disturbances buffered by 500 meters, and unbuffered fire disturbance that is less than 40 years old. See ‘Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada’, Government of Canada, 2012, p. 65.

There are other questionable assumptions embedded in the NWSAR report that are important but will not be discussed here in detail. These four faulty NWSAR assumptions, however, attempt to force a zero-sum predicament on policy makers: There are no choices to be made except to exclude commercial activity on all currently leased or permitted caribou ranges in order to protect the caribou or, alternatively, let commercial activity play out across the ranges in a way similar to the currently leased areas and abandon caribou recovery as a policy objective in many caribou ranges. The only choice appears to be an all-or-nothing, one-or-the-other, zero-sum one.

As discussed above, NWSAR projects that the existing natural resource extractive economy will continue indefinitely into the future, across two hundred years. But this ignores several important characteristics of the existing natural resource extractive economy that have negative impacts on households, businesses, and governments. These negative characteristics have led natural resource economists to discuss “the curse of abundant natural resources.” Those characteristics include:¹⁵

- a. The volatility of natural resource commodity prices and the resulting instability in the economy including recession, high unemployment, reduced incomes and an unattractive investment climate. Below, we document this for Alberta in recent years.
- b. The natural resource sectors have shown a major capacity to replace workers with capital investments in larger and more automated equipment. That, too, leads to accumulating and persistent unemployment even when commodity demand is steady.
- c. The level of commercial timber harvest and the use of clear-cutting methods have led to controversy over the sustainability of Alberta’s forest. In addition, the cumulative level of forest disturbance can be seen as undermining of the natural value of those forests. That can also degrade regional natural landscapes, reducing their attractiveness to other economic activities and new residents.
- d. Climate change will have an impact on the forest lands and their capacity to produce wood fiber in a sustainable manner. Climate change also raises questions about the future of fossil fuels, especially the more carbon-intensive fossil fuels. Limits on the use of those fossil fuels or taxes levied on their use, can be expected to discourage future production and consumption of fossil fuels.

All of these characteristics of natural resource extraction economies represent a significant challenge to the well-being of residents of natural-resource-dependent local economies. A future of “more of the same” dependency on a few extractive industries is not ideal nor is it likely to support local economic development. Economic diversification and the protection and development of local quality of life are crucial to such local economies.

ii. A Practical Economic Approach Reveals Much More Flexibility in Caribou Protection Policy that Results in Lower Costs and Higher Benefits

Basic business and economic principles provide a much more flexible and productive approach to caribou protection. That approach is tied to the basic “facts on the ground” in the caribou ranges. Those important facts on the ground include:

- a. Not all identified caribou range lands are equally important to the regional commercial economy. There are, for instance, Forest Management Units that have not been leased for timber harvest and management and where oil and gas drilling and development is quite limited or non-existent.
- b. Not all disturbances of caribou range lands are equally important to the regional commercial economy. Legacy disturbances are tied to the *past* failure to more strictly regulate seismic lines and

¹⁵ See *Lost Landscapes and Failed Economies: The Search for a Value of Place*, Island Press, Washington, D.C. “The Economic Anomaly of Mining: Great Wealth, High Wages, Declining Communities,” T. M. Power, 2005, a chapter in *Mining in New Mexico—The Environment, Water, Economics, and Sustainable Development: The Decision-Makers Field Guide 2005*, edited by L. Greer Price, et al. New Mexico Bureau of Geology and Mineral Resources, New Mexico Tech University. 2005.

the location and operation of now abandoned wells. Rehabilitating these past disturbances that are no longer important for current commercial extractive activities does not limit that commercial activity and can add significantly to the regional economy by more fully developing a “restoration” component of the natural resource economic base. More importantly, it is also vitally important to caribou conservation and controlling its cost.

- c. The policy objective for protecting caribou is not to ultimately achieve zero disturbance on caribou ranges. The current policy objective for caribou ranges is to reduce the disturbance level to 35 percent or below. Not *all* disturbance has to be avoided or restored but practices that respect caribou should be the norm.

These “facts on the ground” open up a much broader range of policy alternatives.

For instance, provincial lands within identified caribou ranges that are not currently leased or permitted for commercial extractive activities quite likely can be managed for caribou sustainability without limiting existing extractive activity. Those lands have low value from a commercial extractive point of view but a high value for the caribou. As discussed above, much of the disturbance of caribou ranges in these two case-study ranges is damage associated with commercial activities in the past and the failure to repair that damage in a timely manner. That damaged land is no longer commercially productive but continues to impact caribou. In fact, because it threatens caribou survival by undermining natural processes that are important to many species and environmental services important to human beings, such as maintaining and storing clean water and carbon, this legacy disturbance is a drag on the future economy of Alberta. Repairing that disturbance and restoring the caribou ranges can also stimulate the local economies as will be discussed in Part III of this report.

iii. Low Cost Alternative Approaches to Protecting Caribou

For illustrative purposes, one set of policies that would minimize the negative impacts of caribou protection on the existing regional commercial economy could involve the following:

- a. A commitment to protect caribou range lands that are not yet committed to commercial extractive activity. For instance, within the Bistcho and Yates caribou ranges, FMUs F10 and F20 are not subject to Forest Management Agreements and are not available for commercial timber harvest or management; they could continue to be protected from logging and new oil and gas activity with little impact on the existing commercial extractive activities.
- b. A long-run forest restoration program could be funded by the oil and gas industry and the Canadian and Alberta governments that lasted 50 years or more. This activity could provide long term employment and income to local residents while also reducing the level of disturbance on caribou ranges and working towards naturally sustainable caribou herds. This in turn could lay the basis for a more diversified economy by strengthening the outdoor recreation and tourism potential.
- c. We know from the extent of the seismic lines, redundant road infrastructure, and abandoned oil and gas wells, that regulation of commercial extractive activity has not always been sufficient or effective. Going forward, the regulation of such commercial activities in identified caribou ranges should be tightened so that unnecessary damage based on short-run convenience or cost reduction does not make sustainable caribou populations less likely and the overall caribou ranges less productive of a broad range of valuable environmental services.

B. Clarifying the Proposals to Limit Commercial Activity in Some Forest Management Units

In the economic setting described above, substantial parts of different caribou ranges that are not currently contributing significantly to commercial extractive activity can and do support caribou conservation in a significant way. This was pointed out by mediator Eric Denhoff¹⁶ to the Government of Alberta.¹⁷ NWSAR interpreted Denhoff's recommendations as indicating that on Forest Management Units already leased for commercial extractive activity through Forest Management Agreements or oil and gas leases, those existing commercial extractive activities would be banned. This was not the message that Denhoff conveyed.

Denhoff *did* recommend that 1.8 million hectares in Forest Management Units in northwest Alberta be managed for caribou conservation with strict limits on commercial extractive activity. NWSAR's socioeconomic analysis simply *assumed* that those 1.8 million hectares would be carved out of lands that are currently under leases and permits and are currently providing a flow of wood fiber, oil, and natural gas to processing facilities and markets. NWSAR was concerned about the socioeconomic impact of *losing* 1.8 million hectares that currently supported existing commercial economic activity in the effort to protect caribou. But NWSAR's socioeconomic impact analysis was tied to that *assumption*, an assumption that had nothing to do with Denhoff's proposal or most other caribou conservation proposals that have been made.

As discussed above, NWSAR tries to quantify the possible socioeconomic disruption to communities in northwestern Alberta by estimating the commercial economic activity currently taking place on lands that have been identified as caribou ranges. For forest products activities, this calculation is based on the simplifying assumption that all hectares leased for timber harvest are of similar commercial value. Since about 38 percent of the leased forest lands are located in identified caribou ranges, NWSAR assumes that 38 percent of forest product manufacturing revenues and employment could be lost as a result of protecting those caribou ranges. NWSAR calculates that about 660 of the total of about 1,670 FTE jobs in forest products manufacturing could be lost.¹⁸ In addition, NWSAR estimates that of the \$2.5 billion in annual forest products manufacturing revenues, about \$1.1 billion of those annual revenues could be lost if caribou habitat were protected.¹⁹ A similar calculation of the amount of oil and gas reserves under the caribou ranges led to the NWSAR estimate that cumulatively over the years, \$2.8 billion in oil and gas could be produced from those caribou ranges at today's prices and technologies. If prices and technology supported full recovery of the oil and gas reserves under the caribou ranges, NWSAR calculates that \$90.5 billion in oil and natural gas could be produced from under those caribou ranges. If protecting caribou ranges banned all commercial extractive activities throughout caribou ranges, these NWSAR calculations suggest that there could be very significant negative socioeconomic impacts in northwestern Alberta as a result of caribou protection policies.

However, the Denhoff proposals mentioned above were not that all caribou range lands in northwest Alberta currently leased or permitted for timber harvest, oil and gas production, trapping, etc. be closed to those commercial uses. Rather, Denhoff's proposal was that several Forest Management Units (F10, F20, and P8) that have not been leased for commercial timber harvest be permanently set aside from commercial timber management and harvest. Oil and gas extraction currently taking place in those Forest Management Units would be grandfathered in and allowed to continue. The density of oil and gas activity in those areas was already much lower than elsewhere in northwest Alberta because of the isolated locations and limited infrastructure in place.

Figure 2 (below) shows the Yates Caribou range. It also shows the boundaries of FMUs F10 and F26 (the latter covered by a tenured Forest Management Agreement) as well as the areas where timber harvest has taken place. We present this figure to show how large an area FMU F10 is and the allocated forestry area in FMU F26. It is also worth noting that FMU F10 is adjacent to Wood Buffalo National Park which represents about 14 percent of the Yates range. There are no active oil and or gas wells in FMU F10 and no timber harvesting has

¹⁶ Mr. Denhoff subsequently became a senior civil servant in the Alberta Government where at the time of this writing he was Deputy Minister of Alberta Environment and Parks.

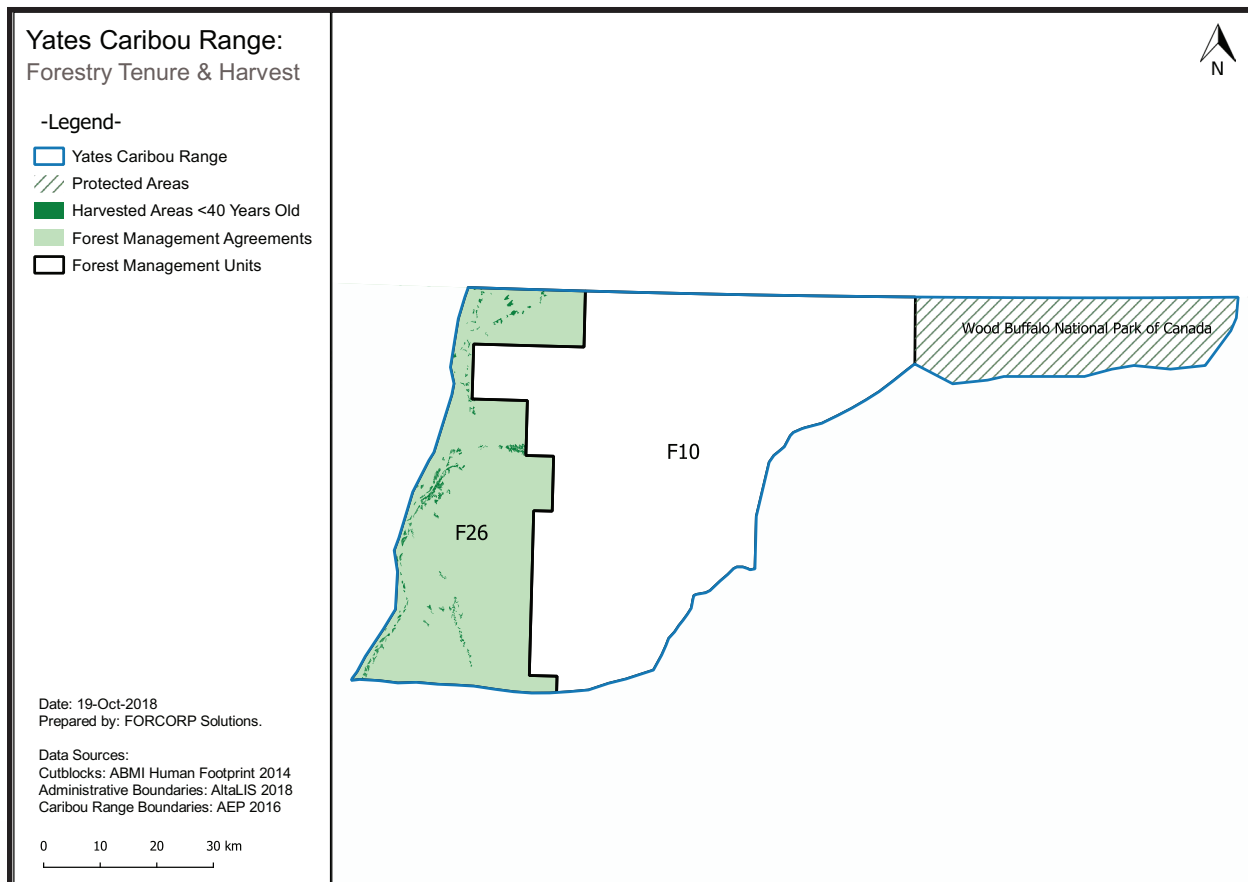
¹⁷ Setting Alberta on the Path to Caribou Recovery, Eric Denhoff, mediator, report to the Government of Alberta, May 30, 2016

