Enabling Solutions for Boreal Caribou Habitat Restoration: A Framework

Prepared for:

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Achieving British Columbia's (BC) goals of stable Boreal Caribou populations and a positive habitat trend across Boreal Caribou ranges will require habitat restoration as a key management lever. For habitat restoration to be applied for caribou recovery, there is a need to move towards coordinated and accelerated habitat restoration programs within priority areas in northeast BC. The BC Oil and Gas Research and Innovation Society (OGRIS) Research Effectiveness Monitoring Board (REMB) commissioned the development of this report to be provided as guidance on a restoration framework to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD). The intent of this report is to provide a common approach to the MFLNRORD, and other agencies to guide restoration planning and implementation in Boreal Caribou ranges under the proposed Boreal Caribou Recovery Implementation Plan (BCRIP).

This habitat restoration framework for Boreal Caribou proposes a planning approach for future restoration programs which will result in coordinated, effective and efficient restoration projects, within selected priority areas based on criteria identified at the landscape and range level scales. Recommendations were generated through the integration of ideas, knowledge and experience gathered at a caribou restoration workshop attended by 60 individuals that represented government regulating agencies, First Nations, industry representatives and subject matter experts. In addition, caribou habitat restoration guidance documents and learnings captured through the BC OGRIS REMB as well as previous learnings from restoration work undertaken by others in BC (e.g., Fort Nelson First Nation [FNFN], Blueberry River First Nation [BRFN] and integration and feedback from neighboring jurisdictions (Alberta) on what has worked well or what they would have changed when developing a restoration framework or approach.

There is currently no legislative requirement to restore caribou habitat specifically. Current regulatory triggers for restoration are provided for provincially regulated projects, federally regulated projects and habitat offsets as a means to address historical human footprint with no existing requirement for reclamation. Opportunities are also explored, including legislation updates to enable restoration on legacy disturbances within caribou ranges.

There is a recognized desire by government agencies, First Nations and stakeholders to develop a framework to strategically guide restoration at the landscape level and achieve coordinated and more holistic results for caribou populations through habitat restoration within northeast BC. Multiple agencies and organizations currently may regulate, influence, fund or may implement habitat restoration projects in BC. To provide a coordinated approach for the allocation of various sources of funds and the timing and location of restoration in priority areas, an organizational structure is proposed that involves a Third Party Integrator (the Caribou Restoration Integrator [CRI]) which is comprised of a Board, a Restoration Planning Steering Committee, and an Operations unit (staff) with clear roles and responsibilities. The CRI brings together key agencies that are responsible for restoration in the future through the CRI. The proposed structure also provides First Nation involvement in habitat restoration through all phases (planning, implementation, monitoring), and decision making around the identification of restoration priority areas. The CRI provides a structure for coordinated restoration to plan long-term five year restoration plans, with inputs from a steering committee to capture First Nation, government agencies and other stakeholders feedback.

The CRI would oversee the planning of restoration, as well as consistent direction and learnings to numerous restoration implementors who could also hold, manage, and distribute funds for restoration work. This would provide advantages such as flexibility of restoration funding over fiscal time lines, flexibility in awarding contracts to promote local capacity building, and the ability to accept funds from a diversity of sources.

A critical stage in habitat restoration planning is selecting priority areas. The identification of key principles and criteria for the selection of priority areas at the landscape, range and site scale are provided, following participant feedback at the workshop, and incorporates targets identified within the proposed BCRIP. In identifying priority areas within the landscape scale of BC's Boreal Caribou ranges, workshop participants identified that priority areas should be selected in a manner that ensures a high likelihood of a positive impact to caribou populations (probability of ecological success), and that if/when selecting one range over another, a conservation assessment of caribou ranges should be completed where ranges with declining caribou populations or at risk of declining due to planned disturbance and that have a viable population are selected. As per the proposed BCRIP, goals are linked to the implementation objective of 'a net decrease in the density of linear features within core areas; leading to a positive habitat trend in each range over time". Within the proposed BCRIP, the measurable target to meet the goal of maintaining a positive habitat trend is having a linear feature density of less than 2 kilometres per square kilometres (km/km^2) in both cores and ranges. Within the context of restoration area prioritization, we propose this target can be used at the landscape scale to compare ranges in terms of understanding the probability of ecological success. If a Boreal Caribou range, and all of the identified core areas, meet the BCRIP target for linear density, it could be deemed *NOT* a restoration priority. For all other ranges where this target is not met, range scale prioritization for restoration should occur. An important consideration is that if this proposed target were to be modified to a lower density target, it should also be shifted over within the context of priority area selection for restoration.

We suggest that in restoration priority area selection at the range scale, that it is appropriate to provide a priority area(s) within each Boreal Caribou range identified at the landscape scale to meet the Province's commitment within the BCRIP to manage caribou by each range. Criteria identified as important for establishing priority restoration areas within each Boreal Caribou range included:

1) Candidate Restoration Areas should have a high use and high value for caribou. These areas can be spatially denoted through the overlap with telemetry/observed caribou locations, including knowledge of habitat use patterns based on Traditional Ecological Knowledge (TEK).

2) Focus on high value caribou habitat areas identified through TEK and oral history.

3) Restoration should focus on increasing the size of core areas or the intact habitat available for caribou within important habitat areas.

4) Areas of high predation risk, or known overlap with predators in historical caribou refuge areas (e.g., peatlands or areas adjacent to peatlands).

5) Area selected for restoration should have a low cost:benefit ratio (cash output/gain in undisturbed habitat).

6) Restoration areas should have a low potential for future industrial and recreational disturbance (low tenure activity and low future disturbance).

To identify priorities within each range, we used Criteria 1) and 2) to spatially map focus areas, referred to here as Candidate Restoration Areas. The first within-range required criterion is that the restoration area should currently be identified as high use by caribou, or important seasonally for life requisites (e.g., calving). Both scientific and TEK should be used to inform that areas currently being used by caribou or areas that are adjacent to current high use areas that were historically important to caribou. The Provincial proposed, revised Boreal Caribou core areas capture the existing caribou location data obtained through telemetry, as well as known important habitats such as calving areas. Traditional Ecological Knowledge is also important for identifying important areas such as rutting

areas. To spatially denote the first criterion of high use, high value caribou areas, we suggest that the Provincial revised core areas can be adjusted by overlapping TEK and culturally important areas that may have been missed with telemetry or are challenging to identify. For habitat restoration priority selection, the revised spatial boundary for each core would become a 'Candidate Restoration Area' to be further evaluated through the remaining criteria. Although TEK may be a data gap at this time to determine the spatial boundaries of the Candidate Restoration Areas, we note that First Nations have already identified candidate areas for protection/restoration or important cultural areas for caribou.

Once Candidate Restoration Areas are spatially mapped within each range, we recommend that the areas are evaluated, or weighted based on three themes as identified at the workshop and that combine the other range scale criteria. Where:

1) Size (area); where bigger is better in terms of increasing the amount of intact habitat available for caribou with a lower predation risk and within important habitat areas;

2) Linear density is closer to meeting the proposed Provincial target for core areas of less than 2 km/km^2 as this relates to predation factor as well as considers Gain In Undisturbed Habitat by Cost; and

3) A low potential for future footprint to keep Candidate Restoration Areas as intact as possible.

We caution that if the linear density target changes under the final BCRIP, the priorities would also need to be evaluated based on the final target and that the current target may be too high for Candidate Restoration Areas.

At the site level, and within selected priority Candidate Restoration Areas, it is recognized that more detailed spatial data will be required to accurately assess the site level considerations to determine if a site is a restoration candidate for treatment. We summarize how restoration treatments are selected at the site level based on previous programs and studies, as well as the site level considerations.

Indicators of Success are provided as guidance on how to successfully monitor habitat restoration outcomes for both compliance and effectiveness monitoring. An important role of the CRI would be not only tracking restoration locations but also to house monitoring data collected on restoration treatments to test effectiveness. It is highlighted that monitoring restoration projects needs to not only evaluate whether trees are growing within treated sites, but monitoring should capture if habitat restoration is resulting in predator movements (speed, spatial overlap) which are similar to the linear disturbances surrounding forest, as well as the overlapping influence of other recovery levers (e.g., predator and prey management levers, protective maternity pens) on the caribou population. To achieve validation monitoring, which links if restoration programs are providing habitat that can support self-sustaining caribou populations, the expectation is that the Province of BC is conducting regular caribou population monitoring.

Lastly, recommended next steps for MFLNRORD are provided as this restoration framework guidance is not modelled off another framework and as such is conceptual and untested. Landscape and range scale restoration planning with priority areas has not been addressed by another jurisdiction in Canada, and is complex and involves several legislative, cultural, economic, social, logistical and biological considerations. Further, many government agencies, industrial proponents, and First Nations have a stake in caribou habitat restoration. Before this framework is implemented, it should be reviewed by First Nations, and BC Government officials and agencies that will be associated with restoration permits, requirements or management. The review could provide valuable insight and thought on how best to strategically plan and implement habitat restoration.

Acknowledgements

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The information contained in this document is based on knowledge generously provided by many individuals who participated in a Boreal Caribou Habitat Restoration Framework Workshop hosted by the BC OGRIS in partnership with the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) in Fort St John, BC on April 17, 2018. Presenters, attendees and facilitators shared their experience, knowledge, lessons learned and considerations on restoration objectives for Boreal Caribou, as well as how to plan and implement habitat restoration. We are grateful for the contribution from all those that attended and the knowledge that was shared (Appendix A).

We would like to express our sincerest thanks to Dr. Steve Wilson, who provided instrumental feedback in drafts of this report to support the culmination of many perspectives and ideas into recommendations. We would also like to acknowledge Melanie Dickie of the Alberta Biodiversity Monitoring Institute for feedback on report drafts and for support of background and workshop materials. Meghan Watters and Paula Bentham of Golder Associates (Golder) prepared draft versions of this document, with a final report prepared by Paula Bentham. Susanna Lin (Golder) developed the figures.

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This report is intended for boreal caribou habitat restoration planning on linear disturbances created by oil and gas development; reclamation or restoration for mining and the forest sector is beyond the current scope of the framework. Recommendations made within this report, are a combination of workshop participant feedback, personal communications following the workshop as well as the consultant's perspective on recommendations for the development of a restoration framework. Recommendations made within this report have not undergone consultation with First Nations, land-users or stakeholders nor has a socio-economic assessment (including traditional land use) been completed. Prior to implementation of the recommendations provided, it will be necessary for the Government of British Columbia to understand the economic trade-offs inherent in decisions concerning measures to address caribou conservation. It is anticipated that the ideas and recommendations shared in this document will be modified or manipulated to support restoration planning. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Golder accepts no responsibility for damages, if any suffered, by any third party as a result of decisions made or actions based on this report.

1.0 INTRODUCTION

The Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population in Canada (Environment Canada 2012) stresses landscape-level planning and recommends planning development activities at appropriate temporal and spatial scales to achieve a minimum of 65% undisturbed habitat in each Boreal Caribou range. One of the management approaches in the federal recovery strategy to address the effects of habitat alteration on Boreal Caribou is to undertake coordinated actions to restore Boreal Caribou habitat. This approach has been carried through to the British Columbia (BC) Draft Boreal Caribou Recovery Implementation Plan (BCRIP; BC Ministry of Environment and Ministry of Forest, Lands, and Natural Resource Operations (BC MOE and MFLRNO) 2017), which identifies the recovery actions that are deemed necessary in BC to stabilize and achieve self-sustaining populations in all Boreal Caribou herds and to maintain a positive habitat trend across the existing Boreal Caribou ranges in BC (BCMOE and MFLRNO) 2017). A minimum of 728 Boreal Caribou currently reside in northeast BC within 16 core habitat areas recognized among five ranges of the Calendar, Chinchaga, Maxhamish, Snake-Sahtaneh, and Westside Fort Nelson (BC MOE and MFLRNO 2017).

A handful of habitat restoration projects have been completed or are ongoing in BC Boreal Caribou ranges. To date, most caribou habitat restoration has either been driven by voluntary efforts (e.g. implemented by First Nations in their traditional territory) or has been required by industry regulators for new development projects. Caribou habitat restoration is relatively new, with some of the first efforts in Canada occurring in Alberta in the early-2000s. Restoration projects initially tended to be small (e.g. restoration of a single linear feature for a localized experimental treatment or a pilot project area) to investigate restoration practices on legacy seismic lines with minimal coordination to restore large tracts of habitat. More recent projects have expanded in scale to cover a larger portion of a caribou range including the Canada's Oil Sands Innovation Alliance (COSIA) Algar Project, Cenovus LiDea 1 and LiDea II, and the BC Oil and Gas Research and Innovation Society (OGRIS) Parker Pilot Restoration Program. For a summary of historic habitat restoration initiatives refer to Golder Associates Ltd. (2012) and Pyper et al. (2014).

Through work commissioned by the BC OGRIS Research and Effectiveness Monitoring Board (REMB) there are several documents available to guide landscape level restoration planning and project-level restoration in BC Boreal Caribou ranges. The Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia provides project-level best practices for implementing Boreal Caribou habitat restoration (Golder Associates Ltd. 2015). To support the restoration toolkit, the Boreal Caribou Habitat Restoration Monitoring Framework guides how to measure the success of both a restoration project and a restoration program (landscape scale) with short and long-term metrics and targets (Golder Associates Ltd. 2016). To help range level planning and determine the amount of restoration required to achieve a desired caribou density, a model of the effects of restoring linear features on caribou density was developed (Serrouya et al. 2017). The Parker Pilot Restoration Program Plan was also commissioned to apply and test habitat restoration techniques over an entire Boreal Caribou range in Canada. The multi-year program included a detailed disturbance inventory, decision support framework for site-specific restoration treatments, a restoration Program Plan, and one year of implementation with a focus on local capacity building through an Aboriginal inclusion procurement plan (Golder Associates Ltd. 2016a, 2017).

These efforts are inputs into the caribou habitat restoration planning toolbox; however, a strategic landscape-level planning tool is lacking in BC, which can help guide where to focus restoration between Boreal Caribou ranges, and within ranges. There is a recognized desire by government, First Nations and stakeholders to develop a framework to strategically guide restoration at the landscape level and achieve coordinated and more holistic results for caribou populations through habitat restoration efforts.

2.0 RESTORATION FRAMEWORK OBJECTIVE

With habitat restoration identified as a key management lever for caribou recovery, there is a need to move towards coordinated and accelerated habitat restoration programs within priority areas in northeast BC. The BC OGRIS REMB commissioned the development of this report to be provided to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD).

This caribou habitat restoration framework (hereafter, restoration framework) is intended to provide a common approach to the MFLNRORD, and other agencies to guide restoration planning and implementation in Boreal Caribou ranges under the BCRIP (Figure 1). The objective is to provide a framework for caribou habitat restoration that results in coordinated, effective and efficient restoration projects, including understanding the legislative triggers for restoration, identifying criteria for selecting priority areas for restoration treatment, as well as to provide an organizational structure that supports engagement, restoration planning, implementation, tracking and monitoring. Our intent is to recommend a possible approach for restoration planning and implementation that incorporates past learnings from BC and other jurisdictions, and actively involves First Nations through collaboration and the incorporation of Traditional Ecological Knowledge (TEK).

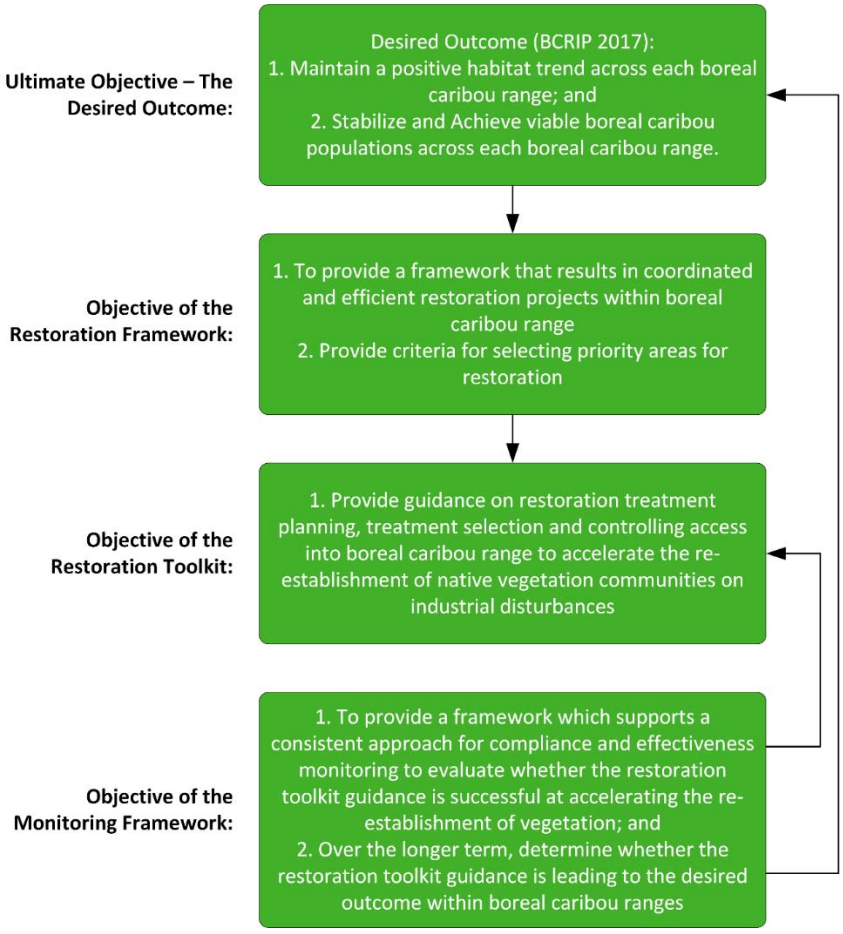


Figure 1: Objective of the BC Boreal Caribou Habitat Restoration Framework and Linkages with Existing Guidance Documents for Restoration

2.1 Methodology

Recommendations within this restoration framework report have been generated through the integration of:

- ideas and knowledge shared and captured through discussions at an April 2018 workshop;
- caribou habitat restoration guidance documents prepared through the BC OGRIS REMB as well as previous learnings from restoration work undertaken by the REMB and others in BC (e.g., Fort Nelson First Nation [FNFN], Blueberry River First Nation [BRFN]) on past projects); and
- integration and feedback from neighboring jurisdictions (Alberta) on what has worked well or what they would have changed when developing a restoration framework or approach.

To provide recommendations into a restoration framework that captured the knowledge of a range of individuals, a one-day caribou habitat restoration workshop was held in Fort St. John on April 17, 2018. The workshop was attended by 60 individuals that represented government regulating agencies, First Nations, stakeholders, and subject matter experts. The goal of the one-day workshop was for participants to develop key principals and criteria to guide habitat restoration planning and implementation. Workshop participants were by invite only so that there was representation from First Nation communities and various stakeholder and regulator points of view. A workshop backgrounder report and agenda were provided to invited participants prior to the workshop (Appendix A). A workshop summary was prepared for participants, including a summary of presentations delivered during the plenary session, and breakout group discussions. Appendix B provides a workshop summary report.

First Nation views presented in this report are from what was shared at the workshop by First Nations, by their consultants or from previously presented reports (Leech et al. 2016a, FNFN 2017). As such, this report is not a comprehensive review of First Nations views in northeastern BC.

This restoration framework attempts to capture multiple perspectives to provide recommendations on an approach to restoration planning and implementation in boreal caribou ranges in BC. This restoration framework guidance is provided under the following key considerations for MFLNRORD.

1) Clarity around the goals and desired outcome of habitat restoration programs.
2) Considerations for revised legislation, regulation or policy to trigger, require and support restoration programs.
3) A proposed governance and implementation structure that will support strategic level habitat restoration planning, including guidance on how various government agencies, First Nations and stakeholders can collaborate in restoration planning and consideration of a third-party restoration integrator approach to shift from planning to implementation.
4) Identification of key principles and criteria for the selection of priority areas at the landscape, range and site scale.
5) Summarize how restoration treatments are selected at the site level based on previous programs and studies.
6) Indicators of Success: Provide guidance on how to successfully monitor restoration outcomes.
7) Recommended next steps for MFLNRORD.

3.0 GOAL AND DESIRED OUTCOMES

Habitat restoration is identified within the proposed BCRIP as a requirement to help achieve the population and habitat goals, which guide the implementation recovery plan for Boreal Caribou in the province through (1) maintaining a positive habitat trend across each Boreal Caribou range, and (2) stabilize and achieve viable populations across each boreal caribou range (BC MOE and MFLNRO 2017). Restoration is therefore considered a key mechanism for meeting the goal of reducing disturbance as measured by reducing linear feature density (BC MOE and MFLNRO 2017). The Province has proposed using a target linear feature density of 2 km/km^2 applied in both cores and ranges to manage caribou habitat (BC MOE and MFLNRO 2017). Boreal Caribou living in areas with higher densities of linear features and other human disturbances have reduced recruitment (Environment Canada 2011), higher probabilities of being predated (Apps et al. 2013) and overall have lower population growth rates (Sorensen et al. 2018). Linear feature density has been linked to stable or increasing Boreal Caribou populations, (but has been suggested to occur at a much lower density target Boutin and Arienti 2008, Antoniuk 2006) as per Wilson unpublished 2017 as referenced within BC MOE and MFLNRO 2017).

Desired outcomes for caribou habitat restoration may vary by interest groups. However, the following is a list of desired outcomes of habitat restoration that were identified during the 2018 workshop:

- habitat restoration is for caribou populations to be capable of sustaining a First Nation hunter harvest;
- improved caribou population status;
- to achieve regulatory requirements and certainty;
- restoration area selection, restoration treatment selection and implementation should involve local communities;
- habitat-based actions within areas identified as important for caribou that improve Boreal Caribou habitat by reducing the benefits predators and their primary prey gain through linear corridor use and to establish or maintain a vegetation trajectory on disturbances that will, in the long-term increase habitat intactness;
- address caribou limiting factors to ultimately (i) increase the amount of intact habitat, and (ii) in the long-term (10–20 years) achieve stable to increasing caribou populations for herds that are currently declining or stabilized by short-term management actions, such as predator control and maternity pens;
- restoration should be coordinated into focused areas where efforts achieve larger tracts of intact caribou habitat, which is protected or managed from future disturbance.

Although there are some divergences in habitat restoration desired outcomes by interest group, there are also shared outcomes. For the purposes of this document, it should be clarified that habitat restoration alone may not lead to Boreal Caribou population recovery. As such, for the purposes of this document, we focus on the desired outcome, or objective of “Habitat-based actions within predetermined priority areas that improve Boreal Caribou habitat by reducing the benefits predators and their primary prey gain through linear corridor use and to establish or maintain a vegetation trajectory on disturbances that will, in the long-term increase Boreal Caribou habitat intactness”.

To meet the objective, there are two types of restoration that may be considered, ecological and functional.

Functional Restoration: consists of habitat management action(s) intended to slow or deter predator movement in caribou habitat (Figure 2).

Ecological Restoration: habitat management action(s) that are intended to restore habitat to a pre-disturbance state (Wilson 2015, DeMars and Benesh 2016), such as a habitat structure that supports pre-disturbance predator-prey densities and ecological interactions (Figure 3).

Figure 2: Functional Restoration
Examples of stem bending on seismic lines, a type of functional restoration treatment.

Figure 3: Ecological Restoration
On the left an excavator is used to dig holes and place the soil beside the hole creating an elevated mound. Elevated mounds create an elevated microsite that increases soil temperature and improves growing conditions for natural regeneration and planted seedlings. Mounds can also help create an access barrier for human travel and may impede predator movement on lines. On the right, an example of mounding within a peatland. Seedlings are planted on mounds to enhance survival and growth of seedlings and to promote natural regrowth of vegetation over time, as higher, drier spots are created that seeds can settle into and germinate. Mounds can also be used in dry stands or upland sites to improve moisture availability (pooling of water in mound holes) and to address seedling competition from undesirable plant species such as grasses.

4.0 Legislation and Opportunities

There is considerable uncertainty and gaps around triggers for caribou habitat restoration in BC as there is currently no legislative requirement to restore caribou habitat specifically. Below we summarize current regulatory triggers for restoration for provincially regulated projects, federally regulated projects and habitat offsets as a means to address historical human footprint with no existing requirement for reclamation. Opportunities are also explored, including legislation updates to enable restoration on legacy disturbances within caribou ranges.

Provincially Regulated Activities

The Province of BC prepares implementation plans to meet its commitments to manage and/or recover species at risk under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada-British Columbia Agreement on Species at Risk*. At a provincial level, wildlife habitat is protected through various statutes, regulations and policy, notably in Parks and Protected Areas, and designated areas such as Wildlife Habitat Areas (WHAs) and Ungulate Winter Ranges (UWRs) established under both the *Forest and Range Practices Act* (FRPA) and the *Oil and Gas Activities Act* (OGAA). General Wildlife Measures (Refer to Appendix C, Table C-1) regulate timber harvesting activities for designations under FRPA. For example, a GWM may place temporal restriction on timber harvesting and silvicultural activities to avoid disturbing wildlife during sensitive time periods. Parallel designations under OGAA can restrict oil and gas activities that have a "material adverse effect" on wildlife for which the UWRs and WHAs were established.

In BC, oil and gas proponents currently have to meet requirements of the BC Oil and Gas Activities Act (OGAA; Sections 40 to 43) and their OGAA permit. The OGAA and its associated regulations specify the requirements that must be followed in applying for and conducting oil and gas activities. The following provides the current link between OGAA and caribou habitat restoration.

- The BC Oil and Gas Commission is the single window regulatory agency with responsibilities for regulating oil and gas activities in BC, including exploration, development, pipeline transportation and reclamation. The Commission's core services include reviewing and assessing applications for industry activity, consulting with First Nations, cooperating with partner agencies, and ensuring industry complies with provincial legislation and all regulatory requirements.
- The OGC is to consider government's environmental objectives for the management of oil and gas activities within caribou ranges as per the proposed BCRIP (2017). In addition, the OGC must consider government's environmental objectives for Boreal Caribou when regulating oil and gas activities within designated Boreal Caribou UWRs and WHAs, as stipulated in the Environmental Protection and Management Regulation (EPMR) under the OGAA.
- Section 19 of the EPMR contains an Operator Requirement, which is a legal requirement for all OGAA permit holders, for "Areas to be Restored", whereby oil and gas operators must restore operating areas as soon as practicable. This restoration is not necessarily restoration of caribou habitat, and only covers new footprint area and not legacy disturbances.
- Authorizations are reviewed using the Interim Operating Practices for Oil and Gas Activities in Identified Boreal Caribou Habitat in British Columbia (IOPs) as identified within the Environmental Protection and Management Guideline (EPMG) to meet the requirements of the EPMR. The IOPs are intended to standardize the management of oil and gas activities to manage the size and mitigating the effects to Boreal Caribou and their habitat from industrial activity. These IOPs are a guideline only. Implementing habitat

restoration treatments is identified within the IOPs as “permanently decommission infrastructure to a state of functional habitat restoration as soon as practical” and “implement interim reclamation program.”

- The IOPs were transmitted to the OGC by the Ministry of Environment (MOE) as operational guidance to be followed for all oil and gas activities within identified Boreal Caribou habitat. For activity in identified Boreal Caribou habitat, the OGC currently considers adherence with the IOPs as a satisfactory requirement for mitigation planning. If a proposed activity does not adhere to the IOPs, the OGC requires a separate mitigation plan, developed by a qualified professional, which outlines how the material adverse effect criteria under Section 6 of the EPMR will be met. The mitigation plan is required to contain additional activities to mitigate, which may include habitat restoration, when there will be residual effects to identified values, including wildlife habitat (as a material adverse effect). Restoration commitments become legally binding as an enforceable condition under an authorized OGC permit if identified within the mitigation plan.
- Reclamation of well pads post-abandonment is under the Certificate of Reclamation (CoR) process. CoR’s are not mandatory but are a voluntary process under which companies can absolve themselves of future commitments by completing the two-part process. The CoR process does not reflect habitat requisites, and often involves regeneration to a vegetative stage that differs to natural succession trajectories and the native, surrounding vegetation. Additional restoration work on reclaimed well pads may be necessary to restore the site to vegetation similar to the pre-disturbance and to remove the disturbance footprint from caribou habitat.