¹⁸ Op. cit. NWSAR Recommendations 2017, pp. 2-3 and Tables 11 and 12.

¹⁹ Ibid. p. 65.

taken place. Maintaining that *existing* protection of FMU F10 and rehabilitating past linear damage could return this habitat back to its former “undisturbed”²⁰ nature with no negative impacts on the current oil and gas and timber industries in the Yates range. In fact the restoration of linear damage would have a positive impact on the local economy.

Figure 2.



Source: Government of Alberta. Indigenous & Multi-Stakeholder Working Session. Slide 26. March 16, 2018.

Thus, the Denhoff proposals would not significantly constrain current commercial economic activity on the caribou ranges. The Denhoff proposals sought to keep *existing* limits on commercial extractive activities in place. As Denhoff stated, his proposal:

“...does not require displacement of any existing forestry tenure and existing oil and natural gas leases can be grandfathered in; these are not as extensive as some other areas. There are no operations currently underway in the [FMU F10] area involving major drilling programs, mines or similar developments. It further protects vast areas of wetlands and there are substantial opportunities to use this protection to provide valuable sinks for carbon.”²¹

The NWSAR “Recommendations” document clearly indicates that the “Denhoff Proposed Protected Areas” do not currently include areas under Forest Management Agreements. NWSAR Figure 9 shows the “Denhoff Proposed Protected Areas” along with the Forest Management Agreement (FMA) area

²⁰ Here Undisturbed is defined as “Habitat not showing any: i) human-caused disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500-metre buffer of the human-caused disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction (without buffer).” Alberta Government. Draft Provincial Caribou Range Plan. 2017. Page 10.

²¹ Op. cit. Setting Alberta on a Path to Caribou Recovery, p. 39.

boundaries and the boundaries of the caribou ranges.²² The areas in which Denhoff proposed limiting additional extractive activities include almost no lands currently under lease to forest products or oil and natural gas firms.

For all of these reasons, NWSAR's focus on the loss of current commercial economic activity on leased caribou range lands is misplaced. Those commercial uses would continue to be allowed in caribou ranges covered by FMAs. As a result, the likely socioeconomic impact of the Denhoff proposals would be very low or non-existent.

2. NWSAR's Calculation of the Commercial Economic Value That Would Be Lost If Caribou Range is Protected in Northwest Alberta

NWSAR's calculations of the potential commercial extractive industry losses associated with protecting caribou range are extreme: tens and hundreds of billions of dollars of lost economic value in the oil and gas sectors and trillions and tens of trillions of dollars in forest product manufacturing. These estimated potential economic losses associated with protecting caribou ranges are so high that they are not believable and require critical review and revision.

A. Wood Fiber for Forest Products Manufacturing

NWSAR estimated the sales revenue currently generated by the regional forest products mills that draw their raw materials from the NWSAR region. NWSAR stated that it used the average annual revenue of forest product mills across Canada that were similar to the mills in the NWSAR region to estimate the forest products manufacturing sales revenue currently associated with the NWSAR lands and the mills.²³ This led to an estimate that the five NWSAR-area mills had annual revenues totaling \$2.5 billion.²⁴ Statistics Canada estimates the total revenues of all wood products manufacturing firms in Alberta to be about \$3.8 billion in 2016.²⁵ Thus, NWSAR has estimated that the five mills in the NWSAR region are the source of almost two-thirds of the wood products revenues in Alberta. Given that the five NWSAR region mills represent only a tiny fraction of all of the forest products mills in Alberta, the NWSAR estimate of the revenues generated by the five mills appears to be much too high.²⁶ For Alberta as a whole, the wood products sales revenue per employee was about \$400,000. For NWSAR's estimated mill revenues, sales revenue per employee was about \$1.5 million per year, about four-times as high as Alberta's average.²⁷ It appears that NWSAR began its estimate of the size and importance of the forest products manufacturing industry in northwest Alberta with a substantial overestimate of the annual forest products sales revenues there.

²² Op. cit. NWSAR "Recommendations," September 1, 2017, p. 65.

²³ NWSAR identified the North American Industrial Classification System (NAICS) number for each of five mills in the NWSAR study area. Those classification numbers distinguished, for instance, between lumber mills, plywood mills, pulp mills, etc.

²⁴ Op. Cit. NWSAR Recommendations, September 2018, Tables 12 and 14, pp. 66-67.

²⁵ Principal statistics for Manufacturing industries, by NAICS. Table: 16-10-0117-01. Alberta, 20-12-2016.

²⁶ For a map of all of the forest products mills in Alberta see: Economic Impact of Alberta's Forest Sector, 2012, <https://www.albertacanada.com/AlbertaForestSector-2012EconomicImpact.pdf> This can be compared to the map of its study area provided by NWSAR (Figure 1, p. iv).

²⁷ Canadian Industry Statistics reports the revenues earned by the 4,195 wood product mills across Canada. The top quarter of those plants by size had revenues in the \$796,000 to \$5,000,000 range. The average annual revenue was \$2,100,000. NWSAR reports mill annual revenues of \$796 million for the largest mill and \$175 million for the smallest mill. The NWSAR annual revenues for the individual mills reported on are much, much larger than Canadian Industry Statistics reports for wood products mills across Canada.

It is possible that the NWSAR-area mills are larger and more automated, i.e. more capital intensive and less labor intensive, than mills elsewhere in Alberta. However, Canadian Industry Statistics data on wood product mills by size (as measured by employment) indicates that there were two "large" (employment greater than 500) wood products mills in Alberta. One of those is the Tolko saw mill in the NWSAR study area. Three of the other NWSAR mills are "medium" in size (100-499 employees): Norbord, DMI, and West Fraser). The fifth mill, is "small" (La Crete). Thus, the NWSAR mills do not appear to be unusually large. There were 32 medium-sized wood products mills in Alberta. The NWSAR area had three of them. Alberta has 155 small-sized wood products mills. The NWSAR had one of them.

Then, as discussed above, NWSAR assumed that timber harvest would not be allowed on lands governed by FMAs that are in caribou ranges. As discussed above, this also appears to be an incorrect assumption. However, if it is adopted, 38.4 percent of the planned timber harvest under FMAs in the region, namely that on caribou ranges, would be lost and forest products manufacturing output and employment were projected by NWSAR to decline in a similar way. NWSAR estimates that this reduces the forest products manufacturing sales revenue in the area by about 1.1 billion dollars and reduces forest products manufacturing jobs by 359.²⁸

NWSAR then proceeds with an estimate of the cumulative forest products sales revenues that could be generated *into the future* if the timber harvest in northwest Alberta is not reduced by efforts to support caribou recovery. It does this by beginning with the approximately \$1.1 billion in annual forest products revenue losses estimated for the base year and projecting those losses over many decades into the future. A century in the future, the cumulative lost forest products manufacturing sales revenues were projected to be about *one trillion dollars*. Two hundred years into the future the lost forest products revenues were projected to total almost \$36 *trillion*.²⁹

For very rural northwestern Alberta forest lands, these would be spectacularly large financial losses. To get these colossal losses, the base year annual loss of a billion dollars in sales revenues was multiplied by a factor of almost a thousand over the following century and by a factor of 36,000 over the next two centuries. The total value of output for the entire Canadian economy in 2017 was \$1.7 trillion dollars.³⁰ The estimated value for the total output of the Alberta economy in 2017 was \$316.5 *billion* dollars.³¹

NWSAR obtained its spectacularly large estimate of the potential economic loss associated with protecting caribou habitat by making three questionable calculations. First, as discussed above, NWSAR started with a very high estimate of the sales revenues associated with forest products manufacturing in northwest Alberta. Second, it then escalated that value every year by 3.6 percent per year, its measure of the rate of inflation in the Canadian economy over the last hundred years. Third, it summed up the escalated yearly losses over the next 100 and next 200 years.

Making projections of economic values centuries into the future is rarely a useful or informative undertaking nor is it generally accepted practice. If some accountant in 1818, in what was going to become Alberta, had tried to project what economic value was going to be produced by different industries two centuries into the future, i.e., in 2018, one would not have expected any useful information to be provided by that projection for the simple reason that no one knew what technological change, changes in tastes and preferences, patterns of economic development and demographic change would be. How would such a person in 1818 imagine the development of a petroleum-based transportation economy and know anything about Alberta tar sands and their economic potential or the changing world climate?

Just as important, the rate of inflation is a measure of the deterioration of the purchasing power of a nation's currency. It is not a measure of the growth of economic value in the economy. Escalating a current economic value at a projected rate of inflation would not tell us anything about future economic value. If that projection of inflation was perfectly accurate, the *real* value in terms of dollars of constant purchasing power would be unchanged from the base year. In that sense, the spectacular increase in the estimated dollar value of the "losses" associated with caribou conservation simply reflect NWSAR's projections of the deterioration of the purchasing power of the Canadian dollar over the next two centuries due to inflation. That provides no useful economic information not already contained in the base year estimates of the potential "losses" associated with caribou conservation efforts.³²

²⁸ Op. cit. NWSAR Recommendations, September 2017, pp. 65-68.

²⁹ Ibid. Table 16, p. 67.

³⁰ Stated in chained 2007 dollars. Statistics Canada, Table 36-10-0434-03, Gross domestic product (GDP) at basic prices, annual average.

³¹ 2007 dollars. P. 8, Fiscal Plan 2018-2021

³² It should be pointed out that the standard way that annual economic values in future years are accumulated into a present economic value is to *discount* future values, not escalate them. The NWSAR approach reverses the standard business method of treating future economic values.

B. Oil and Gas Production

NWSAR's approach to the potential impact of protecting caribou habitat on oil and gas production was similar to the NWSAR approach to impacts on forest products manufacturing: The caribou ranges were overlaid on maps showing where oil and gas reserves exist and production is currently taking place. Production of oil and gas located in caribou ranges were assumed to be prohibited. The percentage of the oil and gas fields that were in caribou ranges was taken to indicate how much of production or reserves might be put off-limits to production.

The Yates caribou range had only one gas and one oil field. So, oil and gas production were not much of an issue with respect to that caribou range.³³ On the other hand, there were 15 oil and gas fields that lay entirely or partially within the Bistcho range. NWSAR made estimates of the oil and gas potential in place under the Bistcho caribou range. This was done by looking at the estimated recoverable oil and gas at current commodity prices with contemporary technology. Alternatively, an estimate of the oil and gas production from each field was made assuming that over time commodity prices and recovery technology would improve enough for all of the oil and gas reserves to be recovered. The oil and gas under the caribou ranges were assumed to be potentially at risk of being stranded due to efforts to protect the caribou. The oil and gas beneath the caribou ranges was valued at 2017 prices: natural gas at \$2.99 per gigajoule and oil at \$64 per barrel. The oil and gas economic value assumed to be at risk due to protection of the Bistcho caribou range was \$685 million for the oil and gas that could be economically recovered today and \$45.6 billion if all of the reserves could be recovered. For the Yates caribou range, the two values were \$5.8 million for the recovery now feasible and \$225 million for full recovery of the reserves.³⁴ The NWSAR report did not take into account likely periods of lower oil and natural gas prices such as those that have disrupted the Alberta economy in the recent past. It also did not take into account the mounting efforts to replace fossil fuels with renewable, low-carbon alternatives.

Note that these estimated commercial oil and gas values that might be at risk due to caribou range protection measures are much smaller than the cumulative forest products manufacturing values NWSAR estimated. It is also important to note that it is not certain that protecting caribou ranges would shut down existing oil and gas operations. The policy adopted could grandfather in the existing oil and gas operations, allowing them to continue to produce subject to operating conditions that align with caribou recovery.

In addition, directional drilling technology has developed to the point that many different wells can be drilled to different, distant, fields. It is possible, for instance, to concentrate drilling locations in relatively small areas, thus, reducing the level of surface disturbance in caribou ranges. This could dramatically reduce the footprint associated with oil and gas production. These potential advancements of technology were not taken into account by NWSAR.

3. The Consequences of Over-Reliance on the Extraction and Processing of Natural Resources

The economy of northwest Alberta, like the Province of Alberta as a whole, relies significantly on oil and gas production and processing as well as on forest products production and manufacturing. These industries, typically, provide jobs paying well above average wages and salaries. That is one of the explanations often offered for why average family income in Alberta is significantly above the other provinces of Canada.³⁵ There

³³ Op. cit. NWSAR "Recommendations," September 2017, p. 69.

³⁴ Ibid. Table 24. Note that these "economic values" are based on the value of the oil and gas after it has been extracted, processed and delivered to a distribution hub. The cost of extraction, processing, and transportation are ignored. Thus, this is a gross value, not a net value after costs have been accounted for. Note that the total reserves, including the majority that are not economically feasible to produce at this point in time are valued at current market prices even though they currently have no economic value because the extraction costs exceed the market value of the commodity produced.

³⁵ Highlights of the Alberta Economy 2017, Alberta Economic Development and Trade, Government of Alberta, PDF pp. 47-48, http://www.albertacanada.com/files/albertacanada/SP-EH_highlightsABEconomyPresentation.pdf

are, however, other significant characteristics of natural resource dependence that are not as positive that also need to be recognized. We will focus on the primary commercial activities that can impact caribou ranges and may also be affected by efforts to protect or rehabilitate caribou habitat: the forest products and oil and gas industries. Because detailed economic statistics are not available at the County or Municipality levels, at times we will use data on the Alberta economy as a whole to characterize the impacts of these two industries.

A. Forest Products Manufacturing

One of the most important uses of harvested timber is the production of building materials such as dimensioned lumber and plywood. Trees chipped into wood fiber are also used to create construction materials such as oriented strand board and particle board. These materials in turn can be used to produce engineered building materials such as trusses and laminated beams. The demand for these wood-based materials is tied closely to new housing construction in Canada and the United States. As a result of the collapse of the housing market in the United States and the “Great Recession” that followed, housing starts fell dramatically. Alberta’s wood products firms felt the impact of those changes in the North American demand for wood building materials. Employment in Alberta wood products manufacturing declined by almost 30 percent between 2006 and 2009. It then recovered between 2009 and 2013 only to tumble down again by about 4,000 jobs during the 2013 and 2016 period, including the most recent Alberta recession.³⁶

Wood fiber is also the basic raw material for the manufacturing of paper and paperboard. The demand for wood fiber for these purposes is subject to different disruptive forces. Technological change in the form of electronic communication displacing newspapers and magazines has significantly reduced the demand for paper, especially newsprint.³⁷

The United States is one of the primary markets into which Canadian firms seek to sell their forest products. However, the American states just south of the U.S. border also produce forest products they seek to sell to Canadians as well as Americans. The competition of these two sources of wood fiber for the same set of customers has led to ongoing trade disputes between the two countries that can also disrupt Alberta wood products manufacturing.

Finally, technological change in forest products production has been dramatic over the last century with handsaws and axes being displaced by chainsaws and then chainsaws being increasingly displaced by feller-bunchers and other machines. Forest products mills have also been increasingly automated reducing dramatically the needed workers per unit of wood product produced.

The demand for Alberta timber fluctuates with U.S. and Canadian new housing starts. U.S. housing starts went through an unusually long expansion from 1990 until 2006, on the eve of the bursting of the U.S. housing market bubble: U.S. housing starts fell from about 2 million per year in mid-2006 to 480,000 in mid-2009.³⁸

All of these economic forces have operated in Alberta to periodically disrupt wood products manufacturing activity and to systematically reduce the size of the workforce supported by this industry. These endemic sources of instability in Alberta’s forest products industry have been much more disruptive than efforts to protect caribou habitat are ever likely to be.

B. Oil and Gas Industry

Oil and natural gas prices plunged in the worldwide recession that began in 2008. Oil prices recovered only to plunge again in 2014. Natural gas prices have continued at a very low level. Those lower oil and natural gas prices led producers to reevaluate their investment strategies, slashing the investments especially

³⁶ Alberta’s Manufacturing Industry is Recovering in 2017, Economic Commentary, October 10, 2017, Government of Alberta, P. 6. http://www.albertacanada.com/files/albertacanada/SP-Commentary_10-10-17.pdf

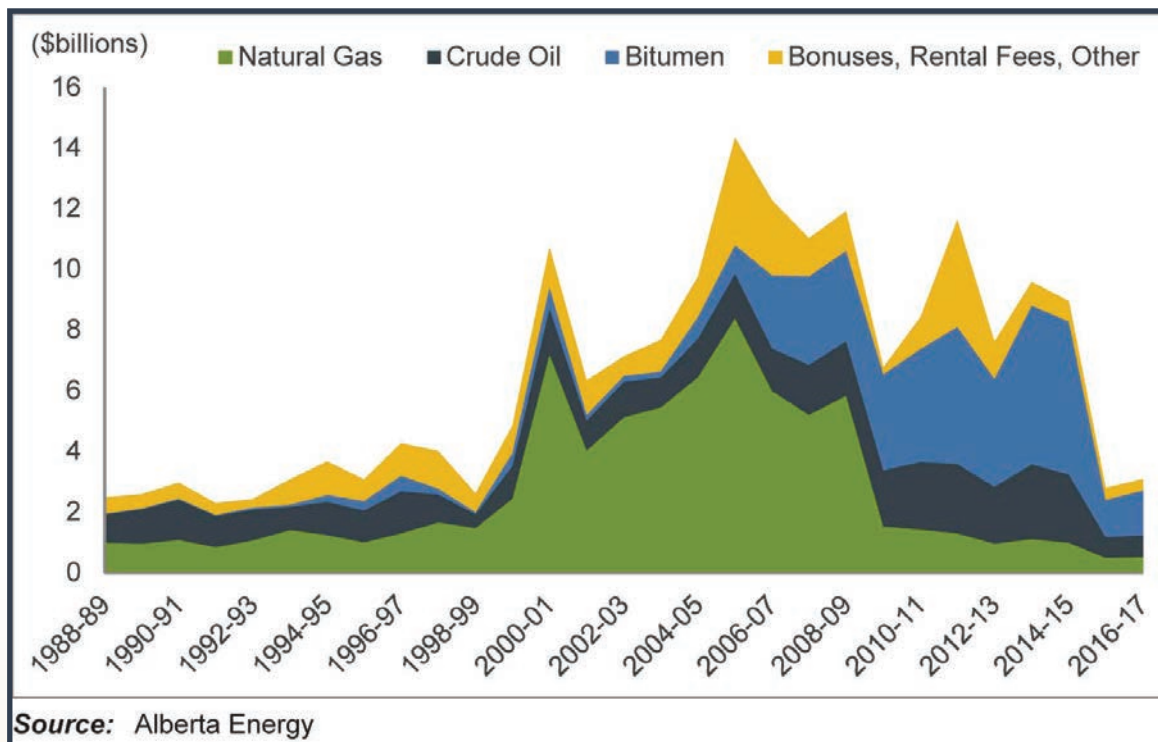
³⁷ The harvest of trees for paper production does not appear to be important in the Bistcho and Yates caribou ranges. Further south from those ranges, there is a pulp mill in Manning that may obtain its raw materials from forests covering other caribou ranges.

³⁸ <https://fred.stlouisfed.org/series/HOUST> .

in conventional oil and gas development. That led to fewer wells being drilled and a reduced demand for Alberta-manufactured equipment that supported oil and natural gas production. The result was to make the 2008 recession worse and to initiate the 2015-2016 Alberta recession.³⁹

Commercial activities that are tied to international markets for natural resources tend to be volatile, expanding when international prices are high and contracting when international prices decline. This leads natural resource industries to “flicker” in economic terms across the year and over several years and to go through significant booms and busts over longer periods of time. That unavoidably destabilizes local and regional economies. The impact of fluctuating oil and gas prices on the Alberta provincial budget provides a visual representation of the stress that local and regional economies dependent on natural resource industries experience too. See Figure 3 below.

Figure 3.
Alberta’s Reliance on Resource Revenue
Alberta Non-Renewable Resource Revenue



Government of Alberta, 2018-21 Fiscal Plan, “Path to Balance,” p. 74. March 22, 2018.

In the northwest corner of Alberta where the Bistcho and Yates caribou ranges are located, oil and gas activity has plunged dramatically to very low levels. See Figures 4 and 5 below.

C. The Economic Impacts of Unstable Natural Resource Industries

Alberta has an intimate and recent experience “riding the natural resource roller-coaster.”⁴⁰ Natural gas prices have been extremely volatile since 2000 but settled into a long run decline beginning in the middle of June 2008 as the U.S. “Great Recession” led to a worldwide financial and economic crisis. Natural gas prices have

³⁹ Alberta’s Manufacturing Industry is Recovering in 2017, Economic Commentary, Government of Alberta October 10, 2017, http://www.albertacanada.com/files/albertacanada/SP-Commentary_1010-17.pdf. Ibid. p. 2. The development of “unconventional” sources of natural gas (e.g. shale gas and other tight gas fields) boosted U.S. natural gas production. The U.S. shifted from a significant importer of natural gas from Canada to an exporter of natural gas to Canada.

⁴⁰ See Canadian economist Dr. Paul Boothe’s opinion piece: “The natural-resource economy is a roller-coaster ride.” Canada.com, November 22, 2012, <http://o.canada.com/news/national/opinion-the-natural-resource-economy-is-a-roller-coaster-ride>. Dr. Boothe is Professor and Director of the Lawrence National Centre for Policy and Management, Ivey Business School, Western University, Ontario. Also see, “Riding the Resource Roller Coaster: Understanding Socioeconomic Differences between Mining Communities,” *Rural Sociology* 69(2):262-281, June 2004.

yet to recover.⁴¹ Oil prices have also been volatile, rising from less than \$20 US per barrel in late 1998 to \$161 US per barrel in May 2008 and then, ultimately, crashing to \$34 US per barrel in February 2016.⁴²

Figure 4.