For oil and gas activities occurring within Boreal Caribou habitat where restoration is a requirement of a permit, or where a company volunteers to complete the CoR process, no additional regulatory authorization is required to conduct caribou habitat restoration activities within permitted project footprints.

Within active tenure areas, responsibility for restoration is often on the tenure holder; however, this limits restoration in two ways. First, proponents have no authority to restore habitat outside their tenure, even when restoration may be more effective for caribou outside their tenure. For example, a core habitat area that overlaps a culturally important area that is outside of a tenure. Additionally, if a third-party restoration implementor (e.g., First Nation) restores habitat within an active tenure the restoration efforts may not have considered future planned footprint, may be removed by the tenure holder, and are not protected from future development.

Federally Regulated Projects

Federally regulated pipeline projects authorized through the National Energy Board (NEB) have in recent years had to restore caribou habitat on Right-of-Way (ROW) as well as offset impacts to caribou habitat through habitat restoration off-ROW. As part of the Environmental and Socio-Economic Impact Assessment, the NEB requires applicants to identify impacts of the proposed project to any SARA listed species and their habitat, as well as all feasible measures to eliminate impacts to the species. In the absence of provincially provided habitat restoration frameworks or structure, in recent years the NEB has been requiring proponents to prepare a Caribou Habitat Restoration Plan (CHRP; on ROW) and a Caribou Habitat Restoration and Offsets Measures Monitoring Plan (CHROMMP; Off ROW). However, there are no guidelines for these documents, including how much habitat should be restored as an offset (offset ratio), where restoration should occur, and measurable targets by which to evaluate and monitor restoration. These off ROW restoration activities also have to be permitted by provincial regulators, and it might not always be clear how, or where, to implement requirements for habitat offsets under authorization conditions.

Current Authorization for Restoration on Legacy Disturbance

Currently, there is no clear regulatory authorization process for implementing habitat restoration on legacy disturbance where a habitat offset approval condition has been identified, or how to direct restoration activities into priority areas. Habitat offsets are generally focused on treating legacy anthropogenic footprint that does not have a responsible proponent already identified to reclaim it. However, this requires access to crown land.

At present, the authorization process used for the Parker Pilot Program Plan (Golder 2016a) can be followed by a proponent for treating those disturbances that do not fall under an active disposition. Through the Parker Pilot Program Plan, only legacy disturbance features were treated that were not associated with an active permit or disposition issued through the OGC to authorize or require restoration activities. Although the legacy disturbance was largely from oil and gas exploration activities, authorization was not required under the OGAA where there was no active disposition or authorization to tie a proponent to complete restoration (L. Helmer, pers. comm., 2015). Through a review of legislation, as well as through discussions with staff from the OGC, the MOE and the MFLNRORD, restoration treatments on legacy disturbance footprint that are not linked to an existing permit of another Ministry or the OGC; a restoration consultant/contractor/or implementor can obtain authorization for the restoration activities through the MFLNRORD under the FRPA. The restoration treatments, and associated obligation to the treatment activities, can be provided as as-builts by the contractor to MFLNRORD to be spatially tracked as a silvicultural opening. Identification of a 'licensee' who carries out the ground activities must be provided. Authorization is considered necessary on a yearly basis specific to the area of restoration treatment. Authorization timeline must account for First Nations consultation led by MFLNRORD. The First Nations consultation and referral process is led by MFLNRORD and completed according to the respective consultation process agreements (e.g., Crown Land Management Agreement, Treaty 8 Economic Benefits Agreement) (J. Hudson, pers. comm. 2015). If there is a desire to place a level of protection on restored footprints, then a Special Use Permit under the Land Act through MFLNRO could be pursued (L. D'Aloia, pers. comm., 2015). For non-Land Act authorized activities, a permit or authorization process has not been determined.

4.1.1 Opportunities

4.1.1.1 Reviewing and Adjusting OGAA and Associated Regulations

For Petroleum and Natural Gas Projects (PNG), government is currently in the process of reviewing the OGAA and considering adjustments to the OGAA and associated regulations and guidelines to enable restoration activity on legacy disturbances as well as for triggering restoration from any new permit applications occurring within Boreal Caribou range (S. Wagner, pers. comm. 2018). The OGC is looking at ways to be transparent and upfront with proponents on the process for applications within caribou range as well as the requirements for new footprint in caribou range. This will provide certainty for proponents on what the requirements will be around caribou habitat and restoration for obtaining any new permits. For example, the OGC could approve a new permit application but tie the approval to restoration of legacy disturbance footprint (i.e., require a habitat offset to achieve a net decrease in the density of linear features within core areas by applying a habitat offset for future development impacts; MOE and FLNRO 2017). The OGC recognizes that there is a need for a tracking process as well as enforceable actions around restoration tied to the permit authorization (S. Wagner, pers. comm. 2018).

In addition to the OGAA review, the OGC is reviewing the EPMR and EPMG to update standards and outcomes that define success for restoration work to add clarity to PNG proponents (S. Wagner, pers. comm. 2018).

The BC government, through the OGC, may implement additional requirements to those outlined by the OGAA for new projects in Boreal Caribou habitat as part of the proposed BC BCRIP. For example, the proposed BCRIP

proposes an offset of 4:1 for future linear developments in core caribou habitat (BC MOE and MFLNRO 2017). This offset expectation received feedback during the workshop; as a starting place to address legacy disturbance footprints, but there was identification that higher, or lower, offsets have been suggested. Having an understanding of where to focus offset restoration efforts is critical, as well as having a clear authorization process to proceed with restoration outside of a proponent's tenure or lease area or off ROW.

Recommendation: The legislation surrounding restoration and reclamation requirements in caribou habitat, needs to be reviewed to 1) provide clear guidelines and instructions to minimize future development footprint and to trigger habitat restoration requirements, and 2) ensure restoration work is monitored and evaluated using clear targets (this review is currently underway).

4.1.1.2 Requirements to Maintain Tenure

In some cases, a change in legislation could reduce the amount of habitat disturbance and the associated need for restoration. During the workshop, it was noted that proponents are required to disturb habitat to keep an active status on tenures. Permits require activities at regular intervals, which can result in tenure holders disturbing habitat even when they would prefer not too. Or, simply to meet tenure requirements, disturbance may occur prior to completed detailed project design and footprint optimization planning, which can be used to greatly minimize habitat loss. Therefore, tenures should provide flexibility for activities that result in reduced habitat intactness to be deferred to avoid unnecessary habitat disturbance. Unintended consequences were also discussed at the workshop, and consideration of tenure 'rent' to balance the unintended consequence of holding tenure and not doing anything was suggested.

4.1.1.3 Land Use Management

Some of the uncertainty surrounding security of habitat restoration can be eliminated with long-term resource extraction planning and land use management; including regional access plans and timber harvest planning. Long-term (e.g., 10 years) resource extraction/development plans allow for more coordinated habitat planning, which captures both economic and environmental certainty. For example, in other restoration planning projects, redundant roads have been identified within caribou ranges based on past authorization processes (Quintette Range, Little Smoky Range). In addition, decadal planning of timber harvest, provides certainty of where harvest will be by decade, which in turn allows for better spatial planning of when linear and polygon restoration can be used to turn off the legacy disturbance over time from legacy seismic lines (Chand and Duffy pers. comm. 2018). Although it is recognized that timber harvest may not be as overlapping with Boreal Caribou ranges in northeastern BC as other areas, timber harvest does contribute to early seral habitats for alternative prey, particularly adjacent to, or within caribou ranges. In Alberta, timber harvesting is being used as a tool by overlapping planned cutblocks with legacy seismic lines and planting the entire cutblock, including the seismic line (G. Duffy pers. comm. 2018). Habitat restoration can be planned outside of areas that are planned for timber harvest (G. Duffy pers. comm. 2018), or more appropriate to Northeastern BC, to habitats which surround identified caribou core areas.

Whether Petroleum and Natural Gas, road building or timber harvest planning, understanding long-term land use plans is important when coordinating habitat restoration efforts as well as identifying restoration candidate sites. Ideally, restoration projects are planned within areas where habitat restoration efforts will be maintained and contribute to Boreal Caribou habitat in the long term.

Recommendation: No current requirement in BC to develop tenure plans or forest harvest plans. May be of limited overlap in Boreal Caribou core areas; however, recommended to build forestry plans into the broader

habitat goal and targets as this is a critical land use to consider since caribou ranges are still part of their timber supply. Forestry future plans needs to be included into selection of and planning of restoration priority areas.

Recommendation: Requirements from applicable regulatory agencies regarding authorizations that are required for land access, or for restoration activities, prior to conducting restoration activities on legacy disturbance footprints are still preliminary and should be confirmed and transparent (underway).

Recommendation: During the 2018 workshop, discussion around value of the WHAs and UWRs identified that GWMs could be revised to increase the value of these areas to caribou through increasing the industrial restrictions.

5.0 A Coordinated and Strategic Approach

Multiple agencies and organizations currently regulate, influence, fund or may implement habitat restoration projects in BC (Figure 4). As restoration is applied within Boreal Caribou range, these projects will not be coordinated within priority or focused areas without a coordinated approach (Figure 4). In addition to the need for a coordinated approach, is a recognized lack of active First Nation participation and incorporation of TEK throughout the entire restoration planning process. Rather, programs to date have focused around scientific considerations and past program results (e.g., Golder 2016a).

Habitat restoration has occurred, or will occur, through the initiative of First Nations or other organizations, as well as through mandated offset or mitigation requirements associated with an industrial permit. First Nations and organizations can seek funding for caribou habitat restoration from the Habitat Stewardship Program (HSP), Aboriginal Fund for Species at Risk (AFSAR), Fish and Wildlife Compensation Program (FWCP), Habitat Conservation Trust Fund (HCTF), and other sources (e.g. private donations). It is anticipated that in the future, multiple funding agencies and implementors will be involved in habitat restoration programs. The challenge will be how to coordinate these efforts to meet the goal of the proposed BCRIP.

To provide a coordinated approach for the allocation of various sources of funds and the timing and location of restoration in Boreal Caribou range, a restoration structure is proposed that involves a Third Party Integrator with a Board, a Restoration Planning Steering Committee, and an Operations unit (staff) with clear roles and responsibilities (Figure 5). The purpose of the Third Party Integrator and Restoration Planning Steering Committee would be to support coordinated restoration efforts within BC Boreal Caribou ranges with inclusion of First Nations throughout the entire restoration program phases. Figure 5 shows a simplified diagram of the proposed structure, with resultant habitat restoration ‘areas’ in coordinated areas.

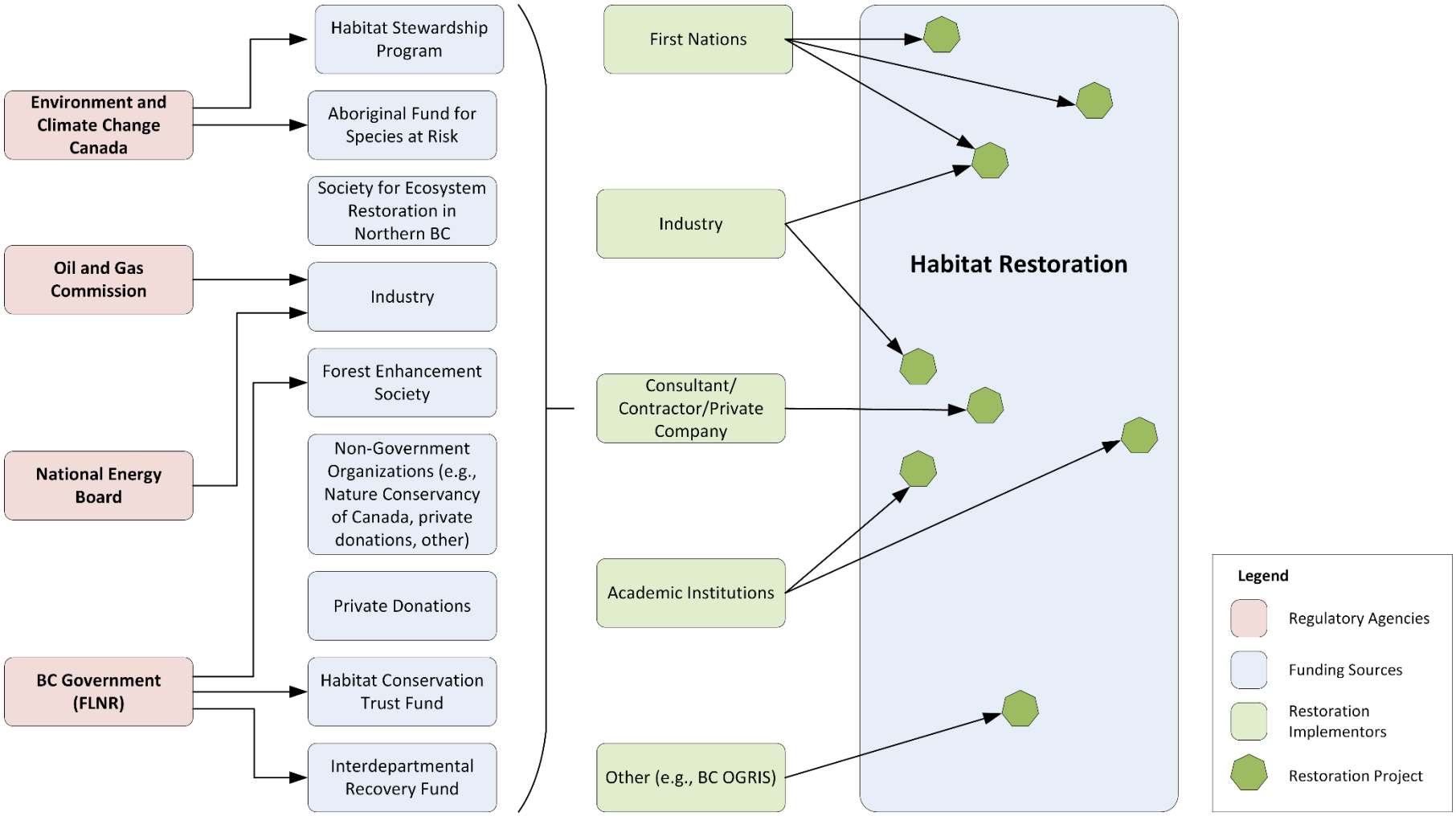


Figure 4: Current Uncoordinated Approach; the Agencies and Organizations that may Regulate, Influence, or Fund Caribou Habitat Restoration Projects in British Columbia

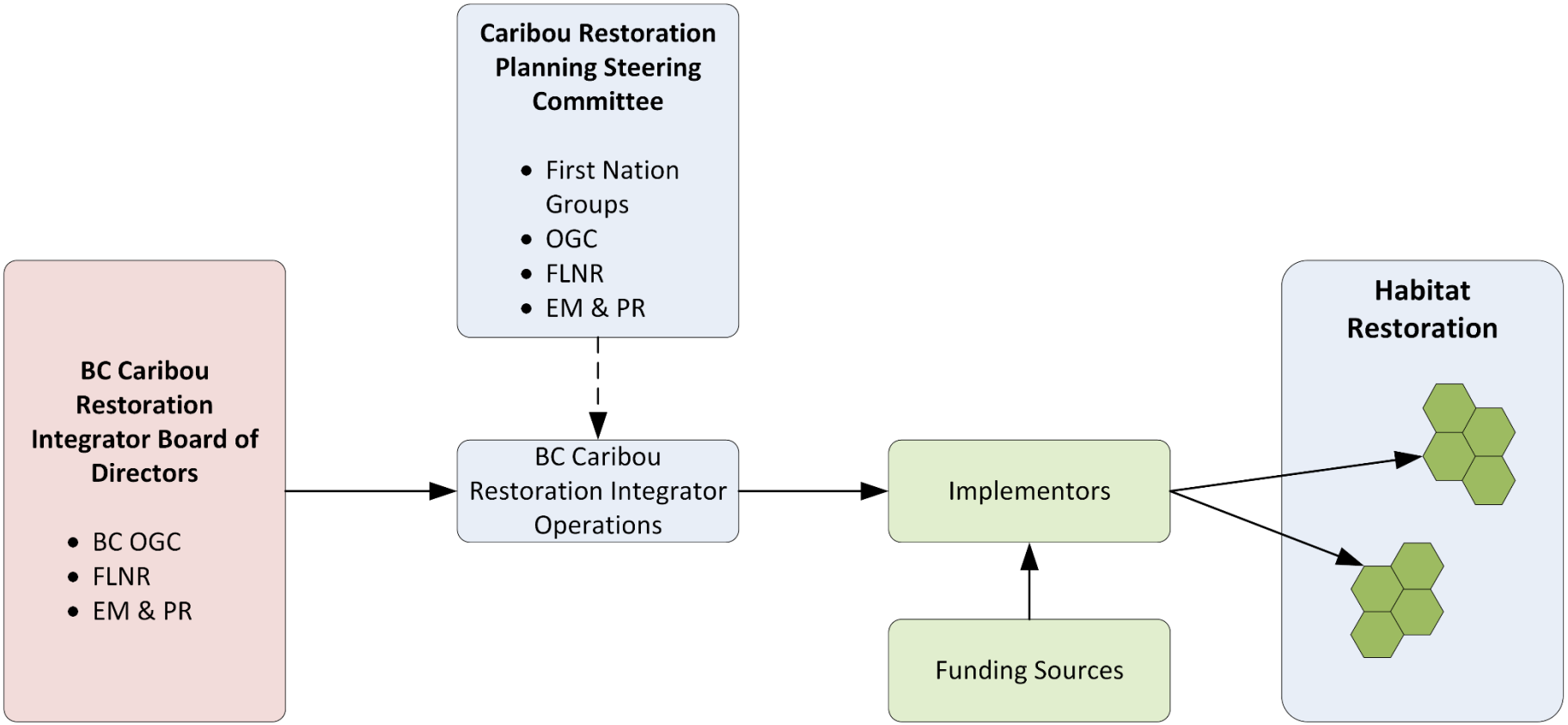


Figure 5: Proposed Organization Chart for the BC Caribou Restoration Integrator

5.1 Proposed Caribou Restoration Integrator

To ensure caribou habitat restoration follows a coordinated approach, using a BC Caribou Restoration Integrator (CRI) structure is recommended to capture critical oversight and advisor feedback during the preparation of long-term (e.g., 5 or 10 year) and annual restoration operational plans (Figure 5). This structure has been developed to incorporate workshop feedback from various agency regulators, First Nations and stakeholders on where and how coordinated implementation of restoration will be implemented. The focus of the CRI would be to implement a coordinated approach to caribou habitat restoration in BC and better planning around priority area identification, restoration planning within priority areas, direction on restoration practices to implementors, and linkages to a consistent monitoring framework to adaptively manage or revise site-level restoration practices. Below is a brief summary of how restoration programs would be planned, delivered, have oversight and advisory roles captured, and monitored to understand progress under the CRI.

5.1.1 Caribou Restoration Integrator Board of Directors

While there are many players that influence caribou habitat restoration (Figure 4), most of these can be traced upstream to 3 key agencies. The CRI would have a Board, with Governance to be a partnership of the key agencies that regulate and trigger caribou habitat restoration: BC government (MFLNRORD, Energy Mines & Petroleum Resources [EM&PR]), and the OGC. Given that the BC Government is responsible for implementing the proposed BCRIP, the provincial agencies that manage activities that occur within the land base for the Province need to govern the delivery of restoration within Boreal Caribou ranges. In addition, it is recommended that the Board could also have Indigenous and public appointments rather than just being restricted to agencies. The Bylaws would define nomination and appointment procedures, as well as provide direction that the Board would be ultimately responsible for management and financial control of the CRI, including the hiring of an executive director and staff to do the heavy lifting on planning. It is envisioned that the CRI would be established as a not-for-profit society, with by-laws outlining the oversight activities of the Board. The CRI Board would provide final sign-off on 5-year restoration plans so that the goal of the proposed BCRIP is being met. These 5-year restoration plans would be developed through a CRI Operations team, managed by the executive director. The executive director would report to the Board.

5.1.2 Caribou Restoration Planning Steering Committee

In addition to a Board to provide oversight, there will be a need to capture First Nation feedback as well as stakeholder feedback into the restoration planning, implementation, monitoring and feedback loops, which would be delivered through the CRI. To capture inputs the CRI operations team would prepare and deliver draft 5-year and annual restoration plans to a steering committee, which is established to provide an advisory role to the Boreal Caribou restoration program. The Steering committee would provide direction and input to key deliverables including annual and 5-year restoration plans. This steering committee would represent First Nations and BC agency representatives who would be responsible for consulting their client groups. For example, the OGC would be responsible for sharing concerns, opportunities and learnings that come through Petroleum and Natural Gas proponents. A First Nation representative from each Nation with traditional territory in Boreal Caribou range would be invited to have a position on the Steering Committee.

5.1.3 Caribou Restoration Integrator Operations

Restoration projects occur over long temporal scales, taking several years to plan and implement, particularly when seed sources need to be established or where several implementors and sources of funding may become involved within a complex and busy landscape. Completing a restoration project within one fiscal year is

challenging or, alternatively, securing funds beyond year 1 for multi-year projects is also a challenge. The concept of the CRI to deliver restoration on the ground, working in parallel with Government as the responsible authority for caribou recovery is not a new one (Chand and Duffy pers. comm. 2018). The Third Party Integrator approach has been identified as a viable option in Alberta based on experience from restoration work led, planned, and implemented by the Province of Alberta. Alberta has since established through the Caribou Habitat Recovery Program (CHRP), an agreement with the Forest Resource Improvement Association of Alberta (FRIAA), as a Third-Party Integrator to support habitat restoration (Chand and Duffy pers. comm. 2018). The FRIAA has issued their first request for proposals to both plan restoration within the Cold Lake Caribou Range, as well as to deliver the implementation of that restoration; with funds provided by the Province.

The CRI would be comprised of an operations team with staff whose primary role is to develop and prepare draft and final 5-year and annual restoration plans to deliver a restoration program within NE BC Boreal Caribou ranges. The CRI would prepare restoration plans and support restoration implementors as they complete the day-to-day contracting and implementation on the ground. The CRI would also be accountable to plan restoration, review implementors operational restoration plans, track restoration, maintain a database from restoration monitoring, complete monitoring data analyses to understand outcomes and make adjustments based on learnings, monitor outcomes, and in some cases may manage and distribute RFPs for restoration implementation or manage the use of funds through contractual agreements with implementors for restoration. The CRI Operations Team could also be responsible for coordinating with adjacent provincial and territorial governments for habitat restoration planning. This is particularly important for the Chinchaga, Calendar, and Maxhamish herds, which have ranges that cross provincial/territorial borders and require coordinated, inter-provincial/territorial management. The CRI would report to the Board through an Executive Director, would be responsible for seeking inputs and advice from the Caribou Restoration Planning Steering Committee, but ultimately would be an agency responsible for the hiring and day-to-day management of the CRI.

Benefits of using the CRI include more flexibility in contracts as they can be spread out over fiscal periods (as opposed to Government contracts) and be more flexible to building local capacity (i.e., more flexibility on contracting with an approach of local and indigenous businesses using an Aboriginal Inclusion Plan). Another important benefit of using the CRI is they can apply for funds from non-governmental organizations (e.g., grants) and accept financial payment as an in-lieu offsets (if implemented in BC) for restoration from industry. In addition to these ephemeral sources of funding it will be important that the CRI receive a secure and consistent source of funding (e.g., from the Province or through a levy) to maintain regular staff and delivery or restoration programs. Ideally, with a coordinated approach to identify and prioritize areas to restore, multiple sources of funding (e.g., federal, provincial, industry, grant funding sources), and multiple contractors/groups as integrators, are working together to plan, deliver and maintain large scale restoration programs.

As Figure 5 depicts, although the implementors are reporting back to the CRI, they are also responsible for obtaining the authorization to conduct restoration activities on the ground and reporting to the agencies that issued the permits to conduct habitat restoration. This is where consultation and engagement remains the responsibility of government agencies or the OGC.

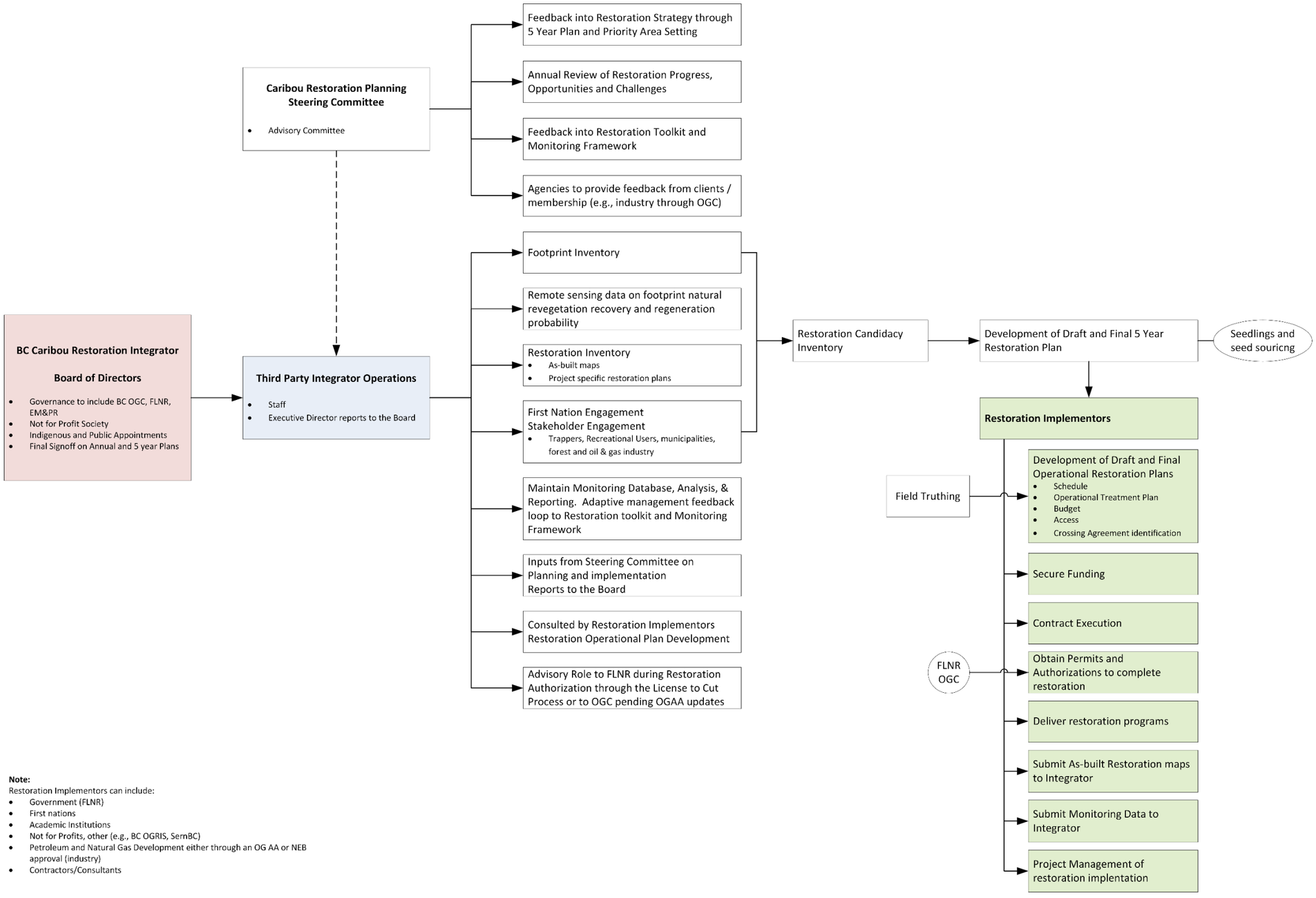
Note: It may be possible that the CRI for caribou restoration is delivered through an existing non-governmental organization such as the Society for Ecosystem Restoration in Northern BC (SERNbc), BC OGRIS or the HCTF. These third parties were not explicitly explored under this scope of work although may differ in their make-up model, may be a good starting place for establishing the Operational component to the CRI. Neither of these organizations currently have staff that deliver projects, so there would be necessary changes.