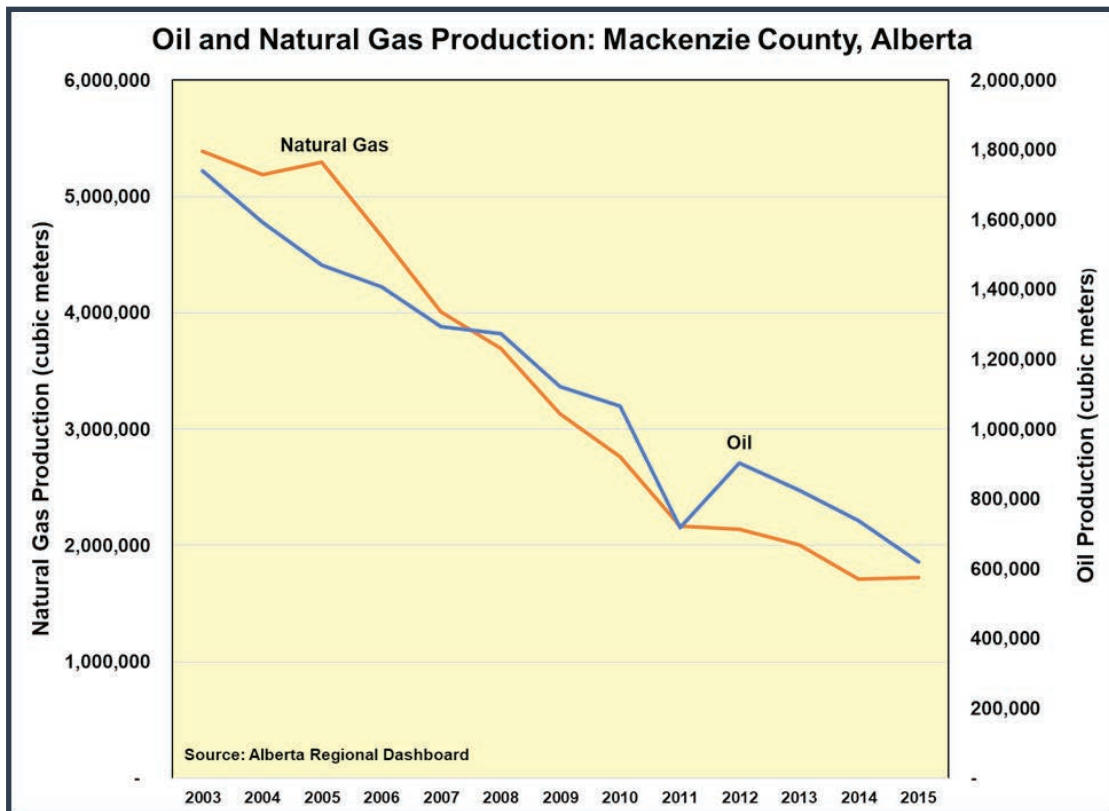
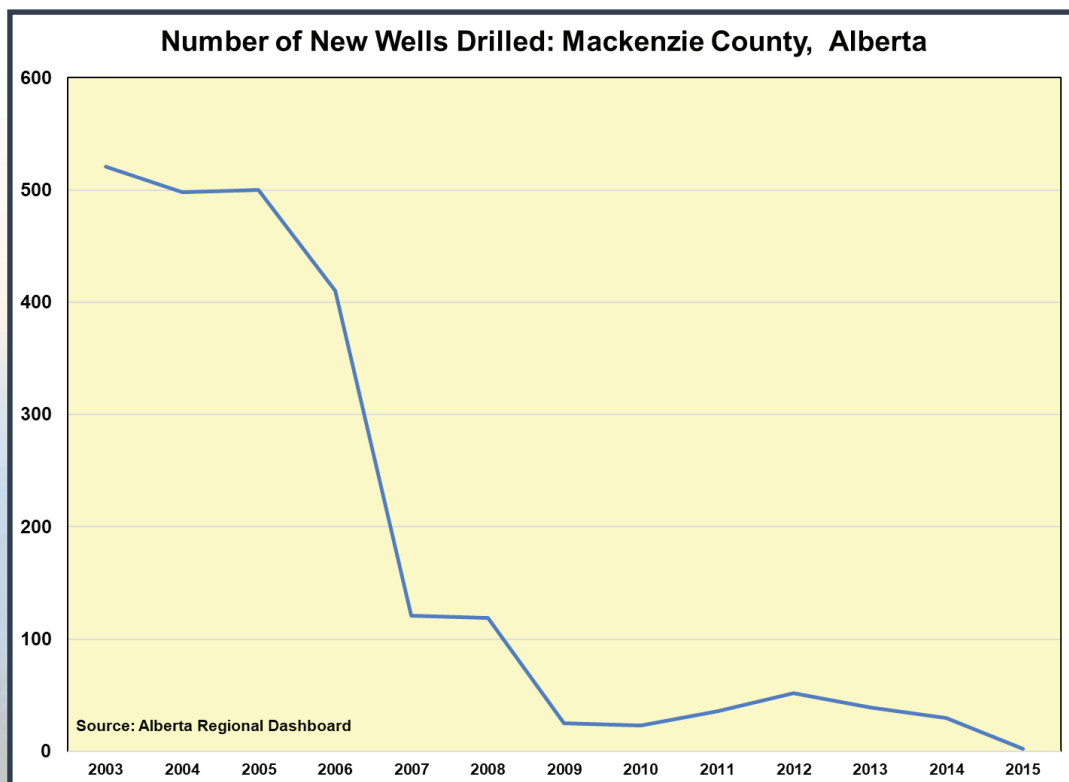


Figure 5.



⁴¹ <https://www.eia.gov/dnav/ng/hist/rngwhhdM.htm> .

⁴² <https://www.macrotrends.net/1369/crude-oil-price-history-chart> .

The volatility of natural resource markets can partially or entirely offset the stimulating effect of the above average pay associated with jobs in most natural resource industries. This can retard regional economic development. This is one of the sources of the “curse of natural resource abundance” that has been widely discussed.⁴³ Most mining and timber dependent areas are not vital, prosperous regions despite the high pay and huge wealth extracted. Reduction in the level of dependence on internationally traded commodities and diversification of the economy should be important economic development objectives for natural-resource-dependent economies, including NWSAR region.

An additional negative feature of heavy reliance on natural resource extraction is the damage done to land and water and the undermining of natural systems in ways that significantly reduce the valuable environmental services those natural systems can provide (services such as carbon sequestration, flood and drought mitigation, air and water purification, etc.). The widespread disturbance of caribou ranges in Alberta by seismic lines, redundant roads, clear cutting of forests, and abandoned oil and gas wells is a cautionary example of the legacy of long-run environmental damage that can be costly to repair in the future, and is often done at the public’s expense. Degraded natural landscapes, polluted waters, and the loss of native wildlife can become a significant future barrier to local economic development. Increasingly, the attractiveness of local areas as places to live, work, and raise a family are an important part of a local area’s economic base. If it is only high but volatile wages that attract workers to a particular location, the size of the local population may also rise and fall with international commodity prices. The labor force for the natural resource sectors can become a temporary labor force that either commutes to distant work opportunities or chooses temporary residence. Such workers tend to send their earnings elsewhere, depriving the local economy of most of the stimulus that should be associated with the local industrial activity and high wages.

Part II. Natural Resource Industries and Caribou Conservation Can Coexist

One of the main suppositions that is made in the socioeconomic section of the NWSAR report, a condition that can also be found in some of the professional journal literature, is that commercial extractive industry and caribou recovery are incompatible on the same caribou range.

“This analysis was completed to determine the present economic values of the lands within the entire caribou ranges. Scenario analysis was not completed, as the NWSAR does not have the capacity to complete this element and believes that it is the responsibility of the provincial government; to complete a detailed socio-economic analysis in consultation with potentially impacted stakeholders, including municipalities. The values within this analysis do not include the potential for future economic opportunities within caribou ranges.”⁴⁴

In the quote above NWSAR makes clear that it does not have the capability to do multiple scenario analyses on the caribou ranges. Given that limitation, NWSAR only analyzed one scenario: the loss of all commercial economic activity on the different ranges. This was also the supposition that has been made by a number of other researchers in the professional journal articles that we will discuss below.⁴⁵ Newspapers⁴⁶ quickly

⁴³ For a discussion of the “Curse of Natural Resource Abundance,” see “Digging to Development? A Historical Look at Mining and Economic Development,” a report prepared for Oxfam America, Thomas Michael Power, September 2002. Also see “The Economic Anomaly of Mining: Great Wealth, High Wages, Declining Communities,” in *Mining in New Mexico—The Environment, Water, Economics, and Sustainable Development*, ed. L. Greer Price, et al. New Mexico Bureau of Geology & Mineral Resources, New Mexico Tech, 2005.

⁴⁴ Alberta NWSAR Committee. Recommendations for Boreal Woodland Caribou Population Recovery in Northwest Alberta. Page 63. June, 2017.

⁴⁵ Both Schneider and Hebblewhite at least initially modeled, or presented others’ modeling efforts, where no industrial activities could take place on the Woodland Caribou ranges.

⁴⁶ <https://business.financialpost.com/commodities/as-woodland-caribou-herds-dwindle-new-policies-from-ottawa-threaten-a->

picked up on the idea that industry and caribou habitat recovery could not take place within the same range. The assertion is that they are mutually incompatible. This has encouraged municipalities, industry, and residents to see caribou conservation as a threat to their economic viability. The perception encouraged by this supposition is that “the Caribou are going to take residents’ jobs.”

What began as an inability to use an optimizing landscape model to account for both the ecological and economic values of the ranges so that the minimum 65 percent threshold of undisturbed habitat could be achieved, a *conservation model*, has morphed into a caribou vs. extractive industry narrative that is distorting the science and policy choices that are available. What the science says, even without the use of a conservation model to balance the different potential values to extractive industry and caribou, is that there are simple steps that can be taken already that would have had very little impact on existing natural resource industrial activities while moving very close to the minimum 65 percent undisturbed threshold for the Bistcho and Yates ranges. The mediator Eric Denhoff pointed out in “Setting Alberta on the Path to Caribou Recovery” that simply setting the unleased Forest Management Units aside for caribou habitat can get the Yates and Bistcho ranges most of the way to the 65 percent undisturbed threshold.

“These measures will achieve permanent protection of 24% of the Chinchaga caribou range, 61% of the Bistcho range, 72% of the Caribou Mountains range and 72% of the Yates range - immediately. It does not require displacement of any existing forestry tenure and existing oil and natural gas leases can be grandfathered in; these are not as extensive as in some other areas. There are no operations currently underway in the area involving major drilling programs, mines or similar developments. It further protects vast areas of wetlands and there are substantial opportunities to use this protection to provide valuable sinks for carbon.”⁴⁷

While this solution lacks the elegance of some of the conservation model strategies that we outline below, it does point out that there are very large unleased tracts of land that lie within the Bistcho and Yates ranges. What Denhoff’s analysis lacks in nuance, it makes up for with the force of a large landscape that comes close, by itself, to meeting the basic federal species at risk directive of at least 65 percent undisturbed habitat. While it now seems clear that there are more nuanced policy solutions that allow both industry and caribou habitat values to be taken into account, this solution already gets around the supposition of the NWSAR study that caribou ranges and industry cannot coexist.

Below we present some of the science that has been used to model the minimum 65 percent undisturbed threshold that is required while still allowing extractive industry to operate in the different caribou ranges. The use of conservation models that value both commercial extractive interests and the undisturbed thresholds allows scientists, the Government of Alberta (GoA), indigenous communities, natural resource industries and conservation groups to develop strategies to avoid the zero-sum conclusion of mutual incompatibility.

1. Other studies using conservation models to solve the Woodland Caribou Conservation Riddle

Although the GoA and the federal government both have the responsibility of finding a management policy that will lead to the naturally sustainable caribou populations that the Species at Risk Act (SARA) requires, they are not the only ones trying to solve this problem. Scholars and other environmental organizations have done their own modeling using widely available conservation modeling software to come to largely the same conclusion: With appropriate policies and regulations, caribou conservation and natural resource industry activity can exist within the same range.⁴⁸

Richard Schneider wrote a series of papers in 2010 and 2012 that looked at the possibility of selecting

[northern-way-of-life](#) and <http://www.outdoorcanada.ca/Is-this-really-the-best-way-to-save-Albertas-woodland-caribou>

⁴⁷ Denhoff, E. Setting Alberta on the Path to Caribou Recovery. May 30, 2017. Page 39.

⁴⁸ Note that this is not an endorsement of the natural resource industry being able to operate in *all* of the different ranges. Rather it is an endorsement of conservation modeling to solve these problems.

'Woodland Caribou Reserves' using an optimization approach. His 2010 paper, which helped to stoke some of the economic fear towards caribou conservation policies, assumed like the NWSAR report did that caribou conservation and industry were mutually incompatible in the same range.⁴⁹ While there are some important takeaways from the 2010 Schneider paper, the basic supposition was flawed. In that paper Schneider defines the triage approach to caribou conservation as:

“Insufficient capacity exists to adequately treat all patients, patients are in a critical state and cannot wait until additional capacity becomes available, and patients differ in their likely outcome and/or the amount of treatment they require.”⁵⁰

It is not surprising that this triage metaphor was likely threatening to those currently dependent on industrial activity in caribou ranges. However, the Yates and Bistcho caribou range examples show us that the first part of Schneider's definition of triage does not apply to these ranges. There is sufficient capacity to adequately serve both caribou recovery and industrial natural resource interests in these ranges. In fact, the impact on industry is likely to be very minor in these two ranges if an optimization approach is used instead of the assumption that industry and undisturbed habitat cannot coexist. Specifically in these ranges, if clear rules are carefully developed and conscientiously observed, the possibility for both industry and caribou recovery in the same ranges appears possible.

Optimization is possible because different lands have different capacities to support the pursuit of different objectives. There can be lands that have relatively low commercial value but high value for caribou conservation or *vice versa*. We take optimization to mean a model that allows for different weights or filters to be placed on different values within the model. An example of a weight or filter would be the value of the land to the oil and gas industry or the value of the land to the timber industry. The end goal of the model is to obtain a solution that, in this case, provides the best use of the landscape given a series of basic constraints. The basic constraints would include rules such as achieving minimum 65 percent undisturbed caribou habitat in each range, providing contiguous habitat in the caribou range (so that it is not broken into small pieces), choosing best suitable habitat, and weighting industry (oil/gas and forestry) values as well as the caribou habitat values. The optimized solution is one that takes all of the different constraints, weights and filters into account and comes up with the superior solutions. Within this framework, there can be many different superior solutions that satisfy the different constraints. From these alternative superior solutions, a choice would be made depending on the values of the stakeholders. What the optimization does is eliminate unnecessarily costly alternatives and alternatives that do not meet the agreed-upon constraints.

Within an optimization framework, the \$100 billion dollar cost that Schneider initially came up with in his 2010 paper was not a superior solution. It was unnecessarily costly. Similarly, the triage approach that turned parts of caribou ranges with high value to industry completely over to caribou habitat or turned areas with high value for a caribou herd recovery completely over to industrial development, were economically irrational. Because there were less costly policy choices that could be made that met caribou recovery requirements, there was no need to “sacrifice” land that was either better suited for industrial development or caribou recovery. There are superior and inferior scenarios that Schneider found in his 2012 paper on selecting caribou reserves using an optimization approach.⁵¹

In Schneider's 2012 paper he made an important change compared to his 2010 paper, allowing for industry on some of the identified caribou ranges (40%) and for caribou protection on the majority of the ranges (60%). Although these are clearly not the thresholds that have been adopted by the Federal Government nor the GoA, this allows us a starting place in this modeling exercise. In Schneider's 2012 paper he made an important change: using the Marxan⁵² model to optimize all of the identified caribou ranges in Alberta together with the current industries, he found that his self-imposed habitat conservation goal of at least

⁴⁹ Schneider, R., Hauer, G., Adamowicz, W., Boutin, S. Triage for conserving populations of threatened species: The case of woodland caribou in Alberta. *Biological Conservation*. Volume 143. 2010.

⁵⁰ Ibid.

⁵¹ Schneider, R., Hauer, G., Dawe, K., Adamowicz, W., Boutin, S. Selection of Reserves for Woodland Caribou Using an Optimization Approach. *PLoS ONE*. 7(2). 2012.

⁵² For the purpose of this report it is enough to know that the Marxan model is a conservation model that has an optimized

60 percent undisturbed habitat could be attained with almost no impact on commercial natural resource activities.

“Our findings suggest that the prospects for habitat protection may be greater than previously supposed. By optimizing the design of the reserve system, 60% of current caribou range can be protected (including 17% in existing parks) while maintaining access to over 98% of the value of [commercial natural] resources on Alberta’s public lands. One of the main reasons for this favorable outcome is that the distribution of resource values is highly variable across our study area, largely because of the presence of the oil sands deposits. Optimization techniques are particularly effective in minimizing the cost of conservation solutions when variance of the cost layer is high.”⁵³

Schneider found that there would only be a drop of 2 percent of the commercial value of the commercial natural resources accessible while protecting 60 percent of the proposed caribou ranges. In Schneider’s 2010 paper he came to the conclusion that \$100 billion dollars of commercial natural resources would be lost protecting Alberta caribou habitat and in his 2012 paper that value was cut by 98 percent by applying an optimization model to find lower cost solutions. It is also important to point out that in the 2012 modeling there was no economic value that was assumed for the conservation of caribou. This includes the potential benefits to society of conserving caribou as an “umbrella species”⁵⁴, which we noted in Section I above, as well as the potential for economic opportunities associated with caribou recovery, which we will discuss in Section III below. The important step that was taken in Schneider’s 2012 paper was that an optimization approach was applied which showed that caribou conservation and industry generally are not mutually exclusive.

One of the main criticisms of Schneider’s work is that it was not spatially explicit. Although we are told how much of each range could potentially be conserved for caribou, we are not told which parts of those caribou ranges were conserved and which were left open for commercial extractive activities.

Hebblewhite argues in his 2017 paper that a series of “conservation filters” must be applied to optimization modeling of the Woodland Caribou so that population viability, habitat quality, seasonal requirements, genetic diversity, economic costs, First Nations Treaties, and climate change can all influence the decisions that will be made on which areas are conserved and which are left open to commercial extractive activity. This represents another advance in obtaining optimal solutions. Hebblewhite argues that very tough choices must be made even with the weighting of the different filters that are applied, or an “unsolvable policy conflict” is inevitable.

“One has to question whether we can afford the costs of effective habitat protection given the economic importance of energy. To maintain that it is feasible to recover all caribou herds while committing to maximizing revenue from oil and gas development (Alberta Energy, 2015) is a clearly unresolvable policy conflict.”⁵⁵

While Hebblewhite appears to be more pessimistic about the future of caribou recovery in Canada when pitted against energy development, his points about spatially specific range plans as well as applying different weights to different optimization filters are well taken.

“...Federal and Provincial governments in Canada need to urgently invest funding to develop regional, spatially-explicit land use planning that addresses recovery targets and improves environmental impact assessment. At the same time, effective harmonization of energy and biodiversity conservation policy is urgently needed, as effective conservation will ultimately be an issue of governance, especially by First Nations”⁵⁶

solution. It is a model that is widely used in academia and one that was developed to try to solve habitat conservation questions. More about the model can be found here: <http://marxan.org/>

⁵³ Schneider, R., Hauer, G., Dawe, K., Adamowicz, W., Boutin, S. Selection of Reserves for Woodland Caribou Using an Optimization Approach. PLoS ONE. 7(2). 2012.

⁵⁴ Hebblewhite, M. Billion dollar boreal woodland caribou and the biodiversity impacts of the global oil and gas industry. *Biological Conservation*. 206 102-111. 2017.

⁵⁵ Ibid.

⁵⁶ Hebblewhite, M. Billion dollar boreal woodland caribou and the biodiversity impacts of the global oil and gas industry. *Biologi-*

Note that there is a dramatic shift in the tone of these debates. Where the initial debates pitted extractive natural resource industry activity against caribou conservation, the debate is now around the weight that each different filter should be given in the conservation modeling exercises. There needs to be spatially specific boundaries that are drawn showing how the minimum 65 percent undisturbed habitat thresholds can be reached while allowing a myriad of other interests to be represented in the conservation models. In this context, more weight is applied to the richest energy plays, the best caribou habitat, the most productive forests, etc. It is also important to note that best operating practices would need to be adhered to for the areas that are left open to extractive industry so that even in those areas the disturbance is minimized. In addition, as we will discuss in detail in Part III below, caribou habitat can be “protected” by restoring to “undisturbed” status the range lands damaged by past activity, in addition to focusing on lands disturbed by *existing or future* commercial activities.

We now turn to the Government of Alberta’s work using a conservation model to put together a starting point for the conversation on where the specific boundaries for the caribou ranges would be.

2. Government of Alberta Efforts

One of the main assumptions that is made in the socioeconomic section of the NWSAR report is that there cannot be extractive industry activity and caribou recovery in the same range.⁵⁷ Fortunately, this assumption is not an accurate statement when the different capabilities and priorities of different parts of the land base are taken into account. The GoA (and many others) do have the capabilities to do scenario analysis and look at different accommodations between caribou recovery and the continuation of extractive natural resource industry activity in caribou ranges. Since there is a threshold of ‘at least 65 percent undisturbed habitat in each range’ that the Canadian government established and the GoA accepted in their draft caribou range plan, there appears to be room for both to coexist at the same time. While at least 65 percent of the habitat has to remain or become undisturbed, a maximum of 35 percent of the land could potentially be disturbed by industry and natural events such as wildfire in any given range and still meet the threshold requirement. When we look to the planning documents from the GoA, the scientific literature associated with caribou recovery, and other environmental groups’ studies on Alberta caribou recovery, all of them find that both industry and caribou recovery can proceed within the same caribou ranges subject to clear, well-enforced management plans. This does not mean, of course, that oil and gas and timber harvest can take place with no disturbance to caribou habitat. It means that the land base is varied enough that it can serve a mix of land commitments to different objectives with caribou conservation constraints being met at relatively low cost to the existing commercial economy.⁵⁸

In fact this is exactly what the GoA is attempting to do in their Draft Provincial Woodland Caribou Range Plan. By using techniques like integrated land management (ILM), restoration can address legacy land disturbances, and ongoing industrial activity on other parts of the land base can also be more closely regulated to minimize damage to caribou habitat. As the GoA put it:

“Integrated Land Management (ILM) is a strategic, planned approach to restore, manage and reduce human footprint on the landscape. This approach aims to balance values, benefits, risks and trade-offs when planning and managing resource extraction, land use activities, and environmental conservation and management. Integrated Land Management will be required and adhered to in applications for development, and throughout project activity cycles.”⁵⁹

cal Conservation. 206 102-111. 2017.

⁵⁷ Alberta NWSAR Committee. Recommendations for Boreal Woodland Caribou Population Recovery in Northwest Alberta. Page 63.

June, 2017.

⁵⁸ The modeling of Schneider in 2012, discussed above, clearly indicates that this is broadly true for the ranges in Alberta. This potentially becomes less applicable at individual wells or individual timber harvest levels. This is perhaps particularly true in ranges with large oil sand deposits, although that is beyond the scope of this report.