Funding Considerations

The CRI, including the Board, the CRI Operations as well as the Steering Committee will need to have a long term and stable funding source to cover administration costs, developing the restoration plans, footprint tracking, managing the restoration/footprint/monitoring data and completing the monitoring analyses.

There are two options for how restoration funding would flow for the CRI to deliver on habitat restoration implementation. Funding to deliver restoration on the ground is expected to come from various sources, to a number of implementors. The most simplistic model would be for the CRI Operations to be contacted by implementors who have secured funding, with the CRI Operations providing direction on where to restore. For example, an industrial proponent is required to implement restoration as an offset for a new project. The proponent contacts the CRI Operations to determine where the restoration should be implemented and what plans are available for the restoration. The CRI would provide an area (or a couple of options) and treatment plan to the Proponent that would meet the required offset. The Proponent then issues contracts to deliver, pay for and manage the work. This provides proponents an opportunity to have flexibility and creativity on managing implementation costs as well as the ability to procure local businesses and Aboriginally owned businesses.

However, an alternative funding model would be that the CRI could accept funding at the Board level or at the Operations level. This assumes that the CRI is accepting money and contracting out the work. In the alternative funding model, the CRI could accept in-lieu payment as a financial offset, if enabled by regulation or policy, based on the hectares of residual disturbance to be offset. They would issue an RFP based on a treatment plan, and manage a contract with an Implementor.



Note:
Restoration Implementors can include:
- Government (FLNR)
- First nations
- Academic Institutions
- Not for Profits, other (e.g., BC OGRIS, SernBC)
- Petroleum and Natural Gas Development either through an OG AA or NEB approval (industry)
- Contractors/Consultants

Figure 6: Workflow Diagram of the Proposed BC Caribou Restoration Integrator Representing how Information, Oversite and Decision Making would Flow during the Planning and Implementation of Restoration within Boreal Caribou Ranges

6.0 Criteria for Establishing Priority Restoration Zones

A critical stage in habitat restoration planning is selecting priority areas. A Provincial restoration framework should address not only a coordinated approach and structure that provides inputs into planning and restoration techniques from First Nations, agencies, and stakeholders but should also provide guidance to agencies and various restoration implementors on where the highest priority areas are to focus habitat restoration.

The process to select an area for restoration considers a combination of ecological, regulatory, land use, cultural and logistical criteria. The following matrix summarizes criteria that have been previously identified to select areas *within a caribou range* for restoration. Few programs have considered how to set priorities *between ranges*. Criteria used have included modelling to compare projected change in caribou and predator populations expected following restoration (ALT 2009, FNFN 2017), or focusing on a herd in greatest decline.

ECOLOGICAL

- Core Habitat Areas[1] / High Value Caribou Habitat[2]
- Calving habitat[2,3,4]
- Caribou locations, high use areas[2,3]
- Predators location/numbers and overlap with caribou[3] (biologically meaningful area such as a wolf pack territory area[4])
- Seismic density[5]
- Mortality event locations
- Existing Natural Vegetation Recovery ("Leave for Natural")
- Large area to create intact habitat patches

LOGISTICAL

- Footprint inventory and natural reveg recovery
- High cost (mounding/seedlings $12,000/km)[4]
- Accessibility, ground conditions
- Available seed source and seedlings (Timeline)
- Available sites (polygonal and linear disturbances not under active disposition, designated trails, and not falling under existing reclamation requirements)
- Predicted natural recovery (fine scale attributes; vegetation height/cover, wetness, nutrients, distance to road, forest stand)[3,7,9,10]
- Stakeholder engagement

REGULATORY / LAND USE / DISTURBANCE

- Current level of disturbance
- % Gain-in-Undisturbed habitat[2,3,5]
- Protected Areas[2]
- Low Economic Value Resource Areas[3,5]
- Provincially-designated land with potential for less future disturbance (WHA, UWR, Parks, OGMA)[2] (with noted exceptions, not protection), 7
- Resource Review Areas[3]
- Outside Fire Areas < 40 years[3,5,7]
- Disturbance under Active Dispositions on Crown Land 'No Treatment', consider reclamation requirements[3,7]
- Outside future harvest management plan areas[2,3,7]
- Outside mountain pine beetle current distribution and susceptibility ranking[7]
- Limited future development potential[3,5,7]
- Limited stakeholder conflicts[7]
- Type of disturbance (seismic, LIS, pipeline)[3]

CULTURAL

- Protection and Restoration Zones[2]
- Oral history[6]; high value caribou habitat
- TEK (knowledge holders, previous studies, studies) [important caribou environmental features, critical areas, observations, kills]
- Spring calving habitat [muskeg, bog, fen, treed fen with access to water to avoid predators]
- Winter foraging areas (fine resolution forage potential in winter based TEK.[6]
- Fall rutting habitat (< calving and late winter)[6]
- Ecological restoration on linear in calving and winter habitat, include measures to restore lichen loads[6]
- Critical Cultural Interest Areas[6]
- Important caribou habitat may be located outside of provincial and federal defined caribou range boundaries based on TEK[2,6]
- Avoidance of, or mitigating impacts from treatments to, archaeological sites or high potential sites[3,7]

1 BC Government spatial boreal ranges and cores; and revised
2 FNFN 2017
3 REMB Parker Pilot Restoration (Golder 2016a)
4 Demars and Benesh 2016
5 ABMI 2016
6 Leech et al. 2016
7 Golder 2017a
9 van Rensen et al. 2015
10 Government of Alberta 2017

It was an objective of the restoration workshop to capture the First Nations and cultural perspectives and feedback on criteria to use to determine priority restoration areas. The following criteria were noted by First Nation representatives or their consultants, who attended the restoration workshop. It should be stressed that this list of criteria has not been derived from engagement or consultation by all First Nations with traditional territory within Boreal caribou ranges;

- high value Boreal Caribou habitat;
- building on habitat areas that are still intact;
- consideration of overlap of high value Boreal Caribou habitat (caribou locations) with high-cultural value areas;
- identification of protection and restoration zones within Boreal Caribou ranges with a focus of first restoring areas within protection zones, followed by restoration zones;
- focusing on blocking key access points into important Boreal Caribou habitats;
- areas with high density of linear disturbance; and
- supporting coordinated efforts in restoration implementation.

For this restoration framework, criteria were used to identify and prioritize areas for restoration at the landscape scale (i.e., all of northeast BC Boreal Caribou ranges), range scale, and site scale (Figure 7). Criteria from the matrix were discussed by the workshop participants. Criteria were placed within the landscape, range, and site scales based on the workshop feedback, with a link back to the goals of the proposed BCRIP (2017) and with cross reference to available First Nation reports, which have captured cultural feedback. Criteria that were identified the most frequently or noted as having a higher weight than other criteria at the workshop, have been weighted as such in the following priority setting exercise (Table 1). Most of the discussion at the workshop was ‘within range’ criteria. To support the landscape scale, the consultant referred to the proposed BCRIP (draft 2017), to align habitat restoration in Boreal Caribou ranges with the desired outcome of the implementation plan.

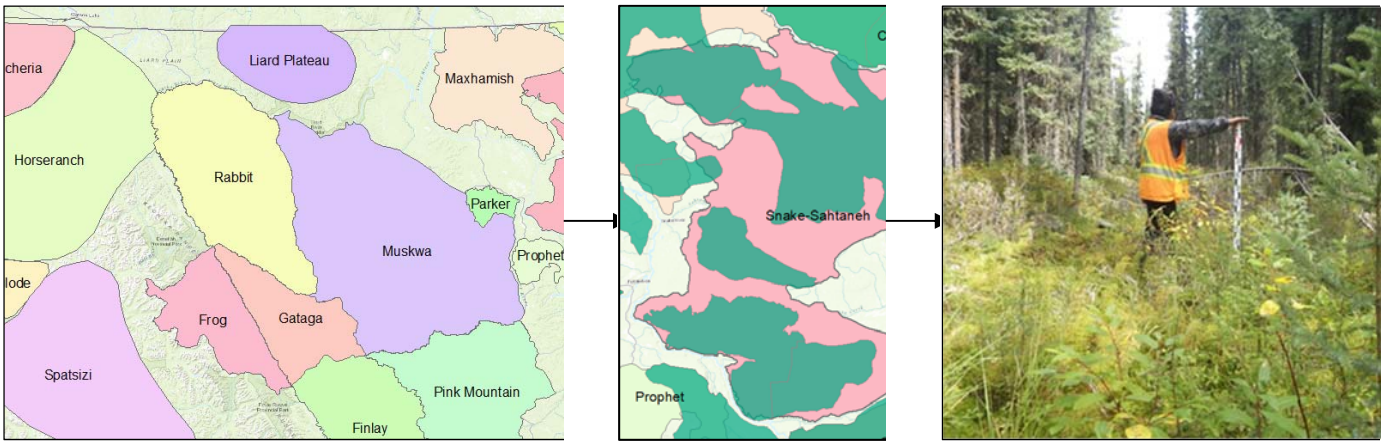


Figure 7: Scales for Boreal Caribou Habitat Restoration Planning

Green polygons at range level are areas for protection and restoration identified by FNFN (FNFN 2017) to represent one criteria which can be used at the range scale.

Table 1: Criteria to Select Areas for Caribou Habitat Restoration at the Landscape, Range, and Site Scale

Scale	Criteria	Source of Data for Weighting Criteria
Landscape Scale (All Ranges in NE BC) – Between Ranges	1) High likelihood of a positive impact to caribou populations (probability of ecological success) 2) Conservation assessment of caribou ranges; ranges where caribou populations are declining (λ<1) or at risk of declining due to planned disturbance and have a viable population. As per the proposed BCRIP, this is all Boreal Caribou ranges in BC Ranges within NE British Columbia that do not meet the proposed BCRIP target for seismic density for both the range and for each core within the range, as a measure of habitat impact on the caribou population within that range carry through to the range scale for Restoration Candidate Area identification***note that if the density target changes under the final BCRIP, the priorities would also need to be evaluated based on the final target	1) Following the BCRIP, seismic density can be used to measure likelihood of positive impact. If density is < 2.0 km/km^2 in the range and all core areas, a range is considered to have met the proposed BCRIP goal. *For NE BC, that would include the Calendar Range at 0.99 km/km^2 [(a)], as well as a stable population trend*[(b)]
Range Scale	1) High use and high value caribou areas (overlap with telemetry/observed caribou locations, including knowledge of habitat use patterns based on TEK or telemetry data) 2) High value caribou habitat areas identified through TEK and oral history 3) Restoration should focus on increasing the size of core areas or the intact habitat available for caribou within important habitat areas 4) Areas of high predation risk, or known overlap with predators in historical caribou refuge areas (e.g., peatlands or areas adjacent to peatlands 5) Linear density provides a low cost:high benefit ratio; for Candidate Restoration Areas; compare cost:benefit ratio between candidates. Candidate Restoration Areas with a linear density closer to the target density will result in a lower cost and timeline to restore, and will have a higher priority as they are more likely to meet the target. 6) Restoration areas should have a low potential future industrial and recreational disturbance (low tenure activity and future disturbance). **Additional Considerations** 1) Amount of current intact habitat around the Candidate Restoration Area. For example, areas that lack linear and polygonal disturbances, and permanent disturbance features surrounding a Candidate Restoration Area is preferred. Condition of the area such as fire, natural disturbances, anthropogenic disturbances. Consider other land user commitments such as Provincial Recreational designated trails. 2) Another restoration project completed or planned 3) Coordinated access management has been developed or is underway 4) Area is accessible	1) Provincially mapped core areas (revised). These areas capture high use caribou areas based on telemetry and calving habitat areas. 2) TEK and oral history identifying high value caribou habitat areas and culturally important areas (add these areas spatially to the Provincially mapped core areas. Data gap within this report)[(c)] 3) Data Gap, but can use linear density CORES + TEK/Culturally IMPORTANT AREAS (Refer to these as Candidate Restoration Areas) Rank Candidate Restoration Areas based on 3 criteria: 1) Size (Area) 2) Non permanent linear density. Where Candidate Restoration Area is < 2 km/km^2, it would not be a priority for restoration. Candidate Restoration Areas that can reach the target faster, are weighted over those areas where more effort/time/cash output would be required to meet the target 3) Proportion overlap with landuse designations that predict a lower potential future footprint (RRAs [or revised RRAs that will capture subsurface tenure], WHA, UWR, Parks, Protected Areas)

Table 1: Criteria to Select Areas for Caribou Habitat Restoration at the Landscape, Range, and Site Scale

Scale	Criteria	Source of Data for Weighting Criteria
Site	1) Focus treatments on disturbance features where natural vegetation recovery is not occurring, with the treatment focused on the site-specific limiting factor 2) Site has a high probability that it will not regenerate naturally without intervention (but requires access control) 3) Site is available for treatment (i.e., not under active disposition or provincial designation [e.g., designated recreational trail]) and not a permanent disturbance feature (e.g., roads) 4) If the restoration treatment involves planting, available seed or seedling sources 5) Area is accessible to implement restoration treatments **Additional Considerations** 1) Additional habitat disturbance is not required to implement treatments 2) Mitigation to minimize environmental impact of treatments, such as archaeological resources, watercourse crossings, minimal impact on other species in decline etc.	1) and 2) collection and interpretation of detailed site level desktop data on limiting factors, collected through a combination of remote sensing and ground-truthed data. Focus on the Priority Candidate Restoration Areas 3) Pull out all disturbances within Candidate Restoration Area that are not available for treatment

(a) Data sources used by Golder to calculate cutline density included: Digital Road Atlas (Data BC, Subset Queried for 'trails'), CanVec Cutlines (Source: Geogratis), GEO 02-06 Seismic Lines (Source Data BC), GEO 96-04 Seismic Lines (Source: Data BC), OG Geophysical Lines (Source: Data BC). Linear features within 20 m of each other were integrated into one single linear feature to reduce the potential for double-counting.

(b) BC Ministry of Environment and Ministry of Forest Lands and Natural Resource Operations. 2017. Boreal Caribou Recovery Implementation Plan. https://engage.gov.bc.ca/app/uploads/sites/121/2017/03/Draft-Boreal-Caribou-Recovery-Implementation-Plan-2017-2.pdf.

(c) Important caribou areas identified through TEK, or as Culturally Important Areas that overlap Provincial 'revised' core areas have not been captured. This is an important data gap to address prior to finalizing priority Candidate Restoration Area boundaries.

6.1 Landscape Scale

The overall criteria for consideration in identifying priority areas within the landscape scale of BC's Boreal Caribou ranges identified during the workshop is that **restoration should have a high likelihood of a positive impact to caribou populations**. Embedded within these criteria, we have summarized considerations from the proposed BCRIP (2017) as well as from the workshop discussions if/when selecting one Boreal Caribou range over another for determining where to focus habitat restoration priority areas:

- Focus on areas where there are caribou (telemetry and observation data, including TEK).
- Focus on ranges where caribou are in decline (as noted in Culling and Cichowski 2017), and where there is a viable population that is capable of recovery and will benefit from habitat restoration (i.e., avoid small populations at risk of extirpation from a single catastrophic event or with low genetic and Allee effects (Allee 1931, McLellan et al. 2010, Serrouya et al. 2015).
- There should be a probability of ecological success.
- Focus on a self-sustaining population to account for time-lag of habitat restoration.
- A caribou range within which multiple recovery levers are being implemented should be a focus; as the probability of achieving a self-sustaining caribou population is increased 50% or more when at least two or three recovery management actions are used together (e.g., predator control in conjunction with habitat restoration; Sutherland et al. 2016). If caribou are unlikely to survive the time required for enough habitat to be restored and for vegetation to be tall enough to be effective, short-term management actions will be necessary to sustain caribou (Schneider et al. 2010, Boutin et al. 2012). For example, ecological restoration can be combined with predator control, alternate prey management, maternity pens, or functional restoration to boost populations (Boutin and Merrill 2016).
- Focus on herds that can withstand climate and vegetation shifts that may occur with climate change *(Note from the authors; this feedback was provided during the workshop in the context of BC caribou across the Province, not just Boreal Caribou ranges in northeast BC. Scope of this work is Boreal Caribou only. In the context of boreal ranges only, it is unclear if notable differences in the effects from climate change would be experienced from one range to the next).*

The proposed BCRIP (BC MOE and MFLNRO 2017) generalized population and habitat goals are developed to guide recovery implementation efforts within the Province and include "Maintain a positive habitat trend across each Boreal Caribou range, and; Stabilize and achieve self-sustaining populations across each Boreal Caribou range". These goals are linked to the implementation objective of 'a net decrease in the density of linear features within core areas; leading to a positive habitat trend in each range over time". Within the proposed BCRIP (2017; Table 2), the measurable target to meet the goal of maintaining a positive habitat trend in each Boreal Caribou range is having a linear feature density of less than 2 kilometres per square kilometres (km/km^2) in both cores and ranges. Section 5.5.1 of the proposed BCRIP provides the rationale for this target and link to stable or increasing caribou populations (e.g., Boutin and Arienti 2008; Antoniuk 2006; Wilson unpublished as presented within Appendix G of MOE and MFLNRO 2017).

Within the context of restoration area prioritization, this target can be used at both the landscape scale to compare ranges in terms of understanding the probability of ecological success. If a Boreal Caribou range, and all of the

identified core areas, meet the BCRIP target for linear density, it could be deemed *NOT* a restoration priority. For all other ranges where this target is not met, range scale prioritization for restoration should occur.

The intent by the Province within the proposed BCRIP is for the linear feature density target to be applied to entire ranges; to ensure that linear features are not concentrated in a boreal caribou core, with the linear feature density in neither the cores nor the ranges should exceed 2 km/km^2. An important consideration is that if this proposed target were to be modified to a lower density target, it should also be shifted over within the context of priority area selection for restoration.

6.2 Range Scale

The Province has made a commitment to manage caribou by each Boreal Caribou range (BC MOE and MFLNRO 2017) with habitat disturbance evaluated for each range. Subsequently, it is appropriate to provide a priority area(s) for habitat restoration within each range identified at the landscape scale.

Consistent criteria identified as important for establishing priority restoration areas within each Boreal Caribou range include:

1) Candidate Restoration Areas should have a high use and high value for caribou. These areas can be spatially denoted through the overlap with telemetry/observed caribou locations, including knowledge of habitat use patterns based on TEK.

2) Focus on high value caribou habitat areas identified through TEK and oral history.

3) Restoration should focus on increasing the size of core areas or the intact habitat available for caribou within important habitat areas.

4) Areas of high predation risk, or known overlap with predators in historical caribou refuge areas (e.g., peatlands or areas adjacent to peatlands).

5) Area selected for restoration should have a low cost:benefit ratio (cash output/gain in undisturbed habitat).

6) Restoration areas should have a low potential for future industrial and recreational disturbance (low tenure activity and low future disturbance).

To identify priorities within each range, we used Criteria 1) and 2) to spatially map focus areas, referred to here as Candidate Restoration Areas. The first within-range required criterion is that the restoration area should currently be identified as high use by caribou, or important seasonally for life requisites (e.g., calving). Both scientific and TEK should be used to inform that areas currently being used by caribou or areas that are adjacent to current high use areas that were historically important to caribou. The Provincial proposed, revised Boreal Caribou core areas capture the existing caribou location data obtained through telemetry, as well as known important habitats such as calving areas. Traditional Ecological Knowledge is also important for identifying important areas such as rutting areas. To spatially denote the first criterion of high use, high value caribou areas, the Provincial revised core areas can be adjusted by overlapping TEK and culturally important areas that may have been missed with telemetry or are challenging to identify. For habitat restoration priority selection, the revised spatial boundary for each core would become a ‘Candidate Restoration Area’ to be further evaluated through the remaining criteria.

It may be a data gap to capture all TEK to determine the spatial boundaries of the Candidate Restoration Areas. However, Fort Nelson First Nation (FNFN 2017) and Blueberry River First Nation (BRFN) have already identified candidate areas for restoration or important cultural areas for caribou. It would be a good starting place for the

Province and FNFN and BRFN (and other Nations who have identified important caribou areas) to work together to combine the known TEK important areas with the revised Boreal Caribou core areas for the purpose of setting Candidate Restoration Areas.

Once Candidate Restoration Areas are spatially mapped within each range, we recommend that the areas are evaluated, or weighted based on three themes as identified at the workshop and that combine the other range scale criteria. Where:

1) Size (area); where bigger is better in terms of increasing the amount of intact habitat available for caribou with a lower predation risk and within important habitat areas;

2) Linear density is closer to meeting the proposed Provincial target for core areas of less than 2 km/km^2 as this relates to predation factor as well as considers Gain In Undisturbed Habitat by Cost; and

3) A low potential for future footprint to keep Candidate Restoration Areas as intact as possible

The forth within-range criterion identified is that priority restoration areas should have high predation risk or known overlap with predators in historical caribou refuge areas (e.g., peatlands or areas adjacent to peatlands). This criterion supports the goal of limiting the predation factor for caribou. Although accurately quantifying predation risk is difficult as it requires population and location data on wolves and bears, or the cause of caribou mortality, linear features do create predation risk in caribou refuge areas (DeMars and Boutin 2017). Linear feature density can be used as a proxy for predation risk (Nellemann and Cameron 1998, James and Stuart-Smith 2000, Whittington et al. 2005, but see Mumma and Gillingham 2016). The spatial data to accurately calculate linear feature density is currently being refined in BC, which will improve existing linear feature density calculations (e.g., BC OGRIS 2018). For denoting priority Candidate Restoration Areas, we suggest that an evaluation of how close each Candidate Restoration Area is to the proposed target of less than 2 km/km^2 linear density would capture the feedback to limit the predation factor on caribou. However, there is evidence that the proposed linear density may have to be much lower and over large areas to reduce predation pressure (Dickie pers. comm. 2018).

Linear density has also been used previously to capture the relative gain in from restoration to undisturbed habitat over the effort/time to implement and cost (ABMI 2016). The fifth within-range required criterion is that the area selected for restoration have a low cost but high benefit ratio (Kellner et al. 2017). Since Candidate Restoration Areas will have been selected within high benefit areas for caribou, then those areas that are larger, and can more quickly be restored to meet the density target, should be a priority. This would mean that Candidate Restoration Areas that achieve the linear feature density target for the least resources or over a shorter time period should be prioritized to be the most efficient with restoration funds.

From both the workshop participant feedback, as well as from past restoration program learnings, the sixth within range criterion is to focus in areas where there is a low potential for future footprint as a means to focus where intact habitat is more likely to be maintained in the future, as well as to provide some level of confidence that habitat restoration treatments will be in place over long time periods . Essentially this is selecting areas with a lower potential conflict with multiple land users occurring within or surrounding Candidate Restoration Areas. To achieve this, Candidate Restoration Areas should overlap as much as possible with:

- protection or conservation areas (e.g. parks);
- areas under land use designations that minimize future habitat disturbance including UWR and WHA’s; and

- areas with a predicted lower future footprint (Resource Review Areas, or revised RRAs that capture areas not currently under subsurface tenure).

The intent is to achieve a larger area of intact habitat with a lower predation risk rather than smaller patches of intact habitat dispersed among disturbance features. This also minimizes conflicts with land users. For example, cores with a higher proportion of overlap with Parks and Protected Areas, RRA's (corresponding with lower overlap with PNR tenures), WHAs and UWRs, where future oil and gas and forestry disturbance is expected to be lower would be of higher value than Candidate Restoration Areas. In addition, some of the uncertainty surrounding security of habitat restoration can be eliminated with long-term resource extraction planning and land use management, including long-term forest harvest plans and access planning. For example, where forestry is a land use within a caribou range this would be a low priority area for restoration as surrounding harvest will reduce the value of the restoration efforts. A higher priority would be to plan habitat restoration outside of areas that are designated for timber harvest within long term planning horizons.

In addition to required criteria for selecting priority Restoration Candidate Areas, there were additional criteria that could be considered. This includes a qualitative consideration of the amount of intact habitat around the Candidate Restoration Area. For example, areas that lack linear and polygonal disturbances, and permanent disturbance features surrounding a Candidate Restoration Area would provide more secure habitat adjacent to a restoration area. Condition of the area such as fire, natural disturbances, anthropogenic disturbances and other land user commitments such as Provincial Recreational designated trails or trapper access.

Other considerations should include whether another restoration project is completed or planned that can be built off of; and areas in ranges that have some form of coordinated road access management with the multiple land users (e.g., coordinated access management in the Fort St. John Pilot Project, Regimbald and Smith 2017). Many restoration programs to-date have been challenged with redundant roads or access/trails, and provided the redundant roads cannot but deactivated and restored, the high road density eliminates potential areas for restoration, and in some cases create an area where restoration of available sites will have little influence on the overall habitat intactness of the area (e.g., Golder 2018b and Chand and Duffy, pers. comm. 2018). Coordinated Access Plans are considered a critical step in the development of restoration programs in other jurisdictions (Chand and Duffy pers. comm. 2018).

Candidate Restoration Areas selected for restoration will need to be accessible. Implementing restoration treatments will be logistically easier with good accessibility during the season where treatments are planned. Major rivers, streams and hydrology layers are used to identify boundaries of restoration areas where limits to access are created.

6.2.1 Preliminary Landscape and Range Scale Weighting of Candidate Restoration Areas

Following the criteria outlined in Section 6.2, priority Candidate Restoration Areas within ranges should be large, able to provide habitat intactness measured by achieving a less than 2 km/km^2 linear density following restoration, and have a low potential for future human footprint.

BC has committed within the proposed BCRIP to recover caribou populations in all ranges. Therefore, at least one Candidate Restoration Area should be selected from each range where the core areas and range area do not meet the less than 2 km/km^2 linear density target (landscape scale selection; Table 2). To compare Candidate Restoration Areas, a score for each area among all the ranges considered can be calculated as:

$$[(\text{area}) / (\text{cutline density} - 2\ \text{km/km}^2) \times (\text{proportional overlap})]$$

Where:

- *area is the size (hectares or km^2) of the Candidate Restoration Area*
- *cutline density is the linear density (km/km^2) within the Candidate Restoration Area subtracted by the proposed linear density target*
- *proportional overlap is the proportional overlap of the Candidate Restoration Area with Parks and Protected Areas, UWR, WHA, and RRA land use designations*

Where a Candidate Restoration Area meets the linear density target of less than or equal to 2 km/km^2, it is given a score of zero (0). A Restoration Value score for each Candidate Restoration Area is then calculated as:

$$(\text{Candidate Restoration Area score}) / (\text{maximum score among ranges}) \times 100$$

The Restoration Value provides a normalized score value of 0 to 100, with values closest to 100 indicating the most preferred Candidate Restoration Area (values of zero are not considered as candidates; the proposed restoration area meets the linear density target).

We used available data on range attributes to test whether the priority setting of criteria described in Sections 6.1 through 6.2 would work spatially within northeastern BC. There is a disclaimer with this exercise in terms of the data that were available for this preliminary test and existing data gaps. Data used for the Candidate Restoration Areas is based on the spatial boundary of revised Boreal Caribou range cores and does not account for TEK of high use or important caribou areas. Data gaps exist based on the linear disturbance data used in this exercise, where available government data sources were used in the calculation of linear density, which could change depending on the data available. Also, there has been no First Nation engagement for feedback into the prioritization process, or to the results of this test in process.

Table 2: Landscape Scale Boreal Caribou Ranges Cutline Density

Current Range (2010)			Linear Features[(a)]
Range	Area (km^2)	Length (km)	Cutline Density (km/km^2)
Maxhamish	7,769.45	22,439	2.89
Chinchaga	13,897.50	35,218	2.53
Snake-Sahtaneh	12,293.67	42,082	3.42
Westside Fort Nelson	8,658.29	18,124	2.09
Calendar	5,409.01	5,365	0.99

[(a)] Data sources used by Golder to calculate cutline density included: Digital Road Atlas (Data BC, Subset Queried for 'trails'), CanVec Cutlines (Source: Geogratis), GEO 02-06 Seismic Lines (Source Data BC), GEO 96-04 Seismic Lines (Source: Data BC), OG Geophysical Lines (Source: Data BC). Linear features within 20 m of each other were integrated into one single linear feature to reduce the potential for double-counting.

Following the proposed BCRIP, seismic density can be used to measure likelihood of positive impact. If density is less than 2.0 km/km^2 in the range and all core areas, the range will not carry a priority Restoration Candidate Area. For northeast BC, this approach would exclude the Calendar Range at 0.99 km/km^2 (Table 2).

The ranges of Maxhamish, Chinchaga, Snake-Sahtaneh and Westside Fort Nelson are recommended to each have a priority Candidate Restoration Area selected. Using the Restoration Value formula for the revised core areas as the spatial extent of the Candidate Restoration Areas, preliminary priority Candidate Restoration Areas can be determined (Table 3). This achieves priorities of the Milligan Core within the Chinchaga Range, (note, a culturally important area within the Milligan Core has previously been identified by BRFN), the Capot-Blanc Core in the Maxhamish Range, the Clarke Core within the Snake-Sahtaneh Range and the Prophet Core within the Westside Fort Nelson (WSFN) Range. Again, this is only a preliminary test to determine if the criteria identified at the landscape and range scales can be used to evaluate spatial priority areas for restoration. As noted, these areas need to be evaluated fully by MFLNORD with consultation with First Nations, which may adjust the spatial extent of the priority, the number of priorities, or the priority itself.

Table 3: Preliminary Priority Candidate Restoration Areas in Northeastern Boreal Caribou Ranges

Range	Core Name	Core Size (km^2)	Cutline Density (km/km^2)	Proportion of Core Intersecting Low Potential Future Footprint	Score	Restoration Value	Priority Candidate Restoration Area
Calendar	Calendar	4,308	1.12	0.9958	0	0	
Chinchaga	Chinchaga North	2,198	1.59	0.6095	0	0	
Chinchaga	Etthithun	1,195	1.79	0.9998	0	0	
Chinchaga	Milligan	5,196	3.73	0.9999	3,006	100	1
Maxhamish	Capot-Blanc	876	2.46	0.6583	1,264	42	1
Maxhamish	Fortune	2,300	1.95	0.6577	0	0	
Maxhamish	Kiwigana	1,301	3.35	0.9284	892	30	2
Snake-Sahtahneh	Clarke	2,339	4.81	0.9139	761	25	1
Snake-Sahtahneh	Etsho	60	1.62	0.9963	0	0	
Snake-Sahtahneh	Kotcho	1,795	1.86	0.8443	0	0	
Snake-Sahtahneh	Paradise	403	0.32	0.5448	0	0	
Snake-Sahtahneh	Shush Creek	282	6.90	0.2925	17	1	3
Snake-Sahtahneh	Tsea	689	6.18	0.3519	58	2	2
WSFN	Fort Nelson	537	1.75	0.9962	0	0	
WSFN	Parker	752	1.69	0.6761	0	0	
WSFN	Prophet	1,403	2.90	0.3520	548	18	1

6.3 Site Level

Site level criteria feedback received from the workshop to consider when choosing restoration sites included:

1) Easy to access treatment sites available;

2) Focus on transition zones between uplands and lowlands;

3) No to minimal effects on other species;

4) Need a suite of restoration practices;

5) Focus on habitats that are similar to habitat that caribou use; and

6) High probability of successful vegetation growth (i.e., good soil and climate).

At the site level, more detailed spatial data will be required within the selected priority Candidate Restoration Areas to accurately assess the site level considerations to determine if a site is a restoration candidate.

The first required criteria at the site level requires detailed data to accurately assess existing vegetation structure and human/predator access on disturbance features. Where vegetation cover has returned through natural processes, treatments are not typically recommended. A general guideline is not treating areas where wolf travel speed is unlikely to be influenced through treatments. One study found that the greatest reductions in wolf travel speeds on linear disturbances occurs when the average vegetation height is greater than 0.50 m; and wolf travel speeds are similar to that of intact forest when the average height of vegetation is greater than 4.1 m on greater than or equal to 30% of a linear feature (Dickie et al. 2017). Some areas in caribou ranges show high levels of natural regeneration on linear disturbances and in many ranges natural regeneration is 50% to 60% of the treatable disturbance (e.g., Golder 2016a).Therefore, assessing existing vegetation structure, including height and cover on linear features can more accurately determine the amount of treatment area (or candidate treatment sites), supports planning within priority Restoration Candidate Areas and helps predict actual cost of a restoration project. This requires use of fine scale remotely sensed data within the priority Candidate Restoration Areas. The following data are important to collect to support treatment decisions based on existing status of a disturbance:

- Adjacent Forest/site type:
  - Uplands, lowlands, transitional sites.
  - In general, seismic lines occurring in deciduous forest stands or mesic forest stands (transitional sites) have greater natural revegetation than lowlands.
- Existing Natural Vegetation Structure:
  - Structure includes conifer versus shrub, percent vegetation cover, heights, and diversity of species.
  - To increase implementation efficiency and costs, treatments are typically focused on lines where natural vegetation recovery is not occurring, with the treatment focused on the site-specific limiting factor for vegetation growth.
  - Compaction during initial disturbance, as well as repeated human and wildlife use of lines (e.g., game trails) hinders vegetation growth
- Access Control Locations:

- Strategically focus on treating disturbances that cross permanent access such as roads, to minimize human use with motorized vehicles. Reducing human use increases natural vegetation recovery and minimizes opportunity for snow packing, which enhances predator mobility.
- Focus treatments to minimize predator travel on transitional habitat types between uplands and lowlands (as per workshop feedback).
- Game trail / UTV trail areas (if not identified for stakeholder use) a focus for functional restoration.

It should be acknowledged, that given the size of the Candidate Restoration Areas, it will be challenging to collect all of the necessary site-level information without using remotely sensed data that can be collected over large areas.

The second required criterion at the site level is that the site has a high probability that it will not regenerate naturally without intervention. The attributes of naturally revegetated linear features (seismic lines) have been documented by the Caribou Range Restoration Project (CRRP 2007), the Foothills Research Institute (FRI 2014) and van Rensen et al. (2015). Natural regeneration does occur, with linear developments in mesic sites the most likely to regenerate naturally without treatment. Natural regeneration to 3 m vegetation height within 30 years is inversely related to terrain wetness, line width, proximity to roads as a proxy for human reuse use of lines, and lowland ecosites such as fens and bogs (van Rensen et al. 2015). Passive restoration can be defined as leaving a treatment candidate site to vegetate naturally to 3 m heights within 30 years without implementation of site preparation or planting techniques. A decision support flowchart linked to the BEC units of NE BC and learnings from past restoration program monitoring was developed within the Restoration Toolkit and should be used for guidance on site level decision making on when to treat, or not to treat a site (refer to Golder 2015 for the site level decision making flowchart).

To capture the probability of sites naturally regenerating, terrain wetness, line widths, proximity to human access, vegetation height, percent (%) cover and game trail presence/absence can be assessed with various remote sensing methods followed by field truthing (e.g. Golder Associates Ltd. 2016a). The key is for a disturbance inventory in Criterion 1 to capture the existing site conditions and limiting factors. For example, vegetation in a fen is 95% less likely to naturally recover to a height of 3 m compared to an upland site (van Rensen et al. 2015). Thus, restoration in fens is likely to require greater effort than other habitat types. In comparison, restoration of transitional sites from fens and bogs to uplands, have proven to have the highest rate of recovery following treatment given moisture and nutrient site characteristics (Golder Associates Ltd. 2015), and offer an area to impede predator overlap with sensitive caribou habitat use areas.

The third criterion at the site level is capturing sites that are available for restoration treatment. The following decision criteria and support tools are used to identify restoration treatment candidates at the site level:

- Avoid restoration treatments on disturbances under an active disposition (e.g., roads, transmission rights-of-way) with existing reclamation requirements. Type of disturbance may also be used to determine if a site is a restoration candidate, or not.
  - Disturbances under active disposition or protective notation, or of a permanent nature (roads, railroad, transmission line, pipelines, wellsites, cutblocks, designated recreational trails) are typically removed as treatment candidate areas. These areas are either permanent provincial infrastructure or have provincial or federal reclamation and reforestation requirements following decommissioning.

- Pipelines may be considered semi-permanent, often with natural vegetation recovery occurring to a certain distance to the 'trenchline' around the pipe itself (typically 10 m). Pipeline integrity, safety and monitoring are criteria used to keep areas of this rights-of-way type cleared until abandonment and reclamation.
- Seismic and cutlines are not all equal, and conditions along lines vary and between different adjacent forest stands (lowland, transitional, upland). Seismic lines can experience a large amount of natural vegetation recovery, which varies based on initial disturbance impact (e.g., low blading, removal of organic soil and compaction), nutrient and moisture conditions.
- Seismic lines can be 'conventional', which are typically 6 to 12 m wide and straight or classified as "Low Impact Seismic" (LIS), which can range from a 1.5 m hand cut line to a 7 m line and may have variable natural revegetation recovery. LIS are almost exclusively cut by mulchers, are younger, and meander through the forest. Wolves have been documenting selecting pipelines and conventional seismic lines over LIS.
- Low Impact Seismic lines are not all equal with level of natural revegetation recovery (and potential treatment) influenced by:
  - North-south orientation have greater vegetation height growth than east-west orientation.
  - Mulch distribution (LIS with no mulch, or scattered mulch supports taller vegetation).
  - Forest type (upland > lowland) influences natural vegetation.

Site level preferred criteria should include potential disturbance to the habitat surrounding the restoration area when accessing the restoration area to conduct treatments. For example, consider the trade-off where naturally recovering vegetation must be mowed down to access a small restoration area to conduct restoration treatments. Will the trade-off be adequately beneficial? Once vegetation is than 4.1 m on at least 30% of a linear feature, wolf travel speeds may be reduced to those similar in intact forests (Dickie et al. 2017). At this point removal of vegetation to restore more of the linear feature may be detrimental to caribou, as there will be a waiting period while the new vegetation grows dense and tall enough to impede movement of predators.

Access for restoration needs to consider multi-year programs and repeat access, with primary and secondary access routes identified (Golder 2016a, Golder 2017).

Another consideration is the potential impacts of the restoration treatments to other at risk species and species that are important to Indigenous communities. Caribou are considered an umbrella species (Hebblewhite 2017) and thus negative impacts to other species in decline are likely to be minimal to none; however, other species and biodiversity values overall should not be ignored.

7.0 Program Level Planning

Properly planning all steps of a restoration program (Figure 8) or the combination of many individual projects over a priority restoration area will increase the effectiveness of restoration success and decrease long-term management costs. For example, planning ahead by identifying a nursery that can supply the appropriate types and amount of plant stock and/or seeds over a multi-year program with secure funding can be more challenging in practice than on paper. Failing to do so can result in a lack of seedlings and force program delays. Additionally, one of the challenges that we acknowledge is that the Candidate Restoration Areas are still very large areas, and it will be challenging to complete the restoration without a well thought out plan.

Once site level desktop data have been collected within a defined priority Candidate Restoration Area, planning needs to consider the logistical aspects of implementing a restoration program over the entire area. From a logistical standpoint, access is critical and the creation of restoration zone boundaries are often drawn in consideration of major rivers, highways and permanent roads from an accessibility standpoint. In general, selection of an area that is accessible, with an overarching restoration program plan to maintain a primary access route for restoring zones, is important to avoid having to access over a previously treated area. Implementing restoration treatments will be logistically easier with good accessibility during the season where treatments are planned. Type of treatment, accessibility and site conditions will determine if a restoration area or zone is treated under frozen ground conditions (winter), or during late summer/fall conditions. Time of year for treatments, and type of treatments, will be linked to the type of equipment and contractors required.

Following the desktop analysis, a field investigation should be performed to confirm restoration treatment prescriptions along candidate segments, access considerations and other important logistical components (e.g., for remote areas, a camp may be required or helicopter landing pads). Field investigation is ideally completed under snow-free conditions and supports the confirmation of treatment prescriptions, but more importantly, access and logistical considerations.

The field investigation should be in the form of a ground truthing visit and helicopter fly-over to review and confirm access routes, confirm any potential watercourse / pipeline / road crossing locations, and the vegetation status and wildlife use of the mapped disturbances identified for treatment. Efficiencies are gained through the use of digital data collection methods (e.g., iPads with uploaded digital forms) linked to maps of the disturbance segments and attributes from the desktop review. The restoration toolkit (Golder 2015) supports the decision making around what restoration treatment to do in consideration of site limiting factors.

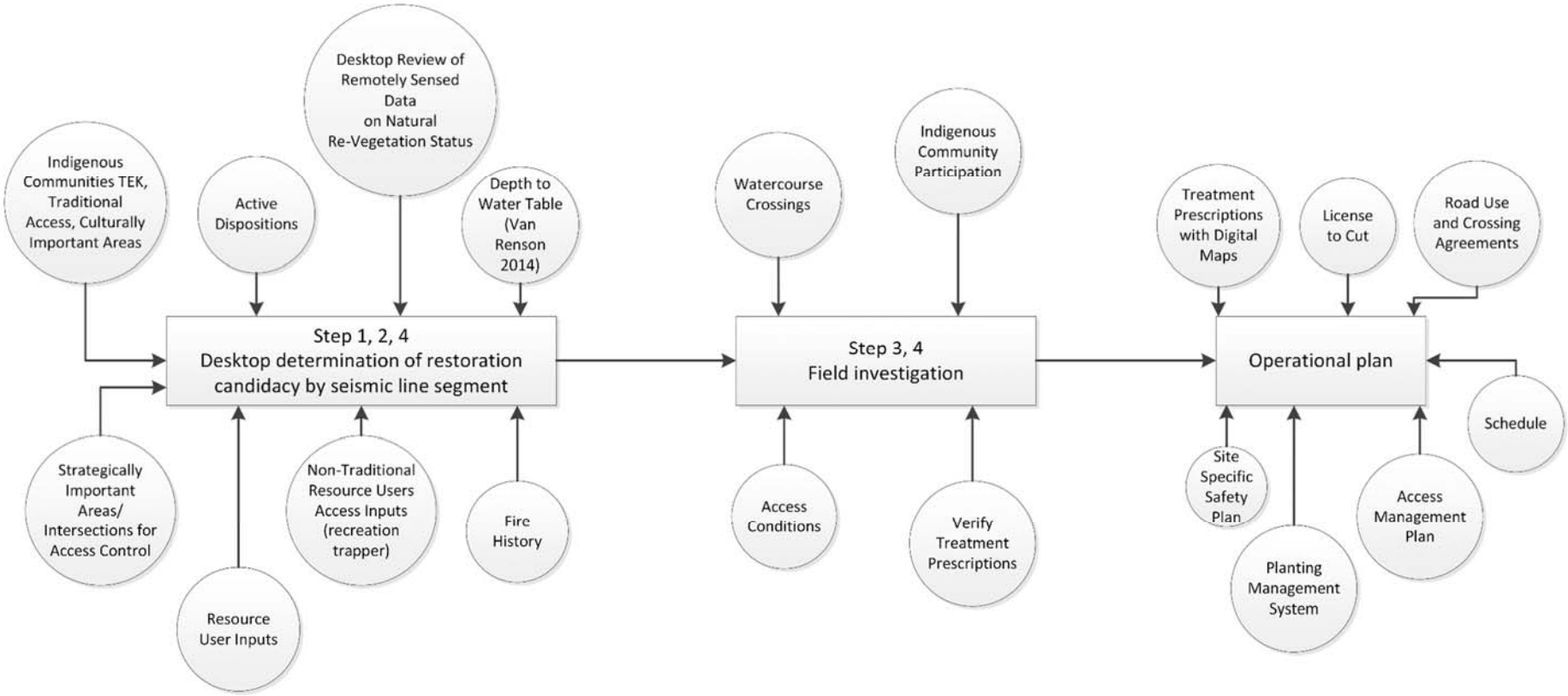


Figure 8: Restoration Program Level Planning Steps'

First Nations should be engaged in the restoration planning process as early as possible. Engagement should consider separate community face-to-face visits and associated field visits with elders or selected land users. If field participation is not achievable, members of communities where traditional territories overlap the restoration area should be visited by a Traditional Knowledge Specialist to understand expectations around restoration treatments, discuss traditional access and areas of cultural resource importance within the restoration area, capture feedback into treatment considerations and mitigation measures needed to minimize impact by prescribed treatments. During each field and community visit, the focus would be to discuss and capture within the Restoration Plan:

- traditional access requirements to maintain opportunities to hunt, fish, trap, gather and use the land;
- knowledge specific to the natural ecosystems and condition of wetlands;
- conduct a map review of proposed restoration treatment sites and treatment prescriptions;
- medicinal plants and other plant species of cultural significance to protect within the reclamation plan; and
- to identify important cultural and traditional sites and features, which will need to be protected through appropriate measures within the operational plan.

In addition to providing feedback into a restoration plan, First Nation employment agencies or lands contacts should be contacted to identify local resources to support implementation (Section 6.4.1). This would include field assistants for the restoration plan field implementation, contractors, equipment providers, monitors, tree planters, tree fellers, Health and Safety field supervisors, and medics.

Although logistically challenging, for efficiencies in large scale restoration program plans, it is highly recommended that TEK and Traditional Access are collected for identified priority restoration areas, even if restoration is expected to occur over multiple years, versus in segments based on individual restoration project plans. This would provide a more robust Restoration Program Plan over multiple seasons or years.

Using the desktop analysis, the field investigation and engagement with First Nations, the detailed treatment prescriptions by line segment is defined within a map, table and a spatial file (ESRI file geodatabase) and includes the line deactivation strategies and implementation methods for the disturbance features identified within the restoration area. Road use agreements, 3rd party crossing agreements, watercourse crossing authorizations, land access authorization, and monitoring design are also important elements of an operational restoration plan.

7.1.1 Engagement and Local Capacity Building

Many groups and individuals have an interest or stake in caribou habitat restoration. In particular, First Nations are eager to be included and consulted at all stages of restoration planning, from project conception to the ground work. In several cases First Nations have spearheaded efforts to strategically plan and restore caribou habitat in their territories (e.g. FNFN 2017, Klinse-za Mt Bickford restoration). Restoration Implementors will need to engage with these groups and individuals to increase habitat restoration success and social acceptance. Further, both TEK and scientific research are important and valuable sources of information for restoration planning and implementation.

Habitat restoration work can be labor intensive, but this presents a good opportunity for local capacity building. When planning restoration work, a process should be established to support hiring locally to staff the project. Locals may also have an intimate knowledge of the terrain, climate, and site access. Site access and seasonal

conditions can be a hurdle to projects and are important to consider in project planning (e.g., seasonal site accessible, and typical snow depths and travel conditions).

7.2 Restoration Treatment Selection

Following the Restoration Integrator structure, detailed site level treatment selection is intended to occur by the individual restoration implementors and rolled up into operational plans within zones of the Priority Candidate Restoration areas. Treatment selection should depend on the site level conditions, as well as the specific restoration planning area in terms of functional, ecological, or a combination of treatments (Figure 9 and Figure 10).

Functional restoration techniques do not necessarily result in the restoration of linear disturbance areas to their pre-disturbance structural state (i.e., ecological restoration) (DeMars and Benesh 2016). Perceived benefits of functional restoration over ecological restoration include more immediate impacts on the targeted biological process, cost-effectiveness, and speed of treatment. Examples of functional restoration are stem bending, mounding, and constructing berms. Functional restoration treatments aim to reduce predator use of linear features, and/or slow the movement of predators on linear features to the same rate or lower as the adjacent forest, and/or eliminate human motorized use and allow vegetation to recover naturally.

In contrast, ecological restoration consists of habitat management action(s) that are intended to restore habitat to a pre-disturbance state (Wilson 2015, DeMars and Benesh 2016), such that the habitat structure and the ecological interactions (i.e., predator-prey densities) stabilize. Ecological restoration considers restoring habitat structure, increasing habitat connectivity, reducing the amount of early seral vegetation and thus the amount of alternate prey forage, and reducing not only predator movement rate on linear features to levels comparable to the adjacent intact forest, but also predator densities. Methods for ecologically restoring linear features within Boreal Caribou ranges have focused on (1) leaving an area for natural vegetation recovery where advanced regeneration is evident, and (2) site preparation methods to address vegetation growth limiting factors (e.g., soil moisture, nutrients, compaction) combined with seedling or seed planting (3), or use of coarse woody debris with planting to address poor site conditions (Pyper et al. 2014, Bentham and Coupal 2015). Mounding is a site preparation technique that can be used as both an ecological restoration treatment and a functional restoration treatment: depending on site condition, mounding can to both increase seedling growth and survival (Bedford et al. 2000) and act as a barrier to animal movement.

Ecological restoration is considered most effective in the long-term for broad ecological goals but takes longer to achieve reductions in predation rates (FNFN 2017). A major drawback is cost, which can be as high as $12,000 per km when seedling planting is combined with mounding and other mechanical site preparation treatments (Demars and Benesh 2016). Ecological restoration may be prohibitive to apply at scales sufficiently large to have an impact on caribou population dynamics (Demars and Benesh 2016). Functional and ecological restoration are not exclusive and can be combined to achieve both short-term and long-term goals.

Figure 9: Ecological Restoration Treatment (mounding and planting)
Nine years post treatment in the Little Smoky Boreal Caribou range, near Grande Prairie, Alberta. Mean revegetation height is 0.6 m, maximum revegetation height of seedlings 2.23 m (photo courtesy of Petroleum Technology Alliance of Canada, Foothills Landscape Management Forum and Alberta Environment and Parks).

Figure 10: Aerial Photo of Mounding with Seedling Planting on a Linear Corridor in the Parker Caribou Range
An example of a combined treatment of both functional and ecological restoration in caribou habitat, 1 year post treatment.

For guidance and details on restoration methods and site level planning, we refer MFLNRO to The Boreal Caribou Habitat Restoration Operation Toolkit for British Columbia (Golder 2015). The operational toolkit is particularly informative as it used two decades of learnings from Alberta, input from subject matter experts, and a workshop with government agencies, and considers site level limiting factors and BEC units when recommending treatments. In addition, research on the influence of vegetation heights and cover on predator movements (Dickie et al. 2016, 2017) and criteria to support decisions for determining when to treat, versus when not to treat and to protect natural vegetation recovery is provided.

An initial version of the operational toolkit was prepared with collaboration from the OGC to help guide the implementation of reclamation techniques that can contribute to the restoration of caribou habitat (Golder 2015). The toolkit is meant to help guide operators and reclamation specialists with activities occurring within Boreal Caribou range to address vegetation recovery, as well as human and predator accessibility within ranges. The toolkit was developed using monitoring and pilot trial results from past restoration projects but is intended to be a living document, to be updated regularly as habitat restoration objectives, guidance, targets, and regulations evolve with learnings from monitoring of current caribou habitat restoration programs and studies.

While this restoration framework does not go into detail on restoration methods and site level planning, learnings related to restoration planning that were shared at the restoration workshop are briefly summarized. The 2018 workshop provided the first opportunity for First Nations to comment on the restoration treatments and the toolkit. In particular, First Nation site visits to the Parker Pilot restoration area have provided the following preliminary findings that should be considered for inclusion within a revised restoration toolkit:

- Mounding appeared to only be useful for blocking recreation access but not animal access. They suggested mounding could be combined with fences or a visual screen to block animal access.
- Some were concerned that mounding is invasive.
- Some were concerned that wolves will use the mounds to drive ungulates towards them and trap them there.
- Suggest planting in a zigzag pattern along seismic lines to create a visual screen and that transplanting should only be done where the soil is good.
- For tree felling, the trees need to be big enough to be effective, otherwise other treatments were preferred.
- Rather than fencing, they suggested using other material (e.g., brush, to provide a functional block).
- Often there are game trails that cross seismic lines, treatments should not block these trails as animal movement should be facilitated on the natural game trails.
- They felt restoration may not be effective because of the long timeline, as a result habitat protection is necessary.
- They suggested protection of movement corridors between the northern mountain and boreal ecotype.
- Suggested inclusion of culturally important shrubs, which can help re-establish organic soils.
- Use locally sourced plants;
- They suggested functional restoration be used on linear features that will recover on their own.
- No herbicides should be allowed in the protection and restoration zones.

- Wolf reduction may be necessary but habitat protection and restoration zones have to be identified first.

Restoration treatments should be tailored to meet site-specific limiting factors and use different approaches along a disturbance feature as site conditions change. However, there are opportunities to modify treatments with the inclusion of advice and knowledge of land users such as the First Nation preliminary feedback provided at the workshop. For example, use of native, site appropriate species and a diversity of vegetative species for restoration should be considered. Consider planting not only trees but also important native shrubs and herbs that can support development of an organic layer, are nitrogen fixers, and appropriate as early successional species. To minimize the amount of moose browse avoid planting common browse species, such as willow (*Salix* sp), red-osier dogwood (*Cornus stolonifera*), and saskatoon (*Amelanchier alnifolia*) (Anderson et al. 2018). At the same time, implementors need to be mindful that planting moose browse is predicted to increase the amount of moose forage and could help fuel apparent competition between moose and caribou (Seip 1992, Seip and Cichowski 1996, Wittmer et al. 2007).

8.0 INDICATORS OF SUCCESS

Feedback received from the workshop included the need to implement monitoring to understand the effectiveness of habitat restoration.

The BC OGRIS REMB supported the development of a Boreal Caribou Habitat Restoration Monitoring Framework (Golder 2016) with the following objectives related to vegetation recovery.

- To determine if restoration treatments are being implemented according to project requirements after one growing season.
- To provide a consistent approach to vegetation monitoring and monitoring protocols to enable the development of a regional dataset for tracking vegetation growth rates and/or the relative success of treatments at restoration treatment sites over time.
- To provide performance measures and recommended targets to determine if restoration treatments are meeting pre-determined recommended targets for native vegetation growth and access control after one, five, ten and fifteen year growing seasons.
- To provide guidance on monitoring timeline and frequency.
- To provide a regional monitoring framework that can be used to determine if restoration treatments are successful at accelerating the re-establishment of vegetation, which will in the long term achieve caribou habitat goals.

Monitoring is critical to evaluate the effectiveness of project planning and treatments, and inform projects for adaptive management and future planning. Monitoring can be seen as a feedback loop: projects are evaluated against a set of quantitative and qualitative metrics at pre-determined time intervals, data are used to assess the project, learning and knowledge gained is used to check assumptions and adapt the program or policy as necessary to meet objectives. Morrison and Marcot (1995) define 3 phases: implementation (compliance), effectiveness, and validation.

1) Compliance monitoring assesses whether restoration was implemented as planned.

2) Effectiveness monitoring assesses whether management activities are resulting in the desired outcome (e.g., are restoration treatment sites meeting pre-determined measurable targets for vegetation growth and access control?)

3) Validation monitoring tests whether underlying assumptions of treatments were correct (i.e., to determine if restoration treatments are accelerating the natural revegetation process by providing habitat that can support self-sustaining caribou populations, thereby contributing to achieve caribou habitat goals).

And we add on a 4th phase for communication:

4) Dissemination of findings from the compliance, effectiveness, and validation phases (e.g., workshop or conference presentations, journal publication, or public report).

The Boreal Caribou Habitat Restoration Monitoring Framework describes the rationale and recommended protocols to monitor the effectiveness of Boreal Caribou habitat restoration treatments with consideration of both a Project-level scale and a NE BC landscape restoration Program-level scale (Table 4). Performance measures and recommended targets defined within the Monitoring Framework are intended to be used to gauge the effectiveness of treatment measures applied over short-term and long-term periods.