⁵⁹ Alberta Government. Draft Provincial Caribou Range Plan. 2017. Page 30.

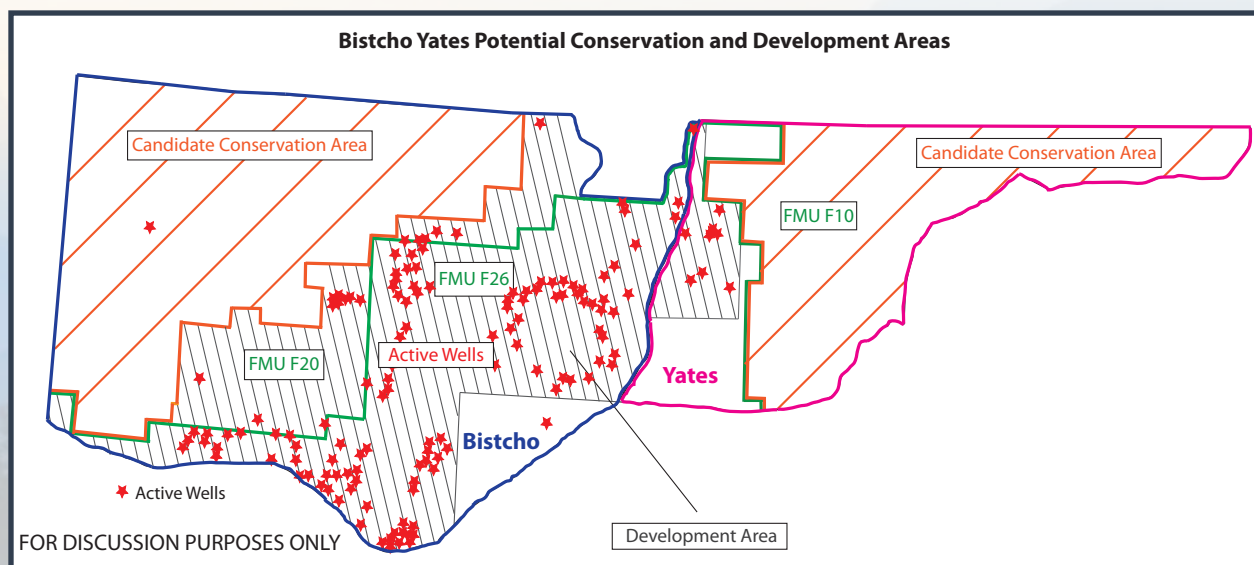
When we look at examples of the range plan scenarios that GoA has developed for discussion purposes, we can clearly see that there are options for both industry and caribou conservation to productively exist within the same caribou range if development practices are sensitive to caribou recovery. More specifically, the Indigenous & Multi-stakeholder Working Session for the Northwest Region that took place on March 16, 2018, provided some clear applications of this Integrated Land Management. Some potential scenarios were presented that would meet federal government habitat requirements for caribou recovery and allow industrial activity to continue within the Bistcho and Yates ranges.

What the different scenario maps from the Multi-Stakeholder meeting show collectively is the extent of the human footprint on the land, the ways that future policies can rehabilitate the land back to undisturbed status, and the ability of the current industries that are active within those ranges to continue operating through their lease time horizons which extend as far out as 100 years. What those different scenarios *do not contemplate* is the conversion of lands currently leased or permitted to commercial operations being converted into an area where such commercial extractive activities are completely banned.

Clearly, if the Yates and Bistcho ranges are to return to at least 65 percent undisturbed habitat, there will have to be very large areas that are protected from commercial extractive activity. The challenge then is to generate alternatives in which the caribou have their undisturbed habitat while not excluding industrial activity from most of the land on which it currently operates. Using the Patchworks optimization model⁶⁰ and best available information, modelers analyzed the value of extractive industrial activity in different portions of the Bistcho and Yates ranges against different ways to meet the constraint that a minimum of 65 percent undisturbed caribou habitat be created and maintained. The modelers found that such alternatives were available.

When we examine the ‘Scenario B’ maps that were presented for discussion purposes by the GoA and reproduced by Power Consulting, we can see the candidate conservation areas, where no additional disturbance would be allowed on caribou habitat (see Figure 6). That strictly protected caribou habitat makes up the east and west sides of the contiguous Bistcho (blue border) and Yates (yellow border) ranges. In the middle of the two ranges is the proposed development area (grey stripes). What is also clear is that the proposed development area holds the vast majority of the active oil/gas wells in the area (red stars). Figure 6 also shows the Forest Management Units (FMUs) outlined in green. F10 and F20 are unleased FMUs. No current forest products company has the rights to harvest timber within these areas. FMU F26, in the middle portion of the figure, is held in a joint forest management agreement (FMA) with Tolko, Norbord, and La Crete Sawmills, and extends well beyond the Bistcho-Yates ranges area.

Figure 6.



Source: Government of Alberta. Indigenous & Multi-stakeholder Working Session. Northwest Region. March 16, 2018.

⁶⁰ <http://www.spatial.ca/products/index.html>

There are two important points that may not be immediately clear when viewing this solution. First, it is important to see that although all of FMU F10 and FMU F20 would be off limits to timber harvest, there would be some oil and gas wells that would be allowed on parts of those FMUs. This can be most clearly seen by looking at FMU F20. We have purposely put the label for FMU F20 in the south east portion of FMU F20 which is also being presented as part of the proposed development area. We point this out because it shows that the conservation model is not simply operating on the boundaries of the FMUs as Denhoff suggested. Because there are high value oil and gas wells in FMU F20, part of that FMU was carved out to allow for that high value commercial resource to be in the proposed development area. This shows some of the nuance that can be reached through the use of a conservation model.

Second, it should be noted that the candidate conservation areas could eventually provide a very large and contiguous amount of largely undisturbed⁶¹ habitat for the caribou. Although the two ranges are separated by a development area, the sequential timber harvest that is included in Scenario B as well as the ILM practices that are meant to minimize the footprint of industry will help to “bridge the gap” between these two ranges. Again, this is a potential solution that sees almost all of the industry remaining on the landscape while attaining the minimum 65 percent undisturbed goal.

Although these maps are for discussion purposes only, they show that the GoA and the modelers that created the different scenarios and ran them through the Patchworks model were able to come up with a solution that allowed industry to remain in the areas that are the most productive for them while also attaining the minimum 65 percent undisturbed threshold that is necessary for caribou recovery. Note that there is only one active well that ends up in a candidate conservation area in the Bistcho range, and it could be grand-parented-in as is customary in Alberta wildland provincial parks. The vast majority of the industrial activities in the Yates and Bistcho ranges are in the central area of the two contiguous ranges. Although this is a unique scenario that the GoA has come up with, and it is for discussion purposes only, the solution allowing industry and significant protected caribou habitat is not unique. As was mentioned earlier there have been a series of other modeling efforts using other conservation models that also show industry activity and sufficient undisturbed caribou habitat for sustainable herds existing within the same range.

What now should seem far clearer is that by using conservation models, like the ones discussed above, and by applying weights to different filters within the model, different parts of the ranges can be optimized for different uses while reaching the minimum 65 percent undisturbed caribou habitat threshold. This is exactly what the GoA has been doing, although their final modeling efforts will likely include socioeconomic impact analyses which have not yet been released to the public, for each of the different ranges. We endorse that optimizing approach and hope that the GoA's socioeconomic impact analysis can assuage the fears that seem to be driven by the false caribou vs. jobs narrative. What seems very clear to us is that through the use of conservation models that produce optimized solutions, both caribou and industry can coexist on the collective ranges. We hope that the GoA can move as quickly as possible with their socioeconomic impact analysis so that all of the stakeholders can collectively move forward and focus their work on caribou conservation. Through the implementation of mandatory Integrated Land Management practices, Alberta can move away from the public policy paralysis created by the zero-sum assumption that commercial extractive industry and protected undisturbed caribou habitat are mutually exclusive. That would allow all stakeholders to focus on the actual implementation of optimized plans for each of the caribou ranges.

⁶¹ The Candidate Conservation Areas, with the exception of the far eastern edge of Yates (Wood Buffalo National Park), are heavily disturbed by legacy seismic lines. We assume that the habitat can eventually return to its former *undisturbed* nature with the help of restoration strategies that will be discussed in Section III of this report.

Part III: The Positive Economic Impacts of Seismic Line Restoration Activities

So far in the discussion of returning the caribou ranges to the minimum 65 percent undisturbed habitat there has been a lot of emphasis put on the potential commercial losses associated with protecting caribou habitat. In section I, we showed that for Bistcho and Yates caribou ranges in northwest Alberta, these commercial losses have been dramatically exaggerated and are likely to be very small if there are any losses at all. In section II, we showed that if conservation models that use an optimization approach apply the right weights to different filters (like caribou habitat and natural resource industry activity), there can be a rational economic solution that sees caribou and economic activity in most caribou ranges. What we see as missing from these optimization approaches are the potential positive economic impacts of habitat restoration. There will be many different potential benefits to restoring caribou habitat, but here we will primarily discuss the additional jobs and income associated with caribou range restoration work. Given the focus of NWSAR concerns about asserted high and negative socioeconomic impacts of protecting caribou range lands and the need for public policy makers to do a detailed socioeconomic impact analysis in cooperation with stakeholders, it is appropriate to discuss the restoration economy aspect of protecting/restoring caribou habitat.

In order to return the caribou habitat to “undisturbed” status, planning, followed by decades of tree planting and other labor-intensive effort will be needed. A host of different jobs, that we will discuss in some detail later, will be created. That job creation will be a positive economic impact to the people who live within commuting distance of the caribou ranges in Alberta. In this section we will highlight some modeled job creation, based on pilot projects from the oil and gas industry as well as the GoA that have restored relatively small amounts of legacy seismic lines. When those pilot projects are scaled up, the potential positive economic impacts to the communities around the different Alberta caribou ranges will be significant, with total payroll impacts in the hundreds of millions of dollars.

1. Literature on Seismic Line Restoration

In this section we will seek to lay out the current scientific understanding of seismic line restoration and identify the strategies that are most likely to be both successful and cost effective. We can then apply those strategies to the Bistcho and Yates ranges to come up with a range of costs and benefits associated with returning both Bistcho and Yates to at least 65 percent undisturbed status partially through seismic line restoration.

Anna Dabros et al. reviewed the scientific literature associated with seismic line restoration in her 2018 paper on “seismic line environmental impacts, challenges, and opportunities.”⁶² Seismic lines, which have been used extensively by the oil and gas industry all over the boreal forest in North America, are a persistent and significant ecological challenge. The typical seismic lines of the past, generally referred to as “legacy seismic” lines, are up to 10 m wide and in Alberta alone there are more than 1.5 million km of them.⁶³ In just the Bistcho and Yates ranges alone there is estimated to be about 67,000 km of legacy seismic lines.⁶⁴ In the Bistcho range 91 percent of the range is disturbed by seismic lines. Although more recent seismic exploration has a smaller footprint than the legacy seismic lines, legacy seismic line disturbances have largely dominated many caribou ranges in the province.

The densest legacy seismic line disturbance in caribou ranges in Alberta is 98 percent in the west central Little Smoky range. The adjacent A La Peche caribou winter range, which requires 65% undisturbed habitat under the federal mountain caribou recovery strategy, has a seismic line disturbance level of 84%.⁶⁵ These

⁶² Dabros, A., Pyper, M., Castilla, G. Seismic lines in the boreal and arctic ecosystems of North America: environmental impacts, challenges, and opportunities. *NRC Research Press*. 2018.

⁶³ Ibid.