Table 4: Objectives of Caribou Habitat Restoration Monitoring at the Project and Program levels

Scale	Monitoring Category	Objective[(a)]
Project-level	Compliance	To determine if restoration treatments are being implemented according to project requirements after one and up to five growing seasons.
Program-level	Effectiveness	To determine if restoration treatments are meeting pre-determined recommended targets for native vegetation growth and access control after five, ten and fifteen year growing seasons.
Program-level + Wildlife monitoring[(a)]	Validation	To determine if restoration treatments are accelerating the natural revegetation process by providing habitat that can support self-sustaining caribou populations, thereby making the program restoration treatments worthwhile to achieve caribou habitat goals.[(a)]

[(a)] The Monitoring Framework is focused on monitoring both planted and natural ingress of native vegetation response to restoration treatments, not wildlife response to restoration treatments. The expectation is that concurrent wildlife population monitoring is on-going by the Province during habitat restoration programs to address Validation Monitoring.

Although recommendations are provided to support a robust monitoring program on the protocols and frequency of monitoring, reporting of results, and adaptive management approach, restoration implementors can use the recommendations in support of Project-level compliance monitoring or by the CRI to understand restoration effectiveness at a broader spatial and temporal Program-level in northeastern BC. The idea is that a recognized ‘responsible authority’, such as the Restoration Integrator, would house monitoring data from individual Project-level restoration projects and combine data from across the region for effectiveness monitoring of treatments at efficient time intervals.

Monitoring for compliance, and effectiveness of restoration treatments requires the incorporation of monitoring plots into the design of Project-level and Program-level restoration projects. Paired reference plots need to be established by Restoration Implementors during treatment periods on untreated gaps of linear features (reference plots- disturbed) and on linear features that are already on a successional vegetation trajectory (reference plots-natural revegetation). These reference plots would be compared to the treatment plots to evaluate the effectiveness of the treatments at achieving the overall objectives of the program, which is to reduce predator and primary prey access and establish a vegetation trajectory that will increase Boreal Caribou habitat intactness.

Measurable targets and monitoring periods are provided in the Monitoring Framework as a means of comparison to evaluate whether the restoration treatment is on a trajectory towards effectiveness. Implementation phase (project compliance) monitoring should allow for a quick desktop evaluation of projects rather than the more detailed, quantitative assessment at the effectiveness and validation phases. Implementation phase monitoring at the project scale can be conducted by the CRI using 3 evaluation criteria: (1) did projects follow planned restoration methods, (2) was the target area for treatment met, and (3) were First Nations effectively consulted and involved? The intent of the first criteria is to ask a question rather than evaluate success. It is common for projects to deviate from the original plan, but it is valuable to ask why the project had to deviate and what can be learned for improved future success. The second evaluation criterion is an important metric because the project may have been selected and funded based on the area that could be restored. Further, failure to meet the targeted restoration area can have consequences for landscape and range level planning. The third evaluation metric, effective engagement, is qualitative and can be evaluated by communication efforts such as phone calls, e-mails, meetings, and participation in the project. The intent of compliance phase monitoring is to review each project and assess where challenges occurred, methods worked or did not, and pass these learnings on to future restoration projects or inform multi-year projects so methods can be modified.

Effectiveness monitoring is much more detailed and labor intensive as it involves data collection from treatment and reference (untreated) plots. The intent will be for Restoration Implementors to establish monitoring plots, and conduct initial Year 1 post treatment data through a consistent data collection process. Whether implementors will have obligations at Year 5 post treatment would be dependent on the government's permitting process. Data from the implementors would be submitted to the CRI. The CRI would house and create a large enough data set for effectiveness monitoring at the Program-level (i.e., across Boreal Caribou ranges in northeast BC). Data on vegetation growth, survival, sightability, wildlife use, and human use are collected at treatment and reference plots to assess the effectiveness of restoration treatments. The Restoration Integrator would be responsible for outlining how many plots each Restoration Integrator needs to establish within an operational plan, as well as for completing (or contracting out) Program level effectiveness monitoring by combining data on vegetation recovery from multiple projects to assess the effectiveness of caribou restoration treatments over a larger area. In addition, a desktop assessment of cumulative effects to examine how much restored habitat has been added versus how much new disturbance has occurred should be completed. The intent will be to evaluate if (i) the rate of restoration is great enough to outpace new disturbance, and (ii) if the rate of restoration is great enough to achieve a trajectory towards a self-sustaining population.

Monitoring restoration projects needs to not only evaluate whether trees are growing within treated sites, but monitoring should capture if habitat restoration is resulting in predator movements (speed, spatial overlap) which are similar to the linear disturbances surrounding forest, as well as the overlapping influence of other recovery levers (e.g., predator and prey management levers, protective maternity pens) on the caribou population. To achieve validation monitoring, which links if restoration programs are providing habitat that can support self-sustaining caribou populations, the expectation is that the Province of BC is conducting regular caribou population monitoring. Given the time expected for habitat restoration at large scales to influence caribou populations, in the shorter term conducting wildlife (predator) behaviour response studies to habitat restoration should be considered (Serrouya et al. 2017). Before-After-Control-Impact (BACI) study designs have been implemented to support validation monitoring.

Sharing of knowledge from habitat restoration experience will lead to greater success in other projects and is critical for fast, effective, and efficient caribou habitat restoration. The CRI should help manage and disseminate information gained from monitoring caribou habitat restoration. Proponents, First Nations, or organizations wishing

to conduct habitat restoration should have access to the Caribou Restoration Implementor who should be responsible for communications through various means: e-mail, website, publications, workshops, and conferences.

9.0 NEXT STEPS

There is an urgent need for habitat restoration in Boreal Caribou ranges in BC, with a focus on priority areas. The guidance we have provided includes both a proposed structure for a coordinated approach to restoration, as well as criteria for establishing priority Candidate Restoration Areas. In addition to suggested legislative reform, which will trigger restoration, we hope this guidance will support a more focused, effective and efficient caribou habitat restoration program within northeast BC Boreal Caribou ranges. However, there are some immediate next steps to consider.

As identified during the workshop, both FNFN and BRFN have spent substantial effort to identify areas for habitat restoration. Fort Nelson First Nations identified areas for restoration (and protection) based primarily on habitat disturbance, calving areas, and high-use caribou areas within the Maxhamish, Calendar, Snake-Sahtaneh, Westside Fort Nelson, and Chinchaga caribou ranges (FNFN 2017). Blueberry River First Nation has identified areas for restoration based on areas identified by Elders and Knowledge Holders as highly used by caribou, spatial data on caribou use, high density of linear disturbance, areas of cultural importance, and areas with winter access (S. Leech pers. comm. 2018). MFLNROD could consider starting with these areas, if/where overlapping the priority areas identified within this report that follow the criteria and weighing as identified during the workshop, as priorities for restoration in the immediate term. This would allow action to start on the ground immediately, while other recommendations contained herein, such as legislative reform to require restoration and the development of a CRI structure is being established.

The caribou restoration workshop highlighted several important barriers to effective and efficient habitat restoration that should be addressed. First, there remains legislative uncertainty surrounding triggers for caribou habitat restoration that the Province will need to address. Will restoration only occur when new footprint is added to a caribou range through the use of offsets? Or will a proposed Provincial Restoration Fund cover restoration activities in priority areas within a defined timeframe? The amount of offsets required may be variable from one project or activity to the next based on the residual effects. The proposed BCRIP currently suggests an offset ratio of 4:1, whereas the offsets calculated for Caribou Mitigation and Monitoring Plans for South Peace Caribou depends on the amount and quality of habitat, as well as other conditions (British Columbia Ministry of Environment 2013). A more consistent and clear method of calculating the amount of restoration requirements linked to residual effects, as well as clear instructions on where restoration should occur (priority area), should be developed to provide better clarity to industrial proponents. Additionally, should restored areas be protected from future development? In terms of cumulative impacts, it may be better to disturb an area that was restored but has not fully recovered to the pre-disturbance state rather than an undisturbed area that is intact. However, unless restored areas are protected, non-industry groups that conduct restoration work (e.g., First Nations) may become discouraged or desensitized.

The need for coordinated restoration with the CRI to plan long-term five year restoration plans, with inputs from a steering committee to capture First Nation, Government Agencies and other stakeholders feedback is an important next step. There are many government bodies, organizations, and groups that currently fund, regulate, or influence caribou habitat restoration. To achieve coordinated caribou habitat restoration, it will be necessary to bring together key agencies that are responsible for restoration in the future through the CRI. The CRI would oversee the planning of restoration, as well as consistent direction and learnings to numerous restoration

implementors who could also hold, manage, and distribute funds for restoration work. This would provide advantages such as flexibility of restoration funding over fiscal time lines, flexibility in awarding contracts to promote local capacity building, and the ability to accept funds from a diversity of sources.

10.0 DISCUSSION

This restoration framework brings together information gathered at a restoration workshop in April 2018, the suggested targets for Boreal Caribou recovery within the proposed BCRIP, the Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia, learnings from a Pilot Landscape Level Restoration Program Plan and Implementation, and the Boreal Caribou Habitat Restoration Monitoring Framework. These sources of information were used to provide guidance on a restoration framework for coordinated and efficient restoration within northeast BC, including a structure that provides First Nation involvement in habitat restoration through all phases (priority area setting, planning, implementation, monitoring), and decision making around the identification of restoration priority areas. The intent of the landscape-level restoration framework is to provide guidance on coordinated planning, prioritize areas for restoration, and effectively restore caribou habitat to support the recovery of caribou populations. In general restoration has occurred in an ad-hoc, project-level scale; landscape scale restoration planning is a gap in restoration work in Western Canada.

The proposed BCRIP (BC MOE and MFLNRO 2017) generalized population and habitat goals are developed to guide recovery implementation efforts within the Province and include “Maintain a positive habitat trend across each Boreal Caribou range, and; Stabilize and achieve self-sustaining populations across each Boreal Caribou range”. The Province has linked these goals to the implementation objective of ‘a net decrease in the density of linear features within core areas; leading to a positive habitat trend in each range over time”. Within the proposed BCRIP (2017; Table 2), the measurable target to meet the goal of maintaining a positive habitat trend in each Boreal Caribou range is having a linear feature density of less than or equal to 2 km per square km in both cores and ranges. This proposed target was used within this restoration framework but may be risky. Others have recognized that a much lower linear density target is needed before woodland caribou populations may begin to stabilize or increase (e.g., ≤ 1 km/km^2 Boutin and Arienti 2008; 1.22 km/km^2 Weclaw and Hudson 2004). We caution that for the priority Candidate Restoration Areas, that a much lower linear density target may be more appropriate when developing restoration targets in these high use and important habitat areas. A lower target would see a re-evaluation of priority areas as noted during our preliminary evaluation, particularly at the landscape scale. In addition, it may not be the linear density that we should be focusing on. Serrouya et al. (2017) identified that the greatest gain in caribou density is predicted to occur when all linear features are restored which addresses both the movement rates of predators and reduces the spatial overlap between predators and prey. When a more realistic scenario of partial restoration is considered, the reduction in spatial overlap between wolves and caribou has the largest potential for managing caribou declines through restoration efforts. The authors suggest focusing on restoring all lines leading into caribou refugia (peatlands).

Recovery of Boreal Caribou is a challenging and uncertain process that will require collaboration with a variety of interested parties, including governments, First Nations, and land users (BC MOE and MFLNRO 2017). The Province is identified as leading the implementation of the management actions and will involve interested parties whenever possible. At the same time, the Province will continue to monitor the health and population of Boreal Caribou to assess the effectiveness of these actions. However, it is understood that the implementation of recovery actions, including habitat restoration, to achieve the goals and objectives identified in the proposed BCRIP are subject to the priorities and budgetary constraints of participatory agencies and organizations (BC MOE MFLNRO 2017). Implementing restoration, even within identified priority Candidate Restoration Areas, will

take significant budgetary investments and a secured funding source. This may be a challenge when implementing large scale restoration programs.

Caribou habitat restoration is a relatively new science and the most effective method will vary from one site to another as site conditions (e.g., soil moisture, disturbance features) change. Therefore, it is important that restoration efforts are monitored at the landscape and project scales to allow for adaptive management of the restoration treatments themselves. However, it should be stressed that monitoring needs to not only evaluate whether trees are growing within treated sites, but monitoring should capture if habitat restoration is resulting in the desired changes in predator movements and spatial overlap particularly within caribou refugia. Validation monitoring will also need to capture the overlapping influence of other recovery measures (e.g., predator and prey management levers, protective maternity pens) on the caribou population. As such, the Province of BC will need to conduct regular caribou population monitoring to understand the response of caribou to all recovery levers; not just habitat restoration.

This restoration framework guidance is not modelled off another framework and as such is conceptual and untested. Landscape and range scale restoration planning with priority areas has not been addressed by another jurisdiction in Canada, and is complex and involves several legislative, cultural, economic, social, logistical and biological considerations. Further, many government agencies, industrial proponents, and First Nations have a stake in caribou habitat restoration. Before this framework is implemented, it should be reviewed by First Nations, and BC Government officials and agencies that will be associated with restoration permits, requirements or management. The review could provide valuable insight and thought on how best to strategically plan and implement habitat restoration.

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Signature Page

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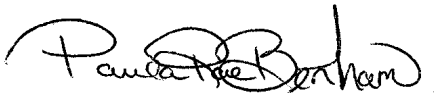

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APPENDIX A

Caribou Habitat Restoration Workshop Background Material

WORKSHOP BACKGROUNDER

British Columbia Boreal Caribou Habitat Restoration

Restoration Framework Workshop

Submitted to:

Workshop Participants

Submitted by:

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1.0 BACKGROUND

The BC Oil and Gas Research and Innovation Society (BC OGRIS) Research and Effectiveness Monitoring Board (REMB) was established to further the goals of the Boreal Caribou Implementation Plan (BCIP; BC MOE 2011; currently under revision (BCRIP draft; BC MOE and BC FLNRO 2017)), including funding research on restoration of boreal caribou habitat. The Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population in Canada (Environment Canada 2012), established a risk-based threshold of a minimum of 65% undisturbed habitat in each population range, to be applied in boreal caribou range planning and action planning across Canada. The threshold was informed by a scientific assessment that evaluated the contribution of natural (fire) and human (industrial) disturbance to range condition, and the likelihood of varying habitat conditions supporting self-sustaining boreal caribou populations (Environment Canada 2011). One of the management approaches in the federal recovery strategy to address effects of habitat alteration on boreal caribou is to undertake coordinated actions to reclaim boreal caribou habitat through restoration efforts. This approach to addressing habitat alteration has been carried through to the draft BCRIP (BC MOE and BC FLNRO 2017) with the proposed revised plan being to **"maintain a positive habitat trend across each boreal caribou range**".

The draft BCRIP identifies that approaches used to achieve sustainable boreal caribou populations should be completed with the least possible impact to economic opportunities. Habitat recovery actions include restoring industrial landscape features such as roads, seismic lines, pipelines, cutlines, and cleared areas in an effort to reduce habitat changes which have increased predator numbers and ultimately caribou mortality rate within fragmented and disturbed landscapes.

Habitat restoration is one tool in the toolbox for caribou population recovery. Habitat restoration alone will not recover boreal caribou. Parallel management levers including predator control and population augmentation (e.g., penning) are recognized as immediate levers given the time lag for habitat to recover.

Artists Rendition of Boreal Caribou Decline Story, commissioned by the REMB.

2.0 WORKSHOP GOAL

The goal of this one-day workshop is for participants to develop key principles and criteria that can guide habitat restoration planning and implementation within boreal caribou ranges. Results of the workshop will subsequently be presented in a Restoration Framework Report. The Restoration Framework Report will be presented to the BC government and other agencies as advice to guide restoration planning and implementation in boreal caribou ranges.

2.1 Workshop Objectives

1) There is recognition that First Nation communities want to be involved in caribou habitat restoration programs and for inclusion in the recovery of woodland caribou. There is also recognition of the value and importance of incorporating First Nations Traditional Ecological Knowledge (TEK) and feedback on what success looks like for habitat restoration. During the workshop, we will discuss how, and at what stages within habitat restoration planning, implementation, and monitoring, that First Nations are included within the delivery of a restoration process and program.

2) Technical discussion of what criteria to use, and how to weight that criteria, to choose priority areas between ranges and within ranges for restoration.

3) To gather feedback on the desired end state of habitat restoration implementation; ‘what does successful restoration look like’? Participants will explore both ecological and functional restoration and provide feedback on current types of treatment, and decision criteria for use around no treatment and leave for natural recovery.

4) Identify workable solutions to avoid or minimize barriers or constraints to administrative and regulatory policy, acts and legislation.

WORKSHOP APPROACH

This one-day workshop has been designed to encourage invitees to provide perspectives so that practical and effective technical solutions can be identified and shared with the BC government.

1) The day will begin with presentations summarizing government, western science, practitioner and First Nation perspectives on the considerations, challenges and potential solutions and opportunities to implementing habitat restoration under the proposed draft BCRIP.

2) All attendees will have the opportunity to ask questions and seek clarification from the presenters.

3) All attendees will have the opportunity to contribute to what is the desired end state of restoration, what success will look like, what restoration treatments have been missing in past projects, decision criteria to support a physical restoration treatment, and at what stages First Nation’s and TEK be included within the delivery of a restoration process and program.

4) Attendees will then be divided into smaller break-out groups to spend several hours discussing a common set of questions:

    i) Where should restoration activities be undertaken (criteria and ranking of criteria both between caribou ranges and within a caribou range)?

    ii) Who should be responsible for planning and delivering habitat restoration plans? Tracking? Monitoring?

    iii) When – what considerations need to be made in sequencing habitat restoration activities on the ground?

iv) How – identify workable solutions to avoid or minimize barriers and constraints, and to identify opportunities.

5) All attendees will reconvene after their small group discussions and each break-out group will have an opportunity to provide their groups' insights on criteria and weighting of criteria for the WHERE, the WHO, the WHEN, and TOP TWO workable solutions to avoid or minimize barriers and constraints, and to identify opportunities.

6) A brief summary of recommended (or alternate) solutions will be prepared and provided to attendees by April 27, 2018.

The workshop objective and agenda is ambitious, and the following background material is provided to help you prepare. Note that we will be using this material to focus on key topics relevant to a technical discussion on habitat restoration.

3.0 HABITAT RESTORATION – *WHAT DOES SUCCESS LOOK LIKE?*

Boreal caribou habitat restoration is a relatively new science, having emerged within boreal caribou ranges in 2002 (Alberta; Szkorupa 2002) and post 2012 in BC. Only in the past 5 years have restoration programs focused on creating larger tracts of intact boreal caribou habitat. Initial restoration and findings on effectiveness were completed on a project by project scale, primarily as mitigation to meet an industrial project approval condition. The short history of restoration, the lack of coordinated and long-term monitoring programs, and the time lag for seedlings to grow, provides only limited insight into the effectiveness of restoration to meet either a functional or ecological objective.

Functional Restoration Objective: this includes application of techniques on human disturbances that aim to limit or deter predator use of linear disturbances to attempt to restore historic caribou-predator encounter rates. Functional restoration techniques do not necessarily result in the restoration of linear disturbance areas to their pre-disturbance structural state (i.e. ecological restoration) (Demars and Benesh 2016). Perceived benefits of functional restoration over ecological restoration include more immediate impacts on the targeted biological process, cost-effectiveness and speed of treatment. Functional restoration techniques have focused on tree felling, but have also incorporated mounding and tree planting between tree felling segments to promote ecological habitat recovery in the long-term.

Photo 1: Example of functional restoration treatments using tree felling from Parker Range.

Photo 2: Example of functional restoration treatments using tree felling from Parker Range.

Ecological Restoration Objective: primary objective is to return a disturbance to a similar state of ecological function, or habitat state, as before the disturbance (Wilson 2015, Demars and Benesh 2016). Methods for ecologically restoring linear features within boreal caribou ranges have focused on 1) leave for natural vegetation recovery where advanced regeneration is evident, and 2) soil mounding (Photo 3) or other site preparation and seedling planting (Photo 4), or use of coarse woody debris with planting to address poor site conditions (Bentham and Coupal 2015; Pyper et al. 2014). Ecological restoration is considered to be most effective for broad ecological goals in the long term, but will take longer to achieve reductions in predation efficiency (FNFN 2017). A major drawback is cost, which can be as high as $12,000 per km when seedling planting is combined with mounding and other mechanical site preparation treatments (Demars and Benesh 2016). Ecological restoration may be prohibitive to apply at scales sufficiently large to have an impact on caribou population dynamics (Demars and Benesh 2016). Treatments are costly and have logistical challenges to cover very large and remote areas over a short time frame (e.g., for peatland areas winter access only with heavy machinery, or use of amphibuous equipment).

Photo 3: An excavator is used to dig holes and place the soil beside the hole creating an elevated mound. Elevated mounds create an elevated microsite that increases soil temperature and improves growing conditions for natural regeneration and planted seedlings. Mounds can also help create an access barrier for human travel and may impede predator movement on lines.

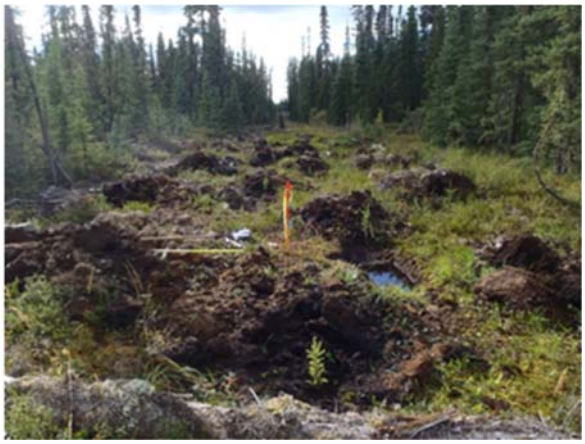

Photo 4: Mounding example with seedlings planted on mounds within a peatland. Mounds are used in lowland sites to enhance survival and growth of planned seed or seedlings and to promote natural regrowth of vegetation over time, as higher, drier spots are created that seed can settle into and germinate. Mounds can also be used in dry stands or upland sites to improve moisture availability (pooling of water in mound holes) and to address seedling competition from undesirable plant species such as grasses.

These two objectives need not be mutually exclusive: ecological restoration can result in functional restoration and vice versa. In general, the focus of functional restoration is to immediately affect the targeted biological process (or processes) while impacts from ecological restoration may require a longer time frame (trajectories from initial restoration programs forecast upwards of 15 to 25 years to reach vegetation heights of 1.5 m to 3.0 m to influence predator movements as identified in Dickie (2015) (Golder 2018)).

Because of the costs and time-lags associated with large-scale ecological restoration (see cost summaries within Pyper et al. 2014), recent focus has been on developing effective methods for functional restoration (Wilson 2015) to address the time lag of ecological restoration and size of areas to be treated.

Where to Implement Restoration Treatments, and Decision Criteria for When Not to Treat

Vegetation re-growth on seismic lines is mainly influenced by the moisture and nutrients that exist on a linear segment of a disturbance (site by site basis), influenced by the surrounding forest or peatland stand where the disturbance occurs, the initial disturbance and method of clearing, and the level of human use following clearing (van Rensen et al. 2015). Natural vegetation regeneration does occur, with linear disturbances with a moderate amount of moisture (mesic sites) the most likely to regenerate naturally without restoration treatments implemented (all things being equal), whereas a linear disturbance in a bog or fen is least likely to regenerate naturally (van Rensen et al. 2015). Natural regeneration to 3 m vegetation height within 30 years occurs more often at sites with moderate amounts of moisture, narrower line widths (e.g., low impact seismic versus conventional seismic), sites occurring at distances further from roads and within upland forests as opposed to peatlands (van Rensen et al. 2015). Areas adjacent to major rivers are more likely to have vegetation naturally regenerate. Overall, terrain wetness and the presence of fens have the strongest negative effect on natural regeneration recovery (van Rensen et al. 2015).

Natural regeneration however is often hindered, depending on a number of site limiting factors. Slow, or in some cases none, tree regeneration has been attributed to root damage from the original disturbance, compaction of the soil in tire ruts, insufficient light reaching the forest floor, maintenance of apical dominance from surrounding stands, introduction of competitive species (i.e., planted seed mixes), poor drainage of sites (i.e., regeneration slowest on poorly drained sites with low nutrient availability such as bogs), thickness of mulch and repeated disturbances (e.g., OHVs, animal browsing, repeated exploration) (Revel et al. 1984; MacFarlane 2003; Sherrington 2003, Golder and Explor 2016).

Seismic lines in boreal caribou range which have regenerated naturally, without any significant human activity (e.g., re-cleared to ground level for winter access or seismic program use), have achieved an average height of 2 m among upland habitat types within 20 to 25 years (Oberg 2001, Golder 2009). Natural recovery and restoration programs however, have also been negatively compromised when OHVs destroyed seedlings, or when a restoration area is re-entered for an industrial or recreational use.

Photo 5: Natural Regeneration of a typical conventional seismic line in the boreal forest.

Photo 6: Natural Regeneration of a typical conventional seismic line in the boreal forest.

Detailed planning has been used as a means to both protect a restoration program investment, as well as to determine where to treat or not to treat for restoration. Typically, the following is decision criteria and support tools are used:

- avoid restoration treatments within areas occurring within approved or future disturbance footprints based on economic value;
- avoid restoration treatments on disturbances under an active disposition (e.g., roads, transmission rights-of-way) with existing reclamation requirements;
- avoid treating disturbances used by trappers or other land users and stakeholders to minimize land use conflicts; and
- mapping of caribou ranges through remote sensing methods or field visits is used to determine existing vegetation structure, site limiting factors, and human/predator access within disturbances.

Typical criteria used to make decisions on where to apply habitat restoration treatments include:

- Type of disturbance:
  - Disturbances under Provincial active disposition or protective notation, or of a permanent nature (typically active roads, railroad, transmission line, pipelines, wellsites, cutblocks, designated recreational trails) are typically removed as treatment candidate areas. These areas are either permanent provincial infrastructure, or have provincial or federal reclamation and reforestation requirements following decommissioning.
  - Pipelines may be considered semi-permanent, often with natural vegetation recovery occurring to a certain distance to the ‘trenchline’ around the pipe itself (typically 5 to 10 m). Pipeline integrity, safety

and monitoring are criteria used to keep areas of this rights-of-way type cleared until abandonment and reclamation.

- Seismic and cutlines are not all equal, and conditions along lines vary as you move along a line and between different adjacent forest stands (lowland, transitional, upland). Seismic lines can experience a significant amount of natural vegetation recovery, which varies based on initial disturbance impact (e.g., low blading, removal of organic soil and compaction), nutrient and moisture conditions.
- Seismic lines can be 'conventional' which are typically 6 to 12 metres wide and straight or classified as "Low Impact Seismic" (LIS) which can range from a 1.5 metre hand cut line to a 7 m line. LIS are almost exclusively cut by mulchers, are younger, and meander through the forest. Wolves have been documenting selecting pipelines and conventional seismic lines over LIS.
- Low Impact Seismic lines are not all equal with level of natural revegetation recovery influenced by:
  - North-south orientation with greater vegetation height growth then east-west orientation.
  - Mulch distribution (LIS with no mulch, or scattered mulch supports taller vegetation).
  - Forest type (upland > lowland) influences natural vegetation.

- Access Control Locations:
  - Strategically focus on treating disturbances that cross permanent access such as roads, to minimize human use with motorized vehicles. Reducing human use increases natural vegetation recovery and minimizes opportunity for snow packing which enhances predator mobility.
  - Focus treatments to minimize predator travel on transitional habitat types between uplands and lowlands.
  - Game trail / UTV trail areas (if not identified for stakeholder use) a focus for functional restoration.
- Adjacent Forest/site type:
  - Uplands, lowlands, transitional sites.
  - In general, seismic lines occurring in deciduous forest stands or mesic forest stands (transitional sites) have greater natural revegetation then lowlands.
- Existing Natural Vegetation Structure:
  - Structure includes conifer vs. shrub, percent vegetation cover, heights, and diversity of species.
  - To increase implementation efficiency and costs, treatments are typically focused on lines where natural vegetation recovery is not occurring, with the treatment focused on the site specific limiting factor.
  - Western science has focused on understanding the influence of vegetation structure to wolf travel speed and hunting efficiency on disturbances as compared to travel within forest stands. If wolves use seismic lines to increase their travel speed and hunting efficiency, it may be appropriate to consider when lines regenerate enough for the vegetation to slow and eventually stop, wolves from selecting lines. For example, once vegetation height reaches 50 cm wolf travel speed is considerably reduced (summer, in upland forests; Dickie et al. 2017).
  - Compaction during initial disturbance, as well as repeated human and wildlife use of lines (e.g., game trails) hinders vegetation growth.

4.0 EXAMPLES OF POSSIBLE CRITERIA FOR CHOOSING PRIORITY RESTORATION AREAS

It is recognized that there is an urgent need to spatially identify and prioritize restoration areas within boreal caribou ranges (FNFN 2017). In past restoration planning exercises, a number of ecological, regulatory, land use, stakeholder, and logistical criteria have been used to identify restoration program areas. More recently, cultural criteria have been identified. The following matrix summarizes criteria which have been previously used, or identified, to select areas ***within a range*** for restoration.

Fewer programs have considered how to set priorities ***between ranges***. Criteria used have included wildlife modelling to compare projected change in caribou and predator numbers expected following habitat restoration (ALT 2009, FNFN 2017), or focusing on the caribou herd in greatest decline.

ECOLOGICAL	**LOGISTICAL**
▪ Core Habitat Areas[1] / High Value Caribou Habitat[2] ▪ Calving habitat[2,3,4] ▪ Caribou locations, high use areas[2,3] ▪ Predators location/numbers and overlap with caribou[3] (biologically meaningful area such as a wolf pack territory area[4]) ▪ Seismic density[5] ▪ Mortality event locations ▪ Existing Natural Vegetation Recovery ("Leave for Natural") ▪ Large area to create intact habitat patches	▪ Footprint inventory and natural reveg recovery ▪ High Cost (mounding/seedlings $12,000/km)[4] ▪ Accessibility ▪ Availlable Seed Source and Seedlings (Timeline) ▪ Ground Conditions ▪ Available sites (polygonal and linear disturbances not under active disposition, designated trails, and not falling under existing reclamation requirements) ▪ Predicted Natural Recovery (fine scale attributes; vegetation height/cover, wetness, nutrients, distance to road, forest stand)[3,7,9,10] ▪ Archeological potential[3,7] ▪ Stakeholder engagement
REGULATORY / LAND USE / DISTURBANCE	**CULTURAL**
▪ Current level of disturbance ▪ % Gain-in-Undisturbed habitat[2,3,5] ▪ Protected Areas[2] ▪ Low Economic Value Resource Areas[3,5] ▪ Provincially-designated land with potential for less future disturbance (WHA, UWR, Parks, OGMA)[2] (with noted exceptions, not protection) 7 ▪ Resource Review Areas[3] ▪ Outside Fire Areas < 40 years[3,5,7] ▪ Disturbance under Active Dispositions on Crown Land 'No Treatment', consider reclamation requirements[3,7] ▪ Outside Future harvest management plan areas[2,3,7] ▪ Outside mountain pine beetle current distribution and susceptibility ranking[7] ▪ Limited future development potential[3,5,7] ▪ Limited stakeholder conflicts[7] ▪ Type of Disturbance (conventional seismic, LIS, pipeline, etc.)[3]	▪ Protection and Restoration Zones[2] ▪ Oral history[6]; high value caribou habitat ▪ TEK (knowledge holders, previous studies, studies) [important caribou environmental features, critical areas, observations, kills] ▪ Spring calving habitat [muskeg, bog, fen, treed fen with access to water to avoid predators] ▪ Winter foraging areas [stands of large spurce/pine with ample ground lichen loads; south facing slopes with early green-up]***fine resolution forage potential in winter with BRFN territory based on BRFN IK.[6] ▪ Fall rutting habitat (< calving and late winter)[6] ▪ Ecological restoration on linear in calving and winter habitat, include measures to restore lichen loads[6] ▪ Critical Cultural Interest Areas[6] ▪ Important caribou habitat may be located outside of provincial and federal defined caribou range boundaries based on TEK[2,6] ▪ Avoidance of, or mitigating impacts from treatments to, archaelogical sites or high potential sites[3]

1 BC Government has identified spatial boreal caribou ranges and cores; and revised ranges and cores
2 FNFN 2017
3 REMB Parker Pilot Landscape Level Restoration (Golder 2015a)
4 Demars and Benesh 2016
5 ABMI 2016
6 Leech et al. 2016
7 Golder 2017a
9 van Rensen et al. 2015
10 Government of Alberta 2017

5.0 MISSING LINKS, GAPS AND CHALLENGES

A common missing link in past restoration programs is active First Nation participation throughout the entire restoration planning process and the inclusion of Indigenous traditional knowledge on objectives of restoration, the planning and selection of restoration priority areas, or the treatment types on finer scale linear segments. Rather, programs to-date have focused around scientific considerations and past program results (e.g., Golder 2016).

A second missing link is establishing criteria for selecting priority areas among ranges. Criteria considered have included habitat recovery potential such as which caribou range would benefit most from restoration activities? (e.g., population-growth rates, additional management already occurring, reduced limiting factors and costs). However, a decision support process has not been established to support decisions on where to focus restoration between ranges.

A third missing link is that the roles and responsibilities for planning and implementation of restoration have not been explicit. Restoration activities need to be enabled in regulation, which is difficult when different Ministries and agencies have different roles in permitting an activity, there is no central planning or tracking responsibility, and there is an unclear role for First Nations in planning restoration as opposed to responding to permit applications.

Restoration Programs are also challenged by:

- a lack of long term funding;
- a lack of Indigenous or First Nation involvement in the where, what, how, when, who;
- a lack of spatially explicit priority area selection;
- lack of coordination across boreal caribou ranges (areas have been chosen based on selection of the herd with the poorest population metrics or based on where industry has a vested interest);
- limited monitoring commitments or results on effectiveness for increasing caribou populations;
- regulatory uncertainty; and
- uncertainty on protection of restoration investment.

Site specific treatments to restore historical linear disturbances have focused on historical seismic lines and the incorporation of learnings from silviculture methods used by the forest sector, including conifer and shrub seedling planting, seeding of tree species, tree transplanting, mounding and soil de-compaction. Lessons learned from these project specific programs have been incorporated into large landscape scale, or range scale, habitat restoration projects near Grande Prairie (CRRP 2007, Government of Alberta 2017-ongoing), Cold Lake (Golder 2010, 2012a; Cody 2013), Fort McMurray (Canada's Oil Sands Innovation Alliance [COSIA] 2014, ABMI 2016), Alberta and more recently within a pilot research area in the Parker caribou core through REMB support (Golder 2015, 2016, 2017b). The Parker Caribou Range Boreal Caribou Restoration Pilot Program Plan incorporates long term and coordinated monitoring for both wildlife and vegetation response and is the first range scale restoration plan in Canada.

In 2015 the REMB supported the development of a Boreal Caribou Restoration Toolkit: A Practitioner's Guide (Golder 2015b). The toolkit provides planning and decision support checklists for site specific restoration treatment selection and considerations for practitioners. The toolkit is intended to be a living document and should be updated as objectives and definition of success are revised, as alternative treatment methods are explored, or when regulatory changes are made.

Over the past 5 years, workshops with restoration practitioners and planners, regulators, and scientists have occurred with the objective of improving common understanding from hands-on restoration programs in terms

of key performance indicators, successes, best practices and outcomes. Efforts have also been made to link the results of these programs back to guidance on habitat restoration considerations.

Key learnings have been to focus on landscape-level restoration versus project scale to contribute to efforts to restore large tracts of boreal caribou habitat, integration between governments and Indigenous communities and industry, incorporation of protecting natural advanced regeneration areas, focusing treatment types to address site-specific limiting factors and human/predator movement on the landscape.

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APPENDIX B

Caribou Habitat Restoration Workshop Summary

GOLDER

REPORT

Enabling Solutions for Boreal Caribou Habitat Restoration

Submitted to:

BC OGRIS Research and Effectiveness Monitoring Board (REMB)

Submitted by:

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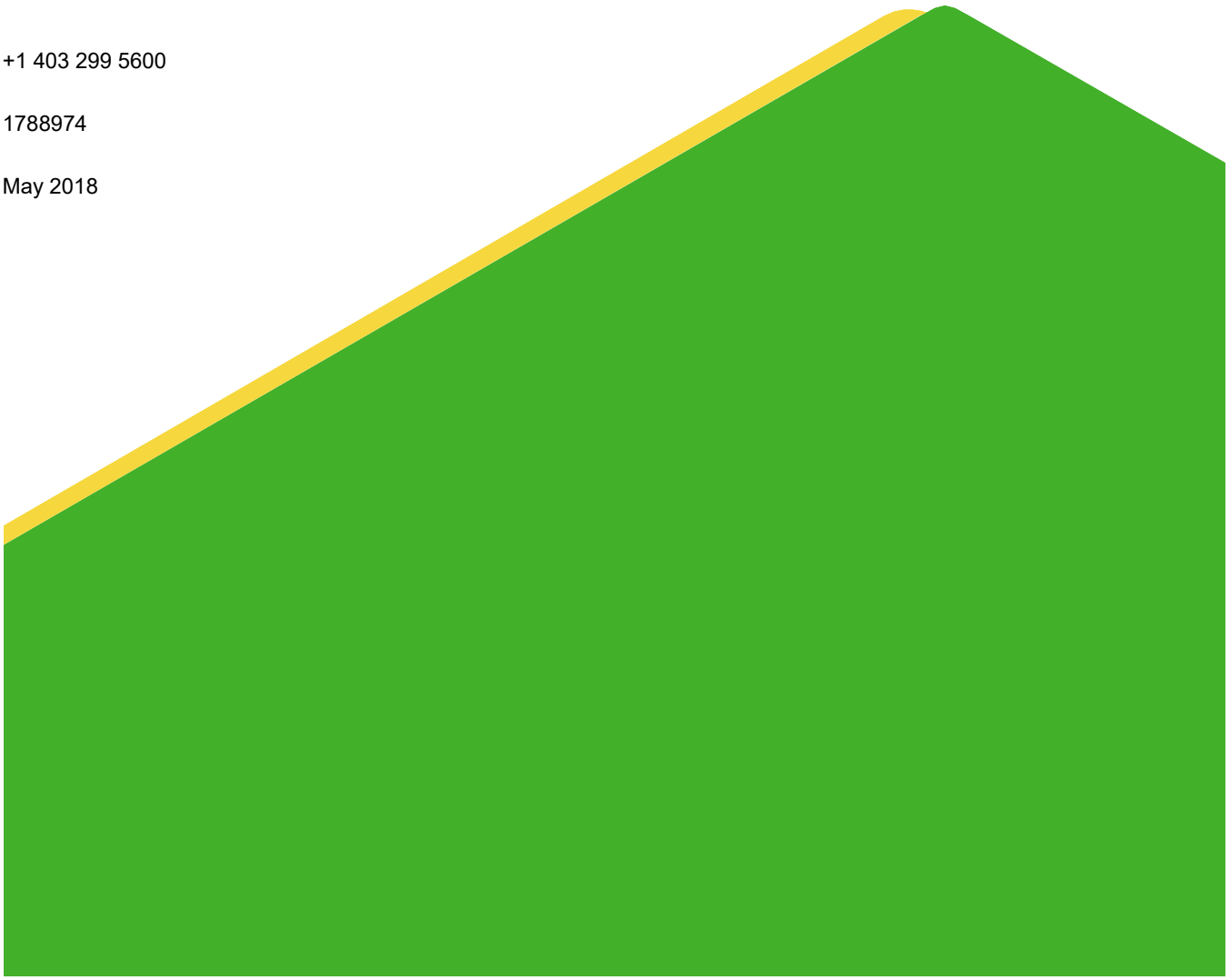

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APPENDICES

1.0 INTRODUCTION

The BC Oil and Gas Research and Innovation Society (BC OGRIS) Research and Effectiveness Monitoring Board (REMB) was established to further the goals of the Boreal Caribou Implementation Plan (BCIP; BC MOE 2011; currently under revision (BCRIP draft; BC MOE and BC FLNRO 2017)), including funding research on restoration of boreal caribou (*Rangifer tarandus caribou*) habitat. Habitat recovery actions include restoring industrial landscape features such as roads, seismic lines, pipelines, cutlines, and cleared areas in an effort to reduce habitat changes which have increased predator numbers and ultimately caribou mortality rate within fragmented and disturbed landscapes.

To move towards coordinated, accelerated habitat restoration programs within priority areas that achieve large areas of intact boreal caribou habitat in BC, Golder Associates Ltd. (Golder) was contracted by BC OGRIS REMB to deliver a one day workshop on habitat restoration within boreal caribou ranges with regulating agencies, stakeholders and First Nations. The goal of this one-day workshop was for participants to develop key principles and criteria that can guide habitat restoration planning and implementation. The workshop results will be used to develop a Restoration Framework Report that will provide guidance on how and when traditional ecological knowledge should be incorporated into habitat restoration planning and criteria identified at the workshop will be used to select and prioritize restoration areas. The Restoration Framework Report will be provided to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD), the BC government, and other agencies as advice to guide restoration planning and implementation in boreal caribou ranges.

The habitat restoration workshop took place in Fort St. John, British Columbia on April 17, 2018. Workshop participants were by invite only to ensure representation from First Nation communities, as well as to cover various stakeholder and regulator points of view. A pre-workshop backgrounder report and agenda were provided to invited participants one week prior to the workshop (Appendix A). The following report provides a workshop summary for participants, including a summary of presentations delivered during the plenary session, and breakout group discussions.

2.0 SUMMARY OF PRESENTATIONS

Table 1: Summary of Presentations

Presenter	Affiliation	Presentation Name	Presentation highlights
Chris Ritchie	MFLNRORD	Introduction to workshop	There is a renewed interested in caribou habitat restoration. This workshop will help inform future habitat restoration work across the BC province and set guidelines as to what successful habitat restoration should look like. We encourage folks to speak honestly and candidly.
Melanie Dickie	Alberta Biodiversity Monitoring Institute (ABMI) / University of Alberta	The Science Behind Caribou Recovery Options	Caribou are declining across western Canada due to industrial disturbance. Habitat disturbance increases predator efficiency and access to caribou. There are several management levers that can be used: ▪ Habitat restoration can reduce predator efficiency, reduce overlap, and reduce moose/deer numbers. ▪ Prey management can reduce moose/deer numbers. ▪ Predator management can reduce predators. ▪ Maternal pens/safe havens can act as predator free zones. All management options have pros and cons, e.g.: ▪ Habitat restoration is slow and expensive. ▪ Predator management has social costs. ▪ It is difficult to achieve targets of prey management. Each management option falls between habitat (e.g., restoration) and caribou (e.g., maternity pen) and each has a different time cost. There are 2 different types of restoration: ▪ Ecological restoration: putting the forest back to what it was, often measure by metrics such as stem density, and tree height. ▪ Functional restoration: implementing measures that interrupt predator efficiency in accessing caribou habitat, e.g., tree stem bending. Restoration does not need to be either functional or ecological, it can be both. Due to the amount of habitat that requires restoration it is important to develop a framework to prioritize restoration. ABMI prioritizes habitat with a cost benefit analysis: bang/buck using seismic line density. Bang is the amount of undisturbed habitat gained and buck is the cost of restoration. Bang/buck can be weighted by other resource values, e.g., oil reserves. Restoration success can be evaluated by: ▪ Decreased prey and predator use of seismic lines. ▪ Decreased prey and predator densities. ▪ Increased caribou survival. However, predator hunting efficiency may only be reduced when there is very low habitat disturbance, even 1 or 2 seismic lines can have an impact on caribou.

Table 1: Summary of Presentations

Presenter	Affiliation	Presentation Name	Presentation highlights
Paula Bentham	Golder	Caribou Habitat Restoration a Practitioners Perspective	Caribou habitat restoration is relatively new and has historically occurred at the project scale rather than at the range scale. Most restoration in the past has been industry driven through project approvals or has been voluntary. Now we are seeing offset requirements for industrial developments in caribou habitat; as well as a push to restore large intact habitat areas. Key finding from restoration related research and restoration projects: ▪ Restoring cutlines is not like restoring cutblocks because the organic soil may have been removed and there may be several transitions between ecozones along cutlines. ▪ New versus old seismic lines have different restoration needs due to differences in impact. ▪ Different types of linear features (e.g., pipelines versus seismic) require different restoration treatments. Pipeline right of ways need to be kept open for safety and integrity reasons, which complicates restoration. ▪ Restoration prescriptions are site specific to address site limiting factors, for further guidance, refer to the Restoration Toolkit developed for BC OGRIS. The Toolkit should be revised and updated with new learnings. Common approach to caribou habitat restoration is to use multiple treatments and combine functional and ecological restoration (e.g., tree felling can be incorporated with site prep/tree planting). ▪ Site conditions, particularly soil moisture and forest stand type, will dictate success and speed of natural succession on linear features. ▪ A linear feature may recover naturally but if a game trail persists, treatment should focus on slowing down human and predator access i.e., functionally restore the game trail. ▪ Mounding and planting requires lots of soil disturbance that could disturb important cultural sites. ▪ A consistent monitoring program should be implemented so results can be compared across projects (BC Caribou Habitat Monitoring Framework has been developed). ▪ Need to move away from project scale restoration to range scale restoration ▪ Better First Nation and Indigenous Community engagement is required early on in restoration planning. Not just for contracts in implementation. ▪ Seeds and seedling availability can hinder restoration timelines, thus it is important to communicate with suppliers/nurseries early on. ▪ Need to identify priorities in caribou habitat restoration. ▪ During the implementation phase, projects should focus on building local capacity in the local community. ▪ Long-term funding should be secured for restoration projects. ▪ There is lots of regulatory uncertainty around caribou habitat restoration.

Table 1: Summary of Presentations

Presenter	Affiliation	Presentation Name	Presentation highlights
Rachel Holt	Veridian Ecological	Fort Nelson First Nation Medzih Action Plan	Fort Nelson First Nation developed the Medzih Action Plan (MAP) to identify core restoration and protection zones for caribou in their traditional territory. Habitat suitability mapping was used to identify core restoration and protection areas. Protection cores are highly suitable habitat and restoration cores are located adjacent to protection cores. We need to strategically identify how to restore areas with the least amount of effort to create safe habitat blocks. No further money should be invested in caribou habitat restoration until there is a strategic plan in place and protection zones are in place. TEK is important for identifying these areas.
Katherine Capot-Blanc	Fort Nelson First Nation (FNFN)	Fort Nelson First Nation Restoration Experience	FNFN completed 3 ecological/functional restoration projects: Golder 2017, Parker Lake, and REMB/MFLNRO project. Success of projects was fairly good and they created good public interested stories. Mounding and tree bending at Parker Lake was successful in blocking snowmobile access. Restoration work at Parker Lake was completed in winter because that is when the site, which was characterized by wet soil, could be accessed. However, winter restoration was challenging and some seedlings died. There was concern over mounding in muskegs as the mounding holes collect water and the long-term effects on hydrology are unknown. There was also concern about the loss of moss, shrubs, and potential for invasive species establishment from restoration activities. Tree hinging and bending was found to be less expensive but labor intensive, which created local employment opportunities. In summary, FNFN found there was no one size fits all restoration solution, different disturbances and sites required different types of restoration. It is important to take strategic, wholesome approach to identify appropriate locations for restoration and long-term monitoring of projects is needed.
Susan Leech	Firelight	Caribou Habitat Restoration in In Blueberry River First Nation's (BRFN) Area of Interest	Presentation on preliminary results of caribou habitat restoration and projects working with knowledge holders. The restoration work built upon earlier work that identified critical cultural areas and caribou habitat based on BRFN knowledge. Habitat Stewardship Plan (HSP) provided the funding for the restoration work, which was completed in winter to meet fiscal year end requirements. Firelight and BRFN identified areas for restoration using habitat mapping based on Traditional Ecological Knowledge (TEK) and spatial data. Criteria for restoration were: ▪ High value caribou habitat. ▪ High density of linear disturbance. ▪ Overlaps with telemetry data. ▪ Area of high cultural importance. ▪ Accessible in winter. Lessons from the restoration work were: ▪ Spatial disturbance data did not line up with what was on the ground. ▪ Access in winter was challenging due to snow depth. ▪ Existing tenures made it difficult to find appropriate places for restoration. ▪ Restoration work is expensive.

Table 1: Summary of Presentations

Presenter	Affiliation	Presentation Name	Presentation highlights
			▪ Current guidance on restoration is forestry focused and does not consider culturally important shrubs. Developed prioritization criteria for restoration: ▪ Restore areas adjacent to intact habitat. ▪ Restore culturally significant areas. ▪ Coordinated efforts are needed. ▪ Restored areas should be closed to recreational hunting. Susan Leech visited the Parker Lake habitat restoration project (Golder 2017) with BRFN knowledge holders. Their feedback on the project is as follows: ▪ In person, mounding looked much better than they thought it would, based on photos. ▪ Mounding appeared to only be useful for blocking recreation access but not animal access. They suggested mounding could be combined with fences or a visual screen to block animal access. ▪ Some were concerned that mounding is invasive. ▪ Some were concerned that wolves will use the mounds to drive ungulates towards them and trap them there. ▪ Transplanting from adjacent sites could provide a visual screen but there was concern about how it affects the site where transplants were taken from. ▪ They suggested planting in a zigzag pattern along seismic lines to create a visual screen and that transplanting should only be done where the soil is good. ▪ For tree felling, the trees need to be big enough to be effective, otherwise other treatments were preferred. ▪ Rather than fencing, they suggested using other material, e.g., brush, to provide a functional block. ▪ Often there are game trails that cross seismic lines, treatments should not block these trails and animal movement should be facilitate on the natural game trails. ▪ They felt restoration may not be effective because of the long timeline, as a result habitat protection is necessary. ▪ They suggested protection of movement corridors between the northern mountain and boreal ecotype. ▪ Restoration should be done with native shrubs. ▪ They suggested functional restoration be used on linear features that will recover on their own. ▪ No herbicides should be allowed in the protection and restoration zones. ▪ Wolf reduction may be necessary but habitat protection and restoration zones have to be identified first.

3.0 SUMMARY OF PLENARY SESSION DISCUSSIONS

Key points from plenary session discussions are provided below:

1) Concern was raised about management of caribou herds that cross provincial borders. To face this challenge, governments need to work collaboratively to manage the entire herd.

2) Multiple management levers are required to address caribou declines and to buffer against uncertainty in the effectiveness of treatment(s).

3) It takes a long time for ecological restoration to have an effect and thus actions that have a faster effect, such as functional restoration are required in conjunction with ecological restoration.

4) The effectiveness of many functional restoration measures are short term (e.g., 1 season for tree bending or <3 years for mounding treatments).

5) We need to consider the impact of accessing sites if passive restoration will be destroyed to complete active restoration.

6) Can restore easy restoration targets but in conjunction with this, a strategic plan needs to be developed to decide where habitat restoration should occur.

7) Transplanting on linear seismic lines is unlikely to be successful because it is logistically too difficult to get enough of the root mass for the plant to survive.

8) Treatments that expose soil provide a seed bed for natural germination, but can also increase risk of invasive plant establishment.

9) Restoration planning needs to be done at the range or landscape scale, not at a project scale.

10) Measures of restoration success could be:

    a) Improved caribou population status

    b) Caribou populations that are healthy enough for First Nations to hunt.

11) Need ways to defer activity on tenures when the proponent does not want to develop, this would avoid unnecessary habitat disturbance.

12) The value of Traditional Ecological Knowledge (TEK) should be recognized and respected.

13) Industry requires clarity on where, and where not to, develop in caribou habitat and restoration requirements.

14) There are large gaps in modern data and we need make sure the most current data are being used in order to make the best decisions.

4.0 CRITERIA FOR SELECTING AND PRIORITIZING AREAS FOR RESTORATION

There were 2 breakout sessions that were used to identify criteria and principles for caribou habitat restoration. The first focused on 1) potential between range criteria for selecting areas for restoration, 2) the within range criteria for selecting areas of restoration, 3) the relative importance of criteria in 1 and 2, and 4) when and how TEK should be incorporated into the process (Table 2).

The second breakout session focused on 1) who should be responsible for planning and delivering habitat restoration plans, 2) when habitat restoration should be implemented and the sequence of activities, 3) how habitat restoration should be implemented and what the barriers are, and 4) what are the missing gaps to achieving restoration (Table 3).

Table 2: Key Points from Breakout Session 1

Group	Key Points
A	Criteria for restoration: 1) Probability of ecological success 2) Focus on transition zones between uplands and lowlands 3) Combine restoration with predator control Other considerations: An overarching plan will be necessary to help make decisions. Restoration should occur where there is high value caribou habitat, low value to humans, and the biggest bang/buck can be achieved. Within caribou ranges restoration should be adjacent to identified caribou core areas/protected habitat. Regulatory changes may be required for habitat offsets and to protect restored habitat from future disturbances.
B	Criteria for restoration: 1) Ensure there are caribou (telemetry data, TEK) 2) Respect all sources of information 3) Ecology should drive where restoration should occur 4) Need a suite of restoration practices Other Considerations: A strategic plan should be used to guide habitat restoration. Habitat restoration should be focused where the amount of intact habitat can be increased with minimal effort. A sliding scale of offsets should be used, requiring more offsets in higher value habitat. Multiple recovery management levers should be used in conjunction with habitat restoration and restoration treatments should be tailored to meet site specific requirements.
C	Criteria for restoration between ranges: 1) High likelihood of a positive impact to caribou populations 2) Current use by caribou 3) Historical use by caribou (TEK) 4) Easy to access treatment sites 5) Far from humans 6) Funding opportunities 7) Connectivity with intact habitat Criteria for restoration within ranges: 1) No to minimal effects on other species 2) Low tenure activity and future disturbance 3) Predator use is low
D	Criteria for restoration between ranges: 1) Self-sustaining population to account for time-lag of restoration 2) Minimal future development 3) Herd can withstand climate and vegetation shifts that may occur with climate change 4) Healthy herd 5) Elder knowledge of herd and sufficient data 6) Low moose density 7) Other management levers are being implemented in the range Criteria for restoration within ranges: 1) Low potential industrial and recreational disturbance 2) Large potential core area 3) High value habitat (e.g., calving area) 4) Low existing disturbance 5) Restoration should occur from within the range to outwards

Table 2: Key Points from Breakout Session 1

Group	Key Points
E	Between Range Criteria: 1) Presence of other management activities that provide results in the interim while waiting for results of restoration 2) Adjacent to intact habitat because whole intact areas are best 3) Urgency, caribou extirpation can be prevented with habitat restoration 4) Possible to restore habitat to historic condition in a time efficient manner 5) Similar habitat to what caribou use 6) Habitat that was historically used by caribou 7) Possible to restore habitat to historic condition, but will take time Within Range Criteria: 1) Chunks of undisturbed habitat and a little effort will result in a lot of undisturbed habitat 2) High value habitat (e.g., calving areas) 3) Predation risk from bears and wolves is high 4) Minimal future anthropogenic disturbance 5) High probability of successful vegetation growth (i.e. good soil and climate) 6) Distribute restoration across the range to buffer against potential natural disturbance 7) Knowledge of habitat use pattern based on TEK or telemetry data TEK should be used early on and throughout the process.