⁶⁴ Government of Alberta. Draft Provincial Woodland Caribou Range Plan, 2017. Table 3, Page 33

⁶⁵ Mountain caribou are a unique type of woodland caribou; they require adequate undisturbed habitat for their summer range, winter range and seasonal migration routes. A La Peche winter range seismic line disturbance is identified in Government of Alberta. Draft Provincial Woodland Caribou Range Plan, 2017 – Appendices. Page 7.

two contiguous ranges are currently part of a pilot project by the GoA to restore approximately 10,000 km of legacy seismic lines in cooperation with energy sector companies in the area.⁶⁶ This partnership, where the GoA is designing and carrying out the seismic line restoration and the energy industry has volunteered to pay for it, is one that could potentially be a roadmap for seismic line restoration across the different ranges in Alberta. Although the “results from the Little Smoky and A La Peche Restoration Pilot Program will be closely monitored and assessed” by the GoA, those results are not currently available to the public.⁶⁷ There are currently many other pilot projects being carried out by the oil and gas industry that may be effective approaches in returning the ranges to the required minimum 65 percent undisturbed status. We will discuss some of those projects later, but, at the time of this writing, there is not one specific strategy that has been identified as better than the others.⁶⁸

The numerous environmental and ecological effects of legacy seismic lines are beyond the scope of this report. In simple terms, a major reason for the persistent disturbance is that once the vegetation has been removed in creating the seismic line, the water intake on that line decreases. This leaves the water to pool, which in turn compacts the relatively limited soil. Tree regrowth without specific planting programs is often nonexistent⁶⁹ and after 35 years, more than 60 percent of the seismic lines in a landscape scale study “showed little or no recovery back to a forested state.”⁷⁰ As persistent linear features, they provide vegetation to feed deer and moose, and they are used as travel corridors for deer, moose, wolves and people (including on motorized vehicles) that would otherwise have a much harder time traveling through the landscape. The increased presence of moose and deer give the wolves more animals to prey on than they otherwise would have, and wolf numbers have increased in the caribou ranges. Because their numbers and travel routes through the forest have increased, wolves prey on caribou more now than in the past. As well, access of motorized vehicles contributes to harassment of caribou and the displacement of them from prime range as well as poaching.

The Dabros review goes on to examine the current practices for restoration of legacy seismic lines and then discusses some of the challenges and opportunities. The restoration is broken into two basic types: ‘habitat restoration’ and ‘functional restoration’. Habitat restoration involves dealing with the site specific issues like soil compaction or the lack of water intake and attempts to revegetate the seismic lines. Functional restoration attempts to limit access along the linear features by placing some type of wooden block or obstacle at intervals on the seismic line. While habitat restoration has been shown to be effective in returning the seismic lines to their previously undisturbed status, functional restoration does not attempt to do that. Functional restoration can help in reducing wolf predation on caribou as well as human recreational disturbance. Both of these techniques can be deployed at the same time during the restoration process. Both of these techniques are seen as integral in the protection of caribou in Alberta.⁷¹

Some of Dabros’ important conclusions were:

“To be successful, restoration treatments must therefore clearly document site limiting factors and address these factors through creation of microsites, facilitation of natural regeneration, mechanical site preparation, and (or) tree planting.

⁶⁶ Government of Alberta. Draft Provincial Woodland Caribou Range Plan. Page 32. 2017.

⁶⁷ The RFP to implement the restoration project closed in January of 2017. https://www.merx.com/English/SUPPLIER_Menu.Asp?WCE=Show&TAB=1&PORTAL=MERX&State=7&id=AB-2016-07498&src=osr&FED_ONLY=0&ACTION=&row-count=&lastpage=&MoreResults=&PUBSORT=2&CLOSESORT=0&IS_SME=N&hcode=YyaSheM%2F2kiguf1%2F4fw-Img%3D%3D

⁶⁸ Although the Government of Alberta has now released the Provincial Restoration and Establishment Framework for Legacy Seismic Lines in Alberta, it is not available to the public and it has not been proven to be effective. Of course it will take upwards of 50 years to prove how effective each restoration strategy will be. The point that we are making is that the restoration strategy is currently fairly fluid.

⁶⁹ The GoA in their Draft Provincial Woodland Caribou Range Plan estimates that of the 250,000 km of legacy seismic lines on the different Ranges, 150,000 km, or 60 percent “are not fully capable of natural woody vegetation re-establishment.” Page 32.

⁷⁰ Dabros, A., Pyper, M., Castilla, G. Seismic lines in the boreal and arctic ecosystems of North America: environmental impacts, challenges, and opportunities. *NRC Research Press*. 2018.

⁷¹ Government of Alberta. Draft Provincial Woodland Caribou Range Plan. Page 38.

The costs, labour, and logistical constraints necessary for restoration of all currently present seismic lines may be a daunting and unrealistic undertaking. Given the scale of this challenge, prioritization of seismic restoration efforts will be inevitable (van Rensen et al. 2015). As such, priority must be established as to which areas need to be restored first, based on their ecological value in terms of supporting biodiversity and (or) vulnerable species, and provision of economic and ecosystem services.”⁷²

The quote above also echoes work done by Justina Ray and colleagues, who in their analysis of several endangered mountain caribou populations, prioritized a “proactive, planned approach coordinated across jurisdictions to conserve landscape processes important to caribou conservation.”⁷³

This brings us back to the actual process of legacy seismic line restoration and the costs of that restoration. Note that in the Dabros quote above there is yet another set of expert voices calling for priorities to be established associated with the ecological value when restoration decisions are made. Whether that value is caribou habitat or biodiversity generally, priorities must be established as to which areas will be restored first. This type of optimization is precisely what the different conservation planning software tools allow land managers to do, and it is exactly what we understand GoA is attempting to do with its range plans. This is also precisely the economic point that we are attempting to make in this paper. Above all else, the goal has to be to do as much conservation as possible with limited costs. In other words, prioritize the areas in each range that have the best chance to return the legacy seismic lines to undisturbed status, while keeping in mind the costs of restoration in each different area. Whether this prioritization is done using conservation models, telemetry from radio collars, indigenous experience like the Doig River First Nations are using on the Chinchaga range,⁷⁴ or all of them together with the help of an optimization model, the point is to prioritize those activities that return the range to at least a 65 percent undisturbed status.

As discussed above, *historically* “disturbed” lands can be converted to “undisturbed” status in order to meet the 65 percent “undisturbed” target, thus reducing the extent to which *current* industrial activity might otherwise have to be reduced to meet that target. In that sense, the out-of-pocket cost of such restoration activities can be seen as an opportunity cost incurred to allow higher levels of industrial activity on caribou ranges while meeting the “undisturbed” target.

Allowing both habitat restoration and industrial practices consistent with caribou recovery in the same range can potentially allow for more cost-effective solutions. These “least cost” solutions are the solutions that are likely to be supported by the largest number of stakeholders in the region and thus more likely to actually be implemented. While identifying this least cost solution, it is also important to account for all of the positive and negative economic impacts associated with restoration activities.

2. Industry and Government Applications of Legacy Seismic Line Restoration

The GoA estimates that there are 150,000 km of legacy seismic lines that “in their current state, are not fully capable of natural woody vegetation re-establishment, and therefore need some treatment(s) to encourage restoration.”⁷⁵ There is an additional 100,000 km of legacy seismic lines that “do not need intervention due to a combination of factors, such as:

- 1) Areas have sufficiently regenerated or are on their way towards natural regeneration;

⁷² Ibid.

⁷³ Ray, J., Cichowski, B., St-Laurent, M., Johnson, C., Petersen, S., Thompson, I. Conservation status of caribou in the western mountains of Canada: Protections under the species at risk act, 2002-2014. *Rangifer*. 35. 49. 10.7557/2.35.2.3647. 2015.

⁷⁴ Leech, S.M., Whittaker, C. and the Doig River First Nation. Madziih (caribou) Tsáá? ché ne dane Traditional Knowledge and Restoration Study. Report prepared for DRFN and the David Suzuki Foundation by the Firelight Group December 2016. 60 pp. 2016. <https://davidsuzuki.org/wp-content/uploads/2016/12/caribou-traditional-knowledge-restoration-study.pdf>

⁷⁵ Government of Alberta. Draft Provincial Woodland Caribou Range Plan. Table 3, Page 32. 2017.

- 2) Historical and near-term approved future timber harvest areas overlap legacy seismic lines, which will be reforested as a best management practice;
- 3) Areas are not practical to restore due to environmental conditions – potential for further ecosystem degradation, poor accessibility, muskeg or bog areas that don't support significant tree cover naturally; and
- 4) Historical wildfire areas, where natural regeneration has been initiated through natural processes.”⁷⁶

These estimates indicate that there is still a large amount of legacy seismic lines that should be restored and that the Bistcho and Yates ranges, when taken together, represent about 27 percent of the legacy seismic restoration that needs to happen in Alberta on the caribou range lands. Bistcho alone represents the vast majority of those two ranges with about 25 percent of the legacy seismic lines.⁷⁷ While there are some economic trade-offs that are mentioned in the GoA's estimation of seismic lines that do not need to be actively restored, clearly the Bistcho/Yates ranges need a tremendous amount of seismic line restoration work.

A conservative estimate of that seismic line restoration is as follows: We assume that the seismic lines are spread evenly across both of the Yates and Bistcho ranges, with the exception of the National Park (Wood Buffalo) that is in the far eastern edge of the Yates range.⁷⁸ Wood Buffalo National Park represents 14 percent of the Yates range, and so we assume that that portion can be subtracted from the 65 percent undisturbed goal for Yates. With that in mind Yates then needs to restore 51 percent of the legacy seismic lines or just under 3,000 km.⁷⁹ The Bistcho range has no National Parks and has some of the highest density of seismic lines when compared to all of the caribou ranges. Assuming that 65 percent of the legacy seismic lines will have to be restored, just under 40,000 km of seismic lines will need to be restored in the Bistcho range.⁸⁰ That brings the total of legacy seismic lines that need to be restored to undisturbed status for the Yates/Bistcho ranges to about 43,000 km, or about 65 percent of the total.

In May of 2017, the GoA released their Provincial Restoration and Establishment Framework for Legacy Seismic Lines in Alberta.⁸¹ This document is meant to be used as the required industry standard for government-led seismic line restoration in Alberta, and provide recommendations for voluntary industry-led programs. The methods that are outlined are largely unproven as they relate to turning the caribou herd survival rates around. While there is a very specific framework that is based on monitoring and reporting habitat restoration, the results will not be known for 50 to 100 years. Since this problem is really just starting to be solved, it is unclear which of the different techniques that are being implemented will be the most successful over the next 50-100 years. This does not mean that one or many should not be chosen and implemented; it simply means that our estimate necessarily becomes a little more uncertain when applied to a large area like the Bistcho and Yates ranges.

Because the GoA has not provided a specific break down of the costs and work load of their legacy seismic restorative efforts in their Little Smoky and A La Peche Restoration Pilot Program,⁸² we have turned to different oil/gas industry sources that are also conducting restorative pilot projects. Craig DeMars and Kendal Benesh, with supports from BC Oil and Gas Research and Innovation Society, in coordination with the University of Alberta and the Alberta Biodiversity Monitoring Institute, produced a report called “Testing Functional Restoration of Linear Features within Boreal Caribou Range.”⁸³ Recall that both functional restoration and

⁷⁶ Ibid.

⁷⁷ Government of Alberta. Draft Provincial Woodland Caribou Range Plan. Table 3, Page 33. 2017

⁷⁸ This is precisely the type of problem that the conservation models solve. Here we are only taking into account the surface area of the ranges and assuming that the seismic lines are evenly distributed about them.

⁷⁹ Ibid.

⁸⁰ Ibid.

⁸¹ Government of Alberta. Provincial Restoration and Establishment Framework for Legacy Seismic Lines in Alberta. May 2017.

⁸² As far as we know this study has not been released to the public. We have read through this Framework but were unable to find specific costs associated with the restoration. Government of Alberta. Provincial Restoration and Establishment Framework for Legacy Seismic Lines in Alberta. May 2017.