Table 3: Key Points from Breakout Session 2

Group	Key Points
A	**Who:** Provincial government owns the plan but engagement should occur with all interested parties. A caribou planning and restoration board should overlook the process and implement restoration. Restoration should be monitored by industry so they can manage adaptively. **When:** The planning board should complete a strategic plan for when and where habitat should be restored but in the interim industry will need clear direction and restoration should begin in low hanging fruit areas. **How:** A sliding scale of offsets should be used, the Oil and Gas Commission (OGC) needs clear direction and performance criteria for offsets, restoration investments should be protected, restoration should be monitored and requirements enforced. There should be incentives for footprint optimization. **Gaps:** Many gaps, among them are long-term accountability for restoration, and risk management of restoration failure.
B	**Who:** Government has overall responsibility, industry and government should provide funding, and chiefs/executive, tenure holders, stakeholders, First Nations, and biologists should lead projects. Projects should be delivered, implemented, and monitored by a board similar to the Fish and Wildlife Compensation Program. **When:** Proceed with restoration projects but begin assembling and structuring the board. **How:** Defer unnecessary development, emphasize high-ratio offsetting, constrain and limit development, and protect restoration investments.

Table 3: Key Points from Breakout Session 2

Group	Key Points
C	**Who:** Planning and development should be a coordinated effort between provincial governments, Federal government, and First Nations. **When:** Identify where to restore, plan around identified areas, and order seedling early in the process. **How:** Use incentives and enforce requirements. **Gaps:** Disturbance data, legislation, tenured responsibility for restoration, cross-jurisdictional collaboration, enforcement, reclamation standards, spatial tracking of disturbance, and industry collaboration.
D	**Who:** The province is legally responsible for oversight but industry is responsible for meeting permit conditions. First Nations should have a role throughout the process and should potentially play “guardians” role similar to a program that Haida Gwaii has. **When:** Restoration should occur when habitat has been protected and infrastructure is no longer needed. First Nations can provide insights on when restoration should occur. **How:** Changes in legislation will be required to facilitate restoration and keep habitat intact, for example, industry should be allowed to defer tenure activity. Restoration should be proponent led but the work should be complete by a third party. Restoration should also be monitored remotely, e.g., with drones to avoid disturbing restoration sites. **Gaps:** Access to funding, high cost of restoration, existing tenure holders and future development, consistent monitoring across all projects, and traplines accessed by existing linear features.
E	**Who:** Government and Indigenous communities should hold industry accountable for restoration. Each responsible body has a different role to play and all should work collaboratively. **When:** Easy restoration targets should be completed immediately, concurrently a strategic plan should be developed to develop range based plans. Restoration plans should be completed before new development projects are approved. **How:** Restoration work should be coordinated between projects and promote local capacity building. Industry needs to be provided with practical line of sight options and practical access management options. **Gaps:** Good working relationships between First Nations and industry, consistent standards in restoration, policy changes to improve caribou habitat management, security of restoration investment, better understanding of restoration objectives, ecological factors, cultural factors, spiritual factors, and economic factors.

Signature Page

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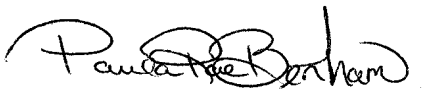
Meghan Anderson, M.Sc., R.P.Bio.
Wildlife Biologist



Paula Bentham, M.Sc., P. Biol.
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https://golderassociates.sharepoint.com/sites/19531g/2000_stakeholder_workshop/workshop_summary/1788974_bcogris_caribouworkshopsummary_final.docx

APPENDIX A

Workshop Agenda



ENABLING SOLUTIONS FOR BOREAL CARIBOU RESTORATION

APRIL 17, 2018
8:30 AM – 4:30 PM
FORT ST. JOHN

WORKSHOP OBJECTIVE:

For participants to develop key principles and criteria which can guide habitat restoration planning and implementation within boreal caribou ranges in NE BC. The workshop findings will be documented in a Restoration Framework Report to be presented to the BC Ministry of Forests Lands Natural Resources Operations and Rural Development (FLNRORD) as advice to guide restoration planning and implementation in boreal caribou ranges.

AGENDA

Timing	Topic	Presenter(s)
8:30 – 09:00	**Opening Remarks:** Welcome and opening remarks, Introductions, House-keeping, Ground Rules and Agenda	Elder, TBD Kevin Seel, Golder
9:00 – 09:10	Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNRORD) perspective on Habitat Restoration and Workshop Objectives	Chris Ritchie, FLNRORD
9:10 – 09:35	**Presentation 1:** Science behind Habitat Restoration as One Recovery Action and Considerations	Melanie Dickie, ABMI/University of Alberta
9:35 – 10:00	**Presentation 2:** Habitat Restoration History, Summary of Potential Restoration Prioritization Criteria	Paula Bentham, Golder
10:00 – 10:15	**Coffee Break**	

AGENDA

Timing	Topic	Presenter(s)
10:15 – 12:00	**Facilitated Group Discussion:** The First Nation Perspective on Habitat Restoration. After a brief presentation from First Nation Participants, the floor will be opened for a group discussion. Possible Group Discussion topics to include: ■ *What does successful restoration look like?* ■ *At what stages within habitat restoration planning, implementation, and monitoring, should First Nation's and Traditional Ecological Knowledge (TEK) be included within the delivery of a restoration process and program?* ■ *What treatments or considerations have been missing in past projects?* ■ *Explore differences between Functional and Ecological Restoration and provide considerations for how objectives are linked to type of treatment; or no treatment* ■ *Feedback on when to treat, or when not to treat* Comments, and key learnings will be gathered from all participants	Katherine Capot-Blanc and Rachel Holt, Fort Nelson First Nation Presentation Title: *Fort Nelson First Nation's Medzih Action Plan and its Implications for Restoration* TBD
12:00 – 1:00	**Lunch Break – *Lunch Provided***	
1:00 – 2:30	**Breakout Session 1:** Participants will be divided into roughly equal groups and work with a facilitator to respond to the following discussion topics: 1. What are the potential "between range" criteria for selecting areas for restoration? 2. What are the "within range" criteria for selecting areas for restoration? 3. Rank the relative importance (1,2,3…etc.) of the above criteria based on balancing caribou conservation priorities, current land base condition, Indigenous priorities, and existing tenures and land-use. 4. Where does First Nation Traditional Ecological Knowledge (TEK) fit in and how? Includes a 30 minute group debrief of breakout discussion results	Breakout group facilitators
2:30 – 2:45	**Coffee Break**	

AGENDA

2:45 – 4:15	**Breakout Session 2:** Participants will be divided into new groups and work with a facilitator to respond to the following discussion topics: 1. Who should be responsible for planning and delivering habitat restoration plans including tracking and monitoring? 2. When – Habitat Restoration activities have been identified to be implemented as soon as possible. However, in light of costs and competing ranges, what considerations should be made in the sequencing of restoration activities? 3. How – Identify workable solutions to avoid or minimize barriers and constraints, and identify opportunities 4. What's missing, what are the gaps? Includes a 30 minute group debrief of breakout discussion results	Breakout group facilitators
4:15 – 4:30	Action Items, Wrap-up and Closing Statements	Kevin Seel, Golder Chris Ritchie, FLNRORD

APPENDIX B

Workshop Background Material

WORKSHOP BACKGROUNDER

British Columbia Boreal Caribou Habitat Restoration

Restoration Framework Workshop

Submitted to:

Workshop Participants

Submitted by:

Golder Associates Ltd.

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April 2018

Table of Contents

1.0 BACKGROUND

The BC Oil and Gas Research and Innovation Society (BC OGRIS) Research and Effectiveness Monitoring Board (REMB) was established to further the goals of the Boreal Caribou Implementation Plan (BCIP; BC MOE 2011; currently under revision (BCRIP draft; BC MOE and BC FLNRO 2017)), including funding research on restoration of boreal caribou habitat. The Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population in Canada (Environment Canada 2012), established a risk-based threshold of a minimum of 65% undisturbed habitat in each population range, to be applied in boreal caribou range planning and action planning across Canada. The threshold was informed by a scientific assessment that evaluated the contribution of natural (fire) and human (industrial) disturbance to range condition, and the likelihood of varying habitat conditions supporting self-sustaining boreal caribou populations (Environment Canada 2011). One of the management approaches in the federal recovery strategy to address effects of habitat alteration on boreal caribou is to undertake coordinated actions to reclaim boreal caribou habitat through restoration efforts. This approach to addressing habitat alteration has been carried through to the draft BCRIP (BC MOE and BC FLNRO 2017) with the proposed revised plan being to **"maintain a positive habitat trend across each boreal caribou range**".

The draft BCRIP identifies that approaches used to achieve sustainable boreal caribou populations should be completed with the least possible impact to economic opportunities. Habitat recovery actions include restoring industrial landscape features such as roads, seismic lines, pipelines, cutlines, and cleared areas in an effort to reduce habitat changes which have increased predator numbers and ultimately caribou mortality rate within fragmented and disturbed landscapes.

Habitat restoration is one tool in the toolbox for caribou population recovery. Habitat restoration alone will not recover boreal caribou. Parallel management levers including predator control and population augmentation (e.g., penning) are recognized as immediate levers given the time lag for habitat to recover.

Artists Rendition of Boreal Caribou Decline Story, commissioned by the REMB.

2.0 WORKSHOP GOAL

The goal of this one-day workshop is for participants to develop key principles and criteria that can guide habitat restoration planning and implementation within boreal caribou ranges. Results of the workshop will subsequently be presented in a Restoration Framework Report. The Restoration Framework Report will be presented to the BC government and other agencies as advice to guide restoration planning and implementation in boreal caribou ranges.

2.1 Workshop Objectives

1) There is recognition that First Nation communities want to be involved in caribou habitat restoration programs and for inclusion in the recovery of woodland caribou. There is also recognition of the value and importance of incorporating First Nations Traditional Ecological Knowledge (TEK) and feedback on what success looks like for habitat restoration. During the workshop, we will discuss how, and at what stages within habitat restoration planning, implementation, and monitoring, that First Nations are included within the delivery of a restoration process and program.

2) Technical discussion of what criteria to use, and how to weight that criteria, to choose priority areas between ranges and within ranges for restoration.

3) To gather feedback on the desired end state of habitat restoration implementation; ‘what does successful restoration look like’? Participants will explore both ecological and functional restoration and provide feedback on current types of treatment, and decision criteria for use around no treatment and leave for natural recovery.

4) Identify workable solutions to avoid or minimize barriers or constraints to administrative and regulatory policy, acts and legislation.

WORKSHOP APPROACH

This one-day workshop has been designed to encourage invitees to provide perspectives so that practical and effective technical solutions can be identified and shared with the BC government.

1) The day will begin with presentations summarizing government, western science, practitioner and First Nation perspectives on the considerations, challenges and potential solutions and opportunities to implementing habitat restoration under the proposed draft BCRIP.

2) All attendees will have the opportunity to ask questions and seek clarification from the presenters.

3) All attendees will have the opportunity to contribute to what is the desired end state of restoration, what success will look like, what restoration treatments have been missing in past projects, decision criteria to support a physical restoration treatment, and at what stages First Nation’s and TEK be included within the delivery of a restoration process and program.

4) Attendees will then be divided into smaller break-out groups to spend several hours discussing a common set of questions:

    i) Where should restoration activities be undertaken (criteria and ranking of criteria both between caribou ranges and within a caribou range)?

    ii) Who should be responsible for planning and delivering habitat restoration plans? Tracking? Monitoring?

    iii) When – what considerations need to be made in sequencing habitat restoration activities on the ground?

iv) How – identify workable solutions to avoid or minimize barriers and constraints, and to identify opportunities.

5) All attendees will reconvene after their small group discussions and each break-out group will have an opportunity to provide their groups' insights on criteria and weighting of criteria for the WHERE, the WHO, the WHEN, and TOP TWO workable solutions to avoid or minimize barriers and constraints, and to identify opportunities.

6) A brief summary of recommended (or alternate) solutions will be prepared and provided to attendees by April 27, 2018.

The workshop objective and agenda is ambitious, and the following background material is provided to help you prepare. Note that we will be using this material to focus on key topics relevant to a technical discussion on habitat restoration.

3.0 HABITAT RESTORATION – *WHAT DOES SUCCESS LOOK LIKE?*

Boreal caribou habitat restoration is a relatively new science, having emerged within boreal caribou ranges in 2002 (Alberta; Szkorupa 2002) and post 2012 in BC. Only in the past 5 years have restoration programs focused on creating larger tracts of intact boreal caribou habitat. Initial restoration and findings on effectiveness were completed on a project by project scale, primarily as mitigation to meet an industrial project approval condition. The short history of restoration, the lack of coordinated and long-term monitoring programs, and the time lag for seedlings to grow, provides only limited insight into the effectiveness of restoration to meet either a functional or ecological objective.

Functional Restoration Objective: this includes application of techniques on human disturbances that aim to limit or deter predator use of linear disturbances to attempt to restore historic caribou-predator encounter rates. Functional restoration techniques do not necessarily result in the restoration of linear disturbance areas to their pre-disturbance structural state (i.e. ecological restoration) (Demars and Benesh 2016). Perceived benefits of functional restoration over ecological restoration include more immediate impacts on the targeted biological process, cost-effectiveness and speed of treatment. Functional restoration techniques have focused on tree felling, but have also incorporated mounding and tree planting between tree felling segments to promote ecological habitat recovery in the long-term.

Photo 1: Example of functional restoration treatments using tree felling from Parker Range.

Photo 2: Example of functional restoration treatments using tree felling from Parker Range.

Ecological Restoration Objective: primary objective is to return a disturbance to a similar state of ecological function, or habitat state, as before the disturbance (Wilson 2015, Demars and Benesh 2016). Methods for ecologically restoring linear features within boreal caribou ranges have focused on 1) leave for natural vegetation recovery where advanced regeneration is evident, and 2) soil mounding (Photo 3) or other site preparation and seedling planting (Photo 4), or use of coarse woody debris with planting to address poor site conditions (Bentham and Coupal 2015; Pyper et al. 2014). Ecological restoration is considered to be most effective for broad ecological goals in the long term, but will take longer to achieve reductions in predation efficiency (FNFN 2017). A major drawback is cost, which can be as high as $12,000 per km when seedling planting is combined with mounding and other mechanical site preparation treatments (Demars and Benesh 2016). Ecological restoration may be prohibitive to apply at scales sufficiently large to have an impact on caribou population dynamics (Demars and Benesh 2016). Treatments are costly and have logistical challenges to cover very large and remote areas over a short time frame (e.g., for peatland areas winter access only with heavy machinery, or use of amphibuous equipment).

Photo 3: An excavator is used to dig holes and place the soil beside the hole creating an elevated mound. Elevated mounds create an elevated microsite that increases soil temperature and improves growing conditions for natural regeneration and planted seedlings. Mounds can also help create an access barrier for human travel and may impede predator movement on lines.

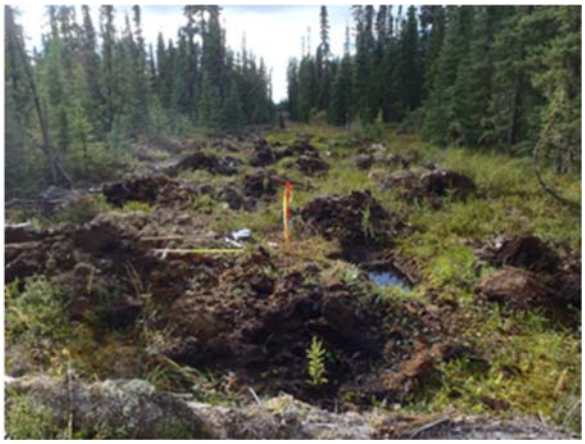

Photo 4: Mounding example with seedlings planted on mounds within a peatland. Mounds are used in lowland sites to enhance survival and growth of planned seed or seedlings and to promote natural regrowth of vegetation over time, as higher, drier spots are created that seed can settle into and germinate. Mounds can also be used in dry stands or upland sites to improve moisture availability (pooling of water in mound holes) and to address seedling competition from undesirable plant species such as grasses.

These two objectives need not be mutually exclusive: ecological restoration can result in functional restoration and vice versa. In general, the focus of functional restoration is to immediately affect the targeted biological process (or processes) while impacts from ecological restoration may require a longer time frame (trajectories from initial restoration programs forecast upwards of 15 to 25 years to reach vegetation heights of 1.5 m to 3.0 m to influence predator movements as identified in Dickie (2015) (Golder 2018)).

Because of the costs and time-lags associated with large-scale ecological restoration (see cost summaries within Pyper et al. 2014), recent focus has been on developing effective methods for functional restoration (Wilson 2015) to address the time lag of ecological restoration and size of areas to be treated.

Where to Implement Restoration Treatments, and Decision Criteria for When Not to Treat

Vegetation re-growth on seismic lines is mainly influenced by the moisture and nutrients that exist on a linear segment of a disturbance (site by site basis), influenced by the surrounding forest or peatland stand where the disturbance occurs, the initial disturbance and method of clearing, and the level of human use following clearing (van Rensen et al. 2015). Natural vegetation regeneration does occur, with linear disturbances with a moderate amount of moisture (mesic sites) the most likely to regenerate naturally without restoration treatments implemented (all things being equal), whereas a linear disturbance in a bog or fen is least likely to regenerate naturally (van Rensen et al. 2015). Natural regeneration to 3 m vegetation height within 30 years occurs more often at sites with moderate amounts of moisture, narrower line widths (e.g., low impact seismic versus conventional seismic), sites occurring at distances further from roads and within upland forests as opposed to peatlands (van Rensen et al. 2015). Areas adjacent to major rivers are more likely to have vegetation naturally regenerate. Overall, terrain wetness and the presence of fens have the strongest negative effect on natural regeneration recovery (van Rensen et al. 2015).

Natural regeneration however is often hindered, depending on a number of site limiting factors. Slow, or in some cases none, tree regeneration has been attributed to root damage from the original disturbance, compaction of the soil in tire ruts, insufficient light reaching the forest floor, maintenance of apical dominance from surrounding stands, introduction of competitive species (i.e., planted seed mixes), poor drainage of sites (i.e., regeneration slowest on poorly drained sites with low nutrient availability such as bogs), thickness of mulch and repeated disturbances (e.g., OHVs, animal browsing, repeated exploration) (Revel et al. 1984; MacFarlane 2003; Sherrington 2003, Golder and Explor 2016).

Seismic lines in boreal caribou range which have regenerated naturally, without any significant human activity (e.g., re-cleared to ground level for winter access or seismic program use), have achieved an average height of 2 m among upland habitat types within 20 to 25 years (Oberg 2001, Golder 2009). Natural recovery and restoration programs however, have also been negatively compromised when OHVs destroyed seedlings, or when a restoration area is re-entered for an industrial or recreational use.

Photo 5: Natural Regeneration of a typical conventional seismic line in the boreal forest.

Photo 6: Natural Regeneration of a typical conventional seismic line in the boreal forest.

Detailed planning has been used as a means to both protect a restoration program investment, as well as to determine where to treat or not to treat for restoration. Typically, the following is decision criteria and support tools are used:

- avoid restoration treatments within areas occurring within approved or future disturbance footprints based on economic value;
- avoid restoration treatments on disturbances under an active disposition (e.g., roads, transmission rights-of-way) with existing reclamation requirements;
- avoid treating disturbances used by trappers or other land users and stakeholders to minimize land use conflicts; and
- mapping of caribou ranges through remote sensing methods or field visits is used to determine existing vegetation structure, site limiting factors, and human/predator access within disturbances.

Typical criteria used to make decisions on where to apply habitat restoration treatments include:

- Type of disturbance:
  - Disturbances under Provincial active disposition or protective notation, or of a permanent nature (typically active roads, railroad, transmission line, pipelines, wellsites, cutblocks, designated recreational trails) are typically removed as treatment candidate areas. These areas are either permanent provincial infrastructure, or have provincial or federal reclamation and reforestation requirements following decommissioning.
  - Pipelines may be considered semi-permanent, often with natural vegetation recovery occurring to a certain distance to the ‘trenchline’ around the pipe itself (typically 5 to 10 m). Pipeline integrity, safety

and monitoring are criteria used to keep areas of this rights-of-way type cleared until abandonment and reclamation.

- Seismic and cutlines are not all equal, and conditions along lines vary as you move along a line and between different adjacent forest stands (lowland, transitional, upland). Seismic lines can experience a significant amount of natural vegetation recovery, which varies based on initial disturbance impact (e.g., low blading, removal of organic soil and compaction), nutrient and moisture conditions.
- Seismic lines can be 'conventional' which are typically 6 to 12 metres wide and straight or classified as "Low Impact Seismic" (LIS) which can range from a 1.5 metre hand cut line to a 7 m line. LIS are almost exclusively cut by mulchers, are younger, and meander through the forest. Wolves have been documenting selecting pipelines and conventional seismic lines over LIS.
- Low Impact Seismic lines are not all equal with level of natural revegetation recovery influenced by:
  - North-south orientation with greater vegetation height growth then east-west orientation.
  - Mulch distribution (LIS with no mulch, or scattered mulch supports taller vegetation).
  - Forest type (upland > lowland) influences natural vegetation.

- Access Control Locations:
  - Strategically focus on treating disturbances that cross permanent access such as roads, to minimize human use with motorized vehicles. Reducing human use increases natural vegetation recovery and minimizes opportunity for snow packing which enhances predator mobility.
  - Focus treatments to minimize predator travel on transitional habitat types between uplands and lowlands.
  - Game trail / UTV trail areas (if not identified for stakeholder use) a focus for functional restoration.
- Adjacent Forest/site type:
  - Uplands, lowlands, transitional sites.
  - In general, seismic lines occurring in deciduous forest stands or mesic forest stands (transitional sites) have greater natural revegetation then lowlands.
- Existing Natural Vegetation Structure:
  - Structure includes conifer vs. shrub, percent vegetation cover, heights, and diversity of species.
  - To increase implementation efficiency and costs, treatments are typically focused on lines where natural vegetation recovery is not occurring, with the treatment focused on the site specific limiting factor.
  - Western science has focused on understanding the influence of vegetation structure to wolf travel speed and hunting efficiency on disturbances as compared to travel within forest stands. If wolves use seismic lines to increase their travel speed and hunting efficiency, it may be appropriate to consider when lines regenerate enough for the vegetation to slow and eventually stop, wolves from selecting lines. For example, once vegetation height reaches 50 cm wolf travel speed is considerably reduced (summer, in upland forests; Dickie et al. 2017).
  - Compaction during initial disturbance, as well as repeated human and wildlife use of lines (e.g., game trails) hinders vegetation growth.

4.0 EXAMPLES OF POSSIBLE CRITERIA FOR CHOOSING PRIORITY RESTORATION AREAS

It is recognized that there is an urgent need to spatially identify and prioritize restoration areas within boreal caribou ranges (FNFN 2017). In past restoration planning exercises, a number of ecological, regulatory, land use, stakeholder, and logistical criteria have been used to identify restoration program areas. More recently, cultural criteria have been identified. The following matrix summarizes criteria which have been previously used, or identified, to select areas ***within a range*** for restoration.

Fewer programs have considered how to set priorities ***between ranges***. Criteria used have included wildlife modelling to compare projected change in caribou and predator numbers expected following habitat restoration (ALT 2009, FNFN 2017), or focusing on the caribou herd in greatest decline.

ECOLOGICAL	**LOGISTICAL**
▪ Core Habitat Areas[1] / High Value Caribou Habitat[2] ▪ Calving habitat[2,3,4] ▪ Caribou locations, high use areas[2,3] ▪ Predators location/numbers and overlap with caribou[3] (biologically meaningful area such as a wolf pack territory area[4]) ▪ Seismic density[5] ▪ Mortality event locations ▪ Existing Natural Vegetation Recovery ("Leave for Natural") ▪ Large area to create intact habitat patches	▪ Footprint inventory and natural reveg recovery ▪ High Cost (mounding/seedlings $12,000/km)[4] ▪ Accessibility ▪ Availlable Seed Source and Seedlings (Timeline) ▪ Ground Conditions ▪ Available sites (polygonal and linear disturbances not under active disposition, designated trails, and not falling under existing reclamation requirements) ▪ Predicted Natural Recovery (fine scale attributes; vegetation height/cover, wetness, nutrients, distance to road, forest stand)[3,7,9,10] ▪ Archeological potential[3,7] ▪ Stakeholder engagement
REGULATORY / LAND USE / DISTURBANCE	**CULTURAL**
▪ Current level of disturbance ▪ % Gain-in-Undisturbed habitat[2,3,5] ▪ Protected Areas[2] ▪ Low Economic Value Resource Areas[3,5] ▪ Provincially-designated land with potential for less future disturbance (WHA, UWR, Parks, OGMA)[2] (with noted exceptions, not protection) 7 ▪ Resource Review Areas[3] ▪ Outside Fire Areas < 40 years[3,5,7] ▪ Disturbance under Active Dispositions on Crown Land 'No Treatment', consider reclamation requirements[3,7] ▪ Outside Future harvest management plan areas[2,3,7] ▪ Outside mountain pine beetle current distribution and susceptibility ranking[7] ▪ Limited future development potential[3,5,7] ▪ Limited stakeholder conflicts[7] ▪ Type of Disturbance (conventional seismic, LIS, pipeline, etc.)[3]	▪ Protection and Restoration Zones[2] ▪ Oral history[6]; high value caribou habitat ▪ TEK (knowledge holders, previous studies, studies) [important caribou environmental features, critical areas, observations, kills] ▪ Spring calving habitat [muskeg, bog, fen, treed fen with access to water to avoid predators] ▪ Winter foraging areas [stands of large spurce/pine with ample ground lichen loads; south facing slopes with early green-up]***fine resolution forage potential in winter with BRFN territory based on BRFN IK.[6] ▪ Fall rutting habitat (< calving and late winter)[6] ▪ Ecological restoration on linear in calving and winter habitat, include measures to restore lichen loads[6] ▪ Critical Cultural Interest Areas[6] ▪ Important caribou habitat may be located outside of provincial and federal defined caribou range boundaries based on TEK[2,6] ▪ Avoidance of, or mitigating impacts from treatments to, archaelogical sites or high potential sites[3]

1 BC Government has identified spatial boreal caribou ranges and cores; and revised ranges and cores
2 FNFN 2017
3 REMB Parker Pilot Landscape Level Restoration (Golder 2015a)
4 Demars and Benesh 2016
5 ABMI 2016
6 Leech et al. 2016
7 Golder 2017a
9 van Rensen et al. 2015
10 Government of Alberta 2017

5.0 MISSING LINKS, GAPS AND CHALLENGES

A common missing link in past restoration programs is active First Nation participation throughout the entire restoration planning process and the inclusion of Indigenous traditional knowledge on objectives of restoration, the planning and selection of restoration priority areas, or the treatment types on finer scale linear segments. Rather, programs to-date have focused around scientific considerations and past program results (e.g., Golder 2016).

A second missing link is establishing criteria for selecting priority areas among ranges. Criteria considered have included habitat recovery potential such as which caribou range would benefit most from restoration activities? (e.g., population-growth rates, additional management already occurring, reduced limiting factors and costs). However, a decision support process has not been established to support decisions on where to focus restoration between ranges.

A third missing link is that the roles and responsibilities for planning and implementation of restoration have not been explicit. Restoration activities need to be enabled in regulation, which is difficult when different Ministries and agencies have different roles in permitting an activity, there is no central planning or tracking responsibility, and there is an unclear role for First Nations in planning restoration as opposed to responding to permit applications.

Restoration Programs are also challenged by:

- a lack of long term funding;
- a lack of Indigenous or First Nation involvement in the where, what, how, when, who;
- a lack of spatially explicit priority area selection;
- lack of coordination across boreal caribou ranges (areas have been chosen based on selection of the herd with the poorest population metrics or based on where industry has a vested interest);
- limited monitoring commitments or results on effectiveness for increasing caribou populations;
- regulatory uncertainty; and
- uncertainty on protection of restoration investment.