⁸³ BC OGRIS. Testing Functional Restoration of Linear Features within Boreal Caribou Range. January 2017.

habitat restoration methods are currently being tested. This study was looking at the costs associated with functional restoration which only aims to create barriers on the legacy seismic lines to animal travel whether it is wolf (predominately), moose, deer, or human. The authors found that:

“Cost effectiveness and logistical feasibility were key components of our overall objective. In term of cost, the techniques suggested here are well under costs associated with current ecological restoration initiatives (mounding and tree planting) on a per km basis (i.e. \leq \$6200 vs. $>$ \$10,000; Pyper *et al.* 2014).”⁸⁴

When we examine their costs a little closer, it appeared that the cost would likely be somewhere around \$4,000 per km if we assume that trees are used to block the seismic lines in place of fences and that helicopters are not used for transportation. This cost estimate is about 40 percent of the cost that is typically cited by the GoA. However it is unclear if functional restoration alone will allow a recovery of the caribou on their ranges in Alberta. While it is likely that the invasive ungulate species would be discouraged, wolf predation would be reduced, and human traffic would be cut down, it is less likely that the forest will grow back on the seismic lines that have been functionally treated. As was stated earlier, there are some 150,000 km of legacy seismic lines that have not grown back on their own. Here we will take this \$4,000 per km cost as the lowest possible cost associated with remediating one km of legacy seismic line. It should be kept in mind that this low cost “restoration treatment” may not qualify as turning the seismic lines into undisturbed caribou range that can contribute to reaching the federal government’s mandate of at least 65 percent undisturbed habitat. “Because predation is the likely proximate cause of caribou population declines and wolves are the primary predator of adult caribou (McLoughlin *et al.* 2003),”⁸⁵ we see this as the lowest cost restoration effort of uncertain long-run efficacy. In other words this solution may help the existing caribou to survive, but it likely will not allow them to recover without actual habitat restoration.

Although there is a tremendous amount of current research that is focused on seismic line regeneration in support of caribou, there is a decided lack of specific costs associated with that seismic line restoration. While the figure \$10,000/km appears to be the most common assumption,⁸⁶ a specific breakdown of that cost per km into its component parts is elusive. There are some exhaustive reviews of habitat restoration for caribou in Alberta,⁸⁷ British Columbia has produced a Boreal Caribou Habitat Restoration Operational Toolkit,⁸⁸ COSIA⁸⁹ and Cenovus⁹⁰ are actively restoring small sections of different caribou ranges in Alberta,⁹¹ and companies like Silvacom are actively promoting and selling fully integrated restoration of seismic lines from modeling to implementation.⁹² But to our knowledge, no one has a detailed breakdown of the specific costs associated with legacy seismic restoration. We will adopt the \$10,000/km cost estimate for our calculations.

Using the estimates from the 2017 study by Craig DeMars and Kendal Benesh on functional restoration, we assume that there will need to be teams of four people that can collectively treat 1 km per day. Assuming that they are working during the winter time and that they are using the

⁸⁴ BC OGRIS. Testing Functional Restoration of Linear Features within Boreal Caribou Range. January 2017. Page 22.

⁸⁵ BC OGRIS. Testing Functional Restoration of Linear Features within Boreal Caribou Range. January 2017. Page 9.

⁸⁶ Cenovus cites \$32 million for 3,500 km of restoration. <https://www.cenovus.com/news/docs/Cenovus-caribou-project-factsheet.pdf> The Caribou Monitoring Unit cites \$10,000/km. <https://cmu.abmi.ca/wp-content/uploads/2017/10/FactSheet-Wolves-OnLinearFeatures2.pdf> At the Seismic Line Restoration Technical Session held by the Canadian Institute of Forestry on December 1, 2016, Matthew Pyper, in his talk titled “Incentives, frameworks, and a path to habitat restoration in Alberta” cited \$10,000-12,000/km. <https://www.cif-ifc.org/wp-content/uploads/2016/10/Seismic-Line-Restoration-Registration-Announcement-and-Session-Schedule.pdf> And COSIA cites \$8,000-\$17,000/km. <https://www.cosia.ca/sites/default/files/attachments/COSIA-Linear-Feature-Restoration-Caribou-Habitat.pdf>

⁸⁷ Bentham, P, Coupal, B. Habitat restoration as a key conservation lever for woodland caribou: A review of restoration programs and key learnings from Alberta. *Rangifer*. 35, Special Issue 23. 2015.

⁸⁸ Golder Associates. Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia. January 2015. <http://www.bcogris.ca/sites/default/files/bcip-2015-05-restoration-toolkit-28final29-jan-2115.pdf>

⁸⁹ Canada’s Oil Sand Innovation Alliance (COSIA). <https://www.cosia.ca/>

⁹⁰ <https://www.cenovus.com/about/index.html>

⁹¹ <https://www.cosia.ca/initiatives/land/projects/caribou-habitat-restoration> and <http://globalrestorationcorp.ca/projects/algar-restoration/> and <https://www.cenovus.com/responsibility/environment/caribou-habitat-restoration-project.html>

⁹² Silvacom. Proactive Caribou Protection Through Linear Restoration. A White Paper. October, 2015. <https://www.silvacom.com/wp-content/uploads/2016/02/Proactive-Caribou-Protection-Through-Linear-Restoration-White-Paper.pdf>

mounding technique that seems fairly well accepted⁹³ in seismic line restoration in areas with wet soil, 5 people per km are assumed to be necessary to plant trees, cut trees, and run the machine that creates the mounds. We assume that one more person will be needed to run the machine which increases our 4 person team to 5. In this way both functional and habitat restoration are accomplished at the same time. We assume that there is also a program manager who is supervising the different field ‘teams’ and that they can work for a third of the year while the ground is frozen.

Given the assumptions that are laid out above and assuming that there will be 20 five-person teams working for 18 years, 65 percent of the linear disturbances in each of Yates and Bistcho ranges could be restored for an annual cost of a little more than \$24 million per year and a total, undiscounted cost of about \$434 million (see Table 1 below).⁹⁴ Invariably there would have to be draft plans, and project managers, and a host of other costs that have not been taken into consideration here and would be specific to the plan that is implemented. Here we are attempting to estimate the direct money that could flow back into the local communities in terms of wages and salaries as well as diesel fuel purchases, equipment rental, etc... associated with the restoration of the legacy seismic lines. These “boots on the ground” would be a tangible workforce that would have continued employment for just short of twenty years. This, of course, would be seasonal work, but all timber harvest and tree planting is seasonal work in northern Alberta.

Table 1.

Estimated Seismic Line Restoration Costs	
Description	Unit
Cost per km	\$ 10,000
Workers per km	5
# of Teams of Workers	20
Total Workers	100
Seismic Line km (Yates & Bistcho)	43,401
km / Day / 5 Person Team	1
Working Days per Year	121.7
Years for 20 Five-Man Teams	17.8
Total Cost	\$434,011,900
Cost Per Year	\$ 24,333,333

Sources: GoA: Draft Provincial Woodland Caribou Range Plan. BC OGRIS: Testing Functional Restoration of Linear Features within Boreal Caribou Range. COSIA: Linear Feature Restoration Habitat: A summary of current practices and a roadmap for future programs.

To put these potential positive benefits for the local economies and communities around the Yates and Bistcho ranges in context, the NSWAR study presents \$691 million dollars in total proven oil and gas reserves, using today’s technology. In this comparison the total cumulative cost of seismic line restoration for the Yates and Bistcho ranges is about 63 percent of the value of today’s expected cumulative oil and gas recovery.⁹⁵

⁹³ COSIA. Linear Feature Restoration in Caribou Habitat: A summary of current practices and a roadmap for future programs. 12.29.2014. https://www.cosia.ca/sites/default/files/attachments/COSIA_Linear_Feature_Restoration_Caribou_Habitat.pdf And Dabros, A., Pyper, M., Castilla, G. Seismic lines in the boreal and arctic ecosystems of North America: environmental impacts, challenges, and opportunities. *NRC Research Press*. 2018. And Golder Associates. Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia. January 2015. <http://www.bcogris.ca/sites/default/files/bcip-2015-05-restoration-toolkit-28final29-jan-2115.pdf>

⁹⁴ Here we are assuming that the Yates range has a smaller percentage of the land that needs to be restored since Wood Buffalo National Park covers 14 percent of the range. This is a small change since the Bistcho range has a significantly larger amount of legacy seismic lines in terms of total length and density.

⁹⁵ This is really a better metric when comparing oil and gas proven reserves since they will not be extracted in a year. In general we prefer to present the annual impacts of different actions since they are far easier to comprehend. In this case we are not presented with the length of time that it will take to extract the proven reserves so the total value of the seismic restoration is more appropriate.

The obvious point that is being made here is that there are substantial positive socioeconomic impacts associated with restoration of damaged caribou habitat. In addition there are real economic values that the restoration of the seismic lines in the Bistcho and Yates ranges is intended to protect and produce. Even though it is unlikely that there will be any direct negative economic impact to the extractive industries as a result of caribou conservation in the Yates and Bistcho ranges, there is certain to be economic gain stretching almost twenty years into the future from a significant restoration workforce.⁹⁶

It is also important to note that we have not considered the potential positive impacts associated with the non-market values that conserving caribou and the other wildlife related to the caribou and their habitat will protect and enhance.⁹⁷ Those protected caribou ranges will also protect environmental services that flow from the natural landscapes to residents of the region, including to indigenous people in the exercise of their rights. Nor have we considered how the conservation of caribou could support a potential increase in tourism and nature-based recreation. Whether or not parts of the Yates and Bistcho ranges will have a Park designation, the ranges would allow for various tourism-related expenditures for people who would like to visit the ranges as well as recreational opportunities for residents, consistent with caribou recovery.

Although the estimated workforce and related wages and salaries that we present as the result of seismic line restoration are preliminary at best, they show that the restoration can bring some significant positive local economic impacts. Although there has not been one technique that has emerged as the clear choice for restoration of seismic lines so that we could give a more complete view of the positive economic impacts from seismic restoration, it is clear that it could stimulate and diversify the economies of local communities. If the secondary impacts were included in this calculation, which are the ripple effects of the workers and companies who do the seismic line restoration spending their money in the local economy, then the seismic line restoration impacts would dramatically grow. For a region of Alberta that has been dependent on the oil/gas industry and the timber industry which, as we have shown in Section I, has been volatile in the recent past, seismic line restoration could present a solid opportunity for employment for the region for at least the next 15-20 years, just considering the Yates and Bistcho ranges alone. Recent Alberta pilot projects have demonstrated the potential to contract indigenous-owned and operated businesses to provide significant caribou habitat restoration services.⁹⁸ Although it is beyond the scope of this report, the caribou ranges are not the only places that have legacy seismic lines that could be restored. There is potential for a restoration economy to continue long into Alberta's future.

⁹⁶ We do not know how long the restoration will take and have estimated the number of workers that will be necessary. Until finalized range plans come out with restoration plans, our estimates should be viewed as conservative.

⁹⁷ Here we take contingent values to mean a "willingness to pay" for the continued existence of Woodland Caribou in the Yates and Bistcho ranges and the environmental preservation associated with the 65 percent undisturbed habitat. These non-market values are often difficult to quantify but have been shown to be real economic values, the pursuit of which changes households' and businesses' economic choices.

⁹⁸ Eric Auger and Sons, along with Silvacom, have recently completed a seismic line restoration pilot project in the A La Pêche caribou range. <http://www.ericaugerandsons.ca/News.page?ArticleID=69951> And the current RFP for Implementation of caribou habitat restoration in the Cold Lake Caribou Range specifically states that there is: "A plan to incorporate Indigenous communities into the scope of work." FRIAA, Page 8, point 2.6

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