Site specific treatments to restore historical linear disturbances have focused on historical seismic lines and the incorporation of learnings from silviculture methods used by the forest sector, including conifer and shrub seedling planting, seeding of tree species, tree transplanting, mounding and soil de-compaction. Lessons learned from these project specific programs have been incorporated into large landscape scale, or range scale, habitat restoration projects near Grande Prairie (CRRP 2007, Government of Alberta 2017-ongoing), Cold Lake (Golder 2010, 2012a; Cody 2013), Fort McMurray (Canada's Oil Sands Innovation Alliance [COSIA] 2014, ABMI 2016), Alberta and more recently within a pilot research area in the Parker caribou core through REMB support (Golder 2015, 2016, 2017b). The Parker Caribou Range Boreal Caribou Restoration Pilot Program Plan incorporates long term and coordinated monitoring for both wildlife and vegetation response and is the first range scale restoration plan in Canada.

In 2015 the REMB supported the development of a Boreal Caribou Restoration Toolkit: A Practitioner's Guide (Golder 2015b). The toolkit provides planning and decision support checklists for site specific restoration treatment selection and considerations for practitioners. The toolkit is intended to be a living document and should be updated as objectives and definition of success are revised, as alternative treatment methods are explored, or when regulatory changes are made.

Over the past 5 years, workshops with restoration practitioners and planners, regulators, and scientists have occurred with the objective of improving common understanding from hands-on restoration programs in terms

of key performance indicators, successes, best practices and outcomes. Efforts have also been made to link the results of these programs back to guidance on habitat restoration considerations.

Key learnings have been to focus on landscape-level restoration versus project scale to contribute to efforts to restore large tracts of boreal caribou habitat, integration between governments and Indigenous communities and industry, incorporation of protecting natural advanced regeneration areas, focusing treatment types to address site-specific limiting factors and human/predator movement on the landscape.

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APPENDIX C

Workshop Attendees and Discussion Groups

Gary Oker, Sam Acko, and 2 other members of Doig River First Nation opened the workshop with a traditional drumming song. Workshop attendees are listed by breakout group in Table 5.

Table C-1: Groups from Breakout Discussions

Group	Facilitator	Participants
A	Paula Bentham	Morgan Kennah, MFLNRORD Sean Curry, BC Oil and Gas Commission Rachel Holt, Veridian Ecological, on behalf of FNFN Fabian Chonkolay, Dene Tha Craig Losos, TransCanada, on behalf of CEPA James Hodson, Government of Northwest Territories Darrel Regimbald, CANFOR Baptiste Metchooyeah, Dene Tha
B	Steve Wilson	Dale Morgan, BC Ministry of Indigenous Relations and Reconciliation Madelaine Oker, Doig River First Nation Susan Leech, Firelight Group, on behalf BRFN Mark Phinney, Encana, on behalf of CAPP Jason Smith, BC Timber Sales (BCTS) Lori Lineham, Doig River First Nation Amber Bergen, BC Oil and Gas Commission
C	Michael Huck	Alena Charlston, MFLNRORD Isabel Ceillier, Species at Risk Program, Government of Canada Katherine Capot-Blanc, FNFN Tim Thielmann, Prophet River First Nation Stephanie Smith, BCTS Blair Hammond, Canadian Wildlife Services Mike Gilbert, Northern Rockies Regional Municipality Kelli Cote, MFLNRORD
D	Megan Watters	Richard Kabzems, MFLNRORD Chris Pasztor, BC Ministry of Energy, Mines, and Petroleum Resources Tamara Dokkie, West Moberly First Nation Dale Seip, BC Ministry of Environment Jon Gareau, Canadian Natural Resources Limited (CNRL), on behalf of Canadian Association of Petroleum Producers Ben Rauscher, BC Oil and Gas Commission Dan Rose, Peace River Regional District
E	Meghan Anderson	Chris Ritchie, MFLNRORD Trevor Hann, MFLNRORD Connie Martel, Dene Tha Fred Didzena, Dene Tha James Robert, Enbridge, on behalf of Canadian Energy Pipeline Association Brett Elkin, Government of Northwest Territories Melanie Dickie, ABMI Jack Yurko, Golder

Note: Although participants are listed in a group, not all participants actively contributed to the discussion. Naomi Nichol, Ministry of Environment and Climate Change Strategy was absent for the breakout group discussion and Michael Cody, Cenovus remotely attended the workshop (phoned in to workshop) but did not participate in the breakout groups.

APPENDIX D

Workshop Presentations

Presentation by ABMI; Presented by: Melanie Dickie

The Science Behind Caribou Recovery Options

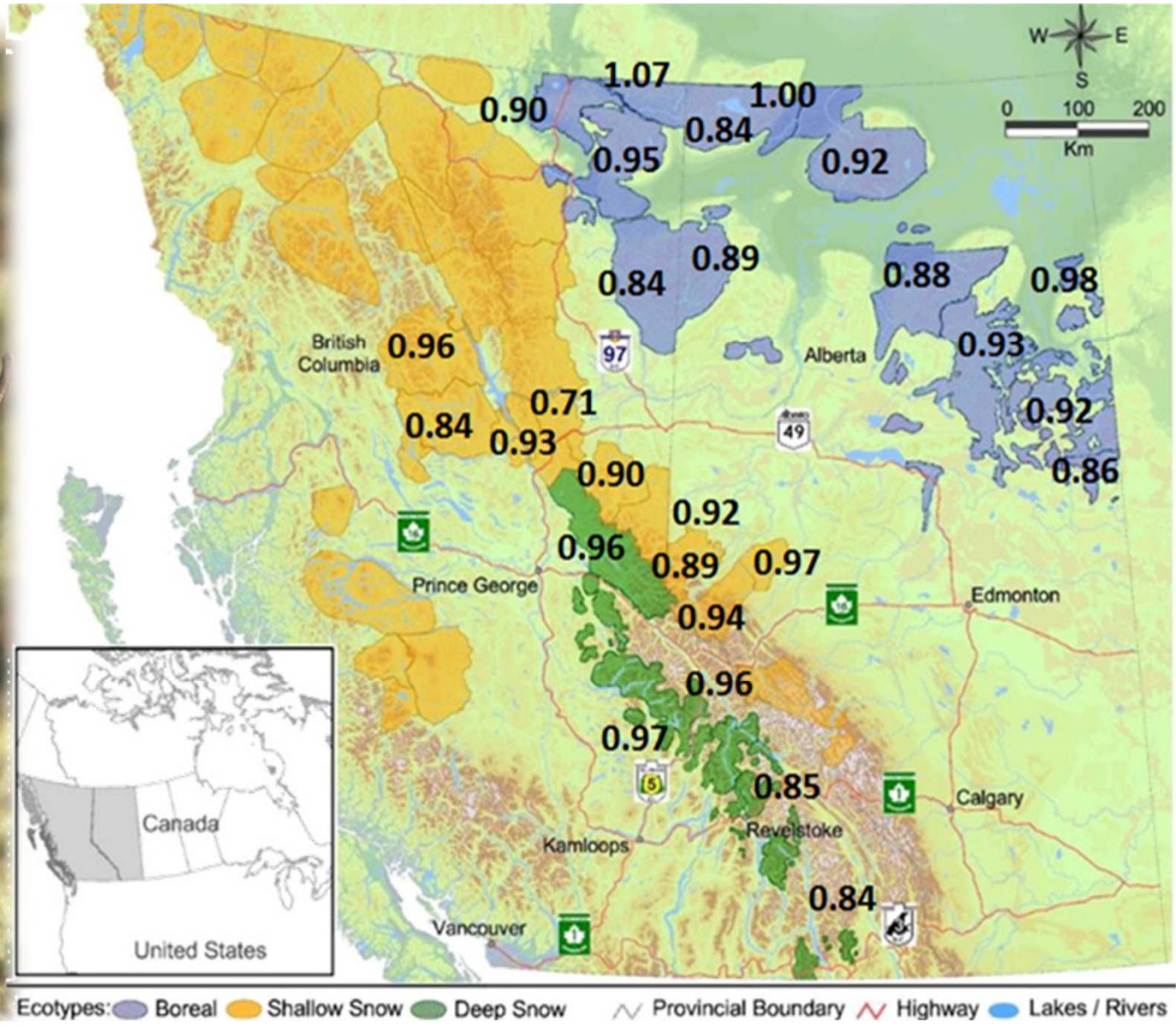
M DICKIE

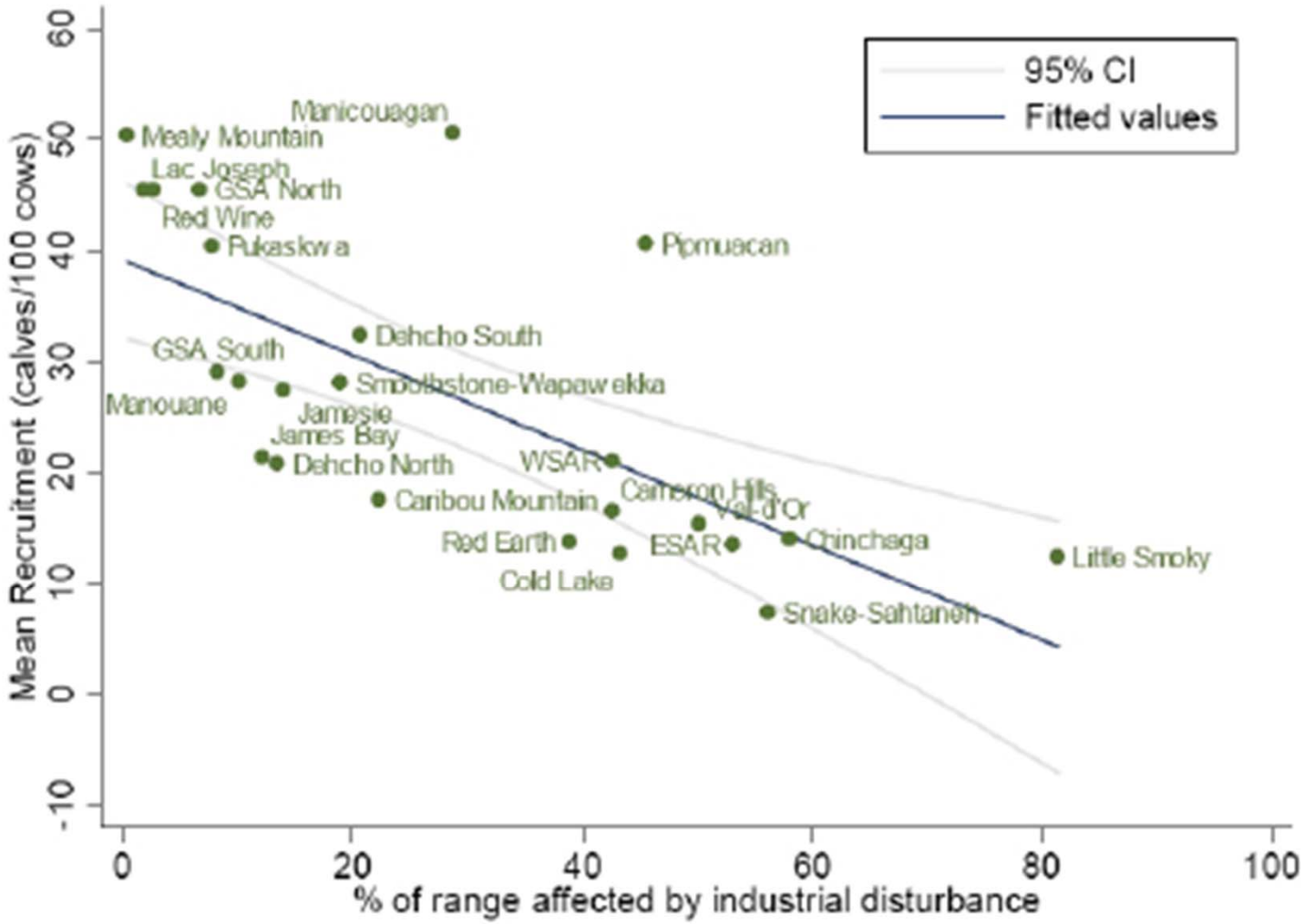
RESTORATION PLANNING WORKSHOP

APRIL 2018

Hervieux et al 2013
Serrouya et al 2017

The caribou story




95% CI
Fitted values
Manicouagan
Mealy Mountain
Lac Joseph
GSA North
Red Wine
Pukaskwa
Pipmuacan
Dehcho South
GSA South
Smoothstone-Wapawekka
Manouane
Jamesie
James Bay
Dehcho North
WSAR
Cameron Hills
Caribou Mountain
Val-d'Or
Red Earth
ESAR
Chinchaga
Little Smoky
Cold Lake
Snake-Sahtaneh
Mean Recruitment (calves/100 cows)
% of range affected by industrial disturbance
-10
0
10
20
30
40
50
60
0
20
40
60
80
100

What can we do about it?

Habitat Restoration
- Reduce efficiency
- Reduce overlap
- Reduce moose/deer

Habitat Restoration
- Reduce efficiency
- Reduce overlap
- Reduce moose/deer

Prey Management
-Reduce moose/deer

Habitat Restoration
- Reduce efficiency
- Reduce overlap
- Reduce moose/deer

Predator management:
-Reduce predator density

Prey Management
-Reduce moose/deer

Habitat Restoration
- Reduce efficiency
- Reduce overlap
- Reduce moose/deer

Predator management:
-Reduce predator density

Prey Management
-Reduce moose/deer

Caribou Management
-Penning
-“Safe Havens”

Habitat Restoration
- Slow
- Access
- $$

Predator management:
- Social $$

Prey Management
-Difficult to achieve targets

Caribou Management
-“zoos”
-$$

Habitat Restoration

Predator Management

Prey Management

Penning Save Havens

Time Matters

Habitat Restoration

Predator Management

Prey Management

Penning Save Havens

Time Matters

Habitat Restoration

Predator Management

Prey Management

Penning Save Havens

Defining Restoration

Ecological Restoration:

- Restoring ecological processes
- Putting the forest back to how it should be
- Defining “should be” can be difficult
- Vegetation structure and composition

Functional Restoration:

- Reducing predator movement
- Reducing human access

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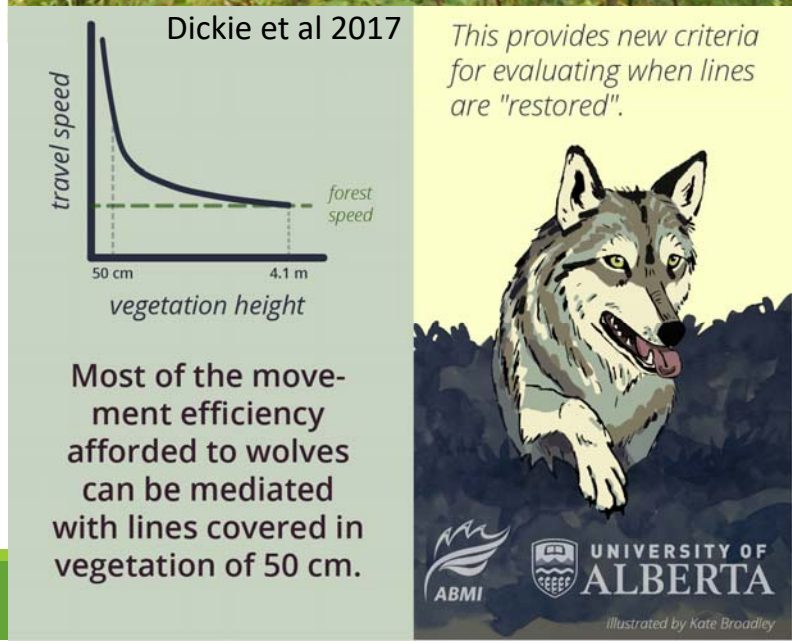


Defining Restoration

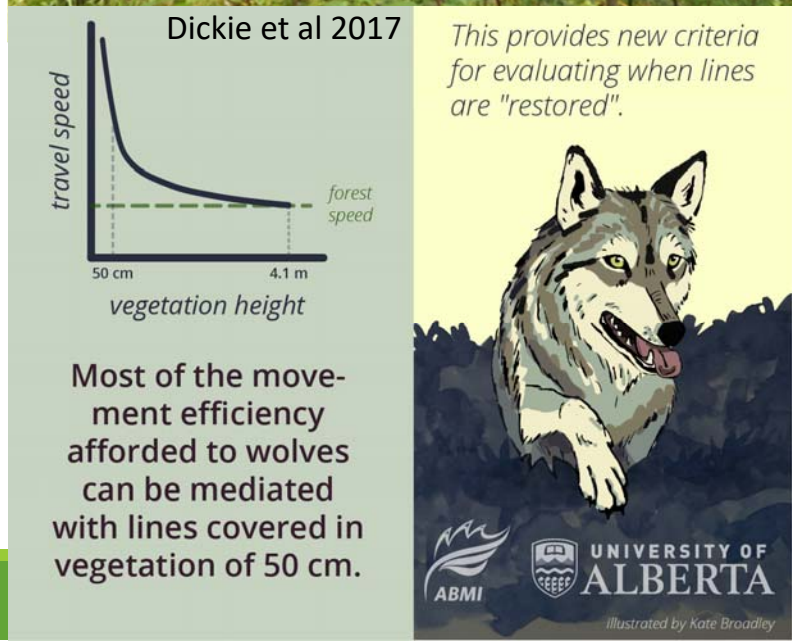
Ecological Restoration:

- Restoring ecological processes
- Putting the forest back to how it should be
- Defining “should be” can be difficult
- Vegetation structure and composition

Functional Restoration:

- Reducing predator movement
- Reducing human access

Clear goals are important for success



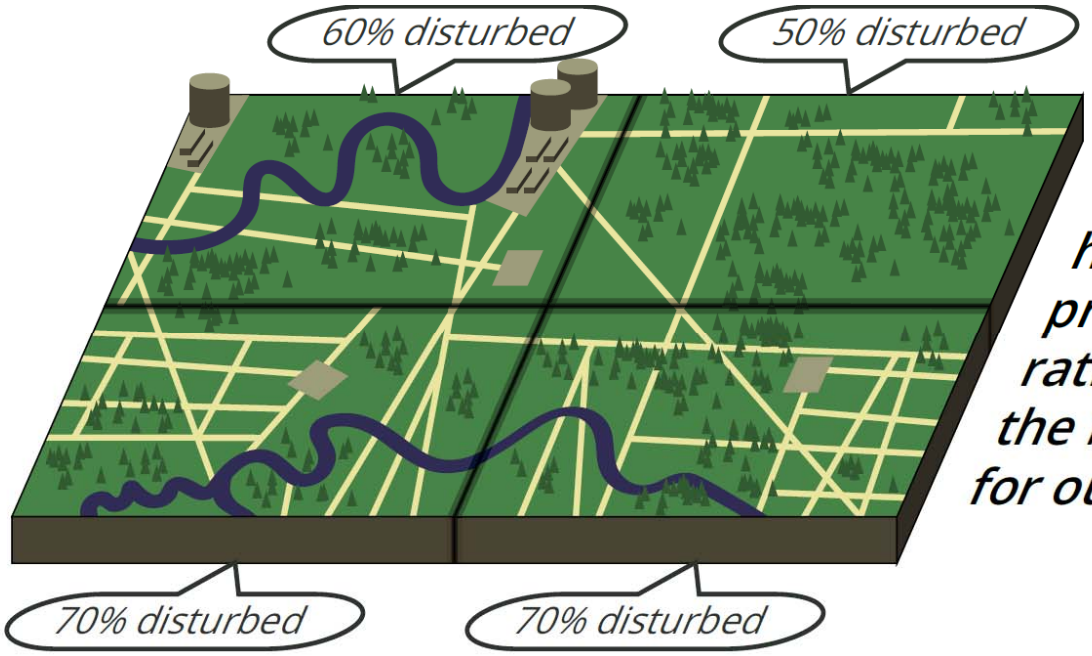
How can we make restoration most effective?

Limited conservation resources mean we have to be efficient

~ $10,000 / km restored

Prioritize areas that will make the biggest difference to caribou

Example of Prioritizing in Alberta

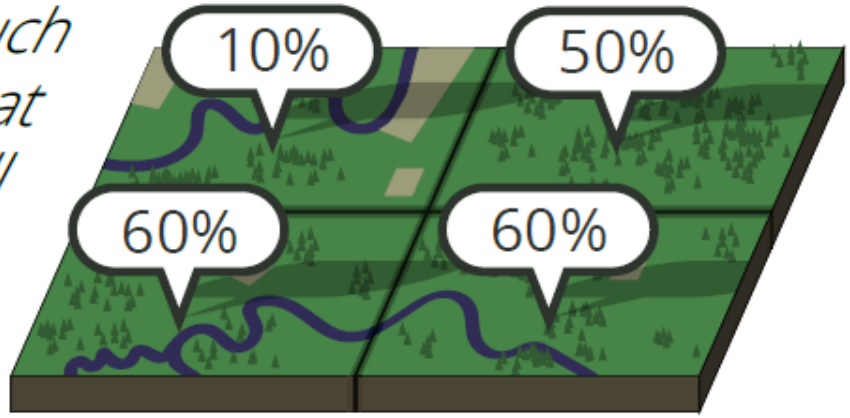


In a working landscape, *how do we prioritize resto-ration to get the best "bang" for our "buck?"*

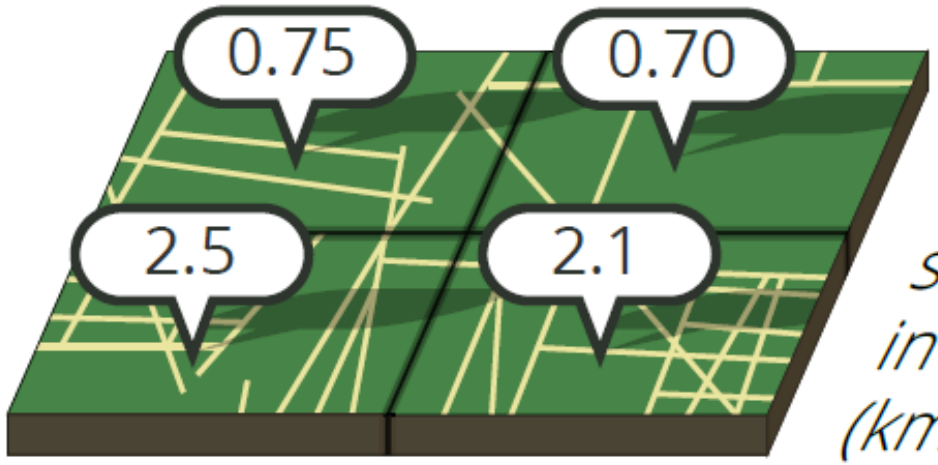
Example of Prioritizing in Alberta

the BANG:

How much undisturbed habitat is gained if all seismic lines are restored? (% disturbed - % disturbed if restored)



Example of Prioritizing in Alberta

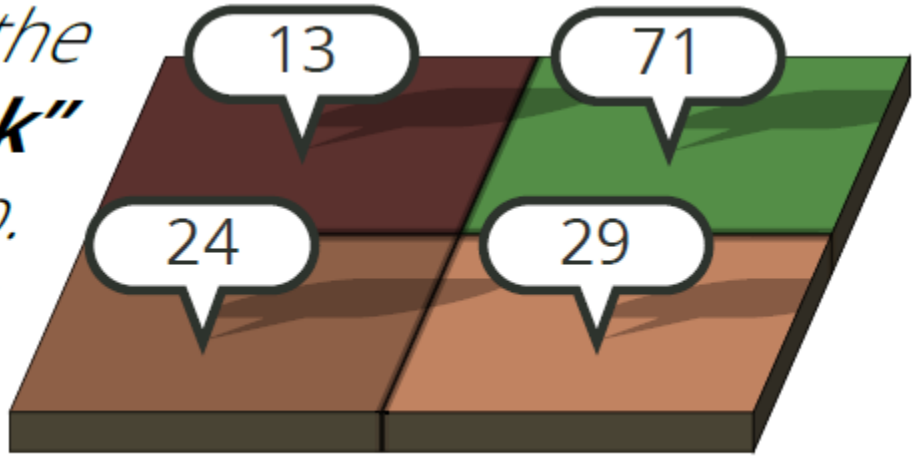


the BUCK:

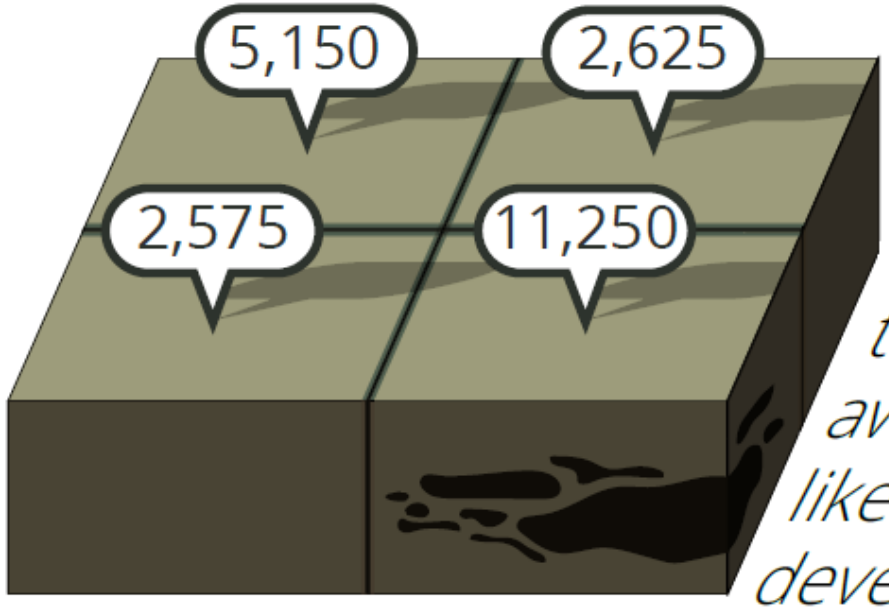
The density of seismic lines that are in each township. (km/km²)

Example of Prioritizing in Alberta

We divide to get the ***"bang-for-buck"*** *of each township. Higher* ***"bang-for-buck"*** *= higher priority.*

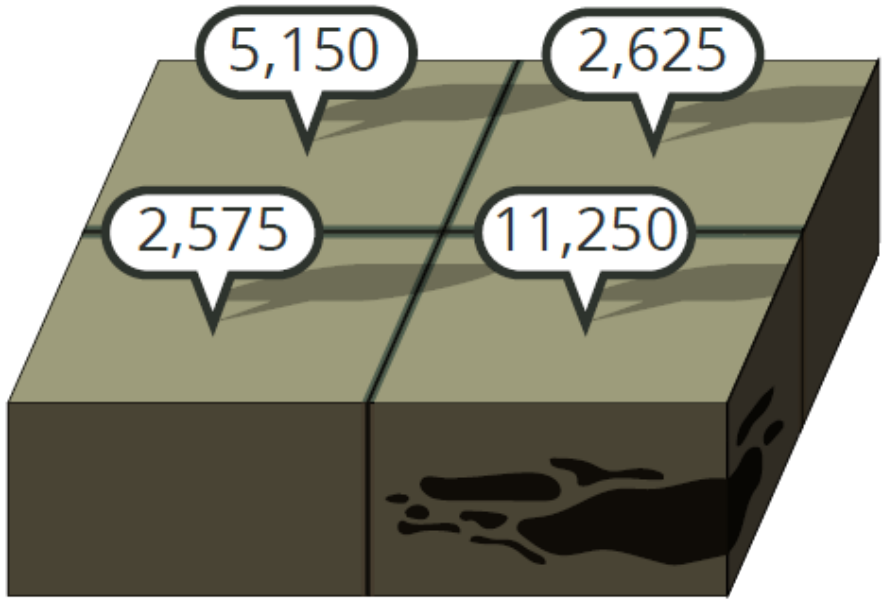


Example of Prioritizing in Alberta



Lastly, adjust to ***resource value*** *($MM CDN). to pull restoration away from areas likely to be developed in the near future.*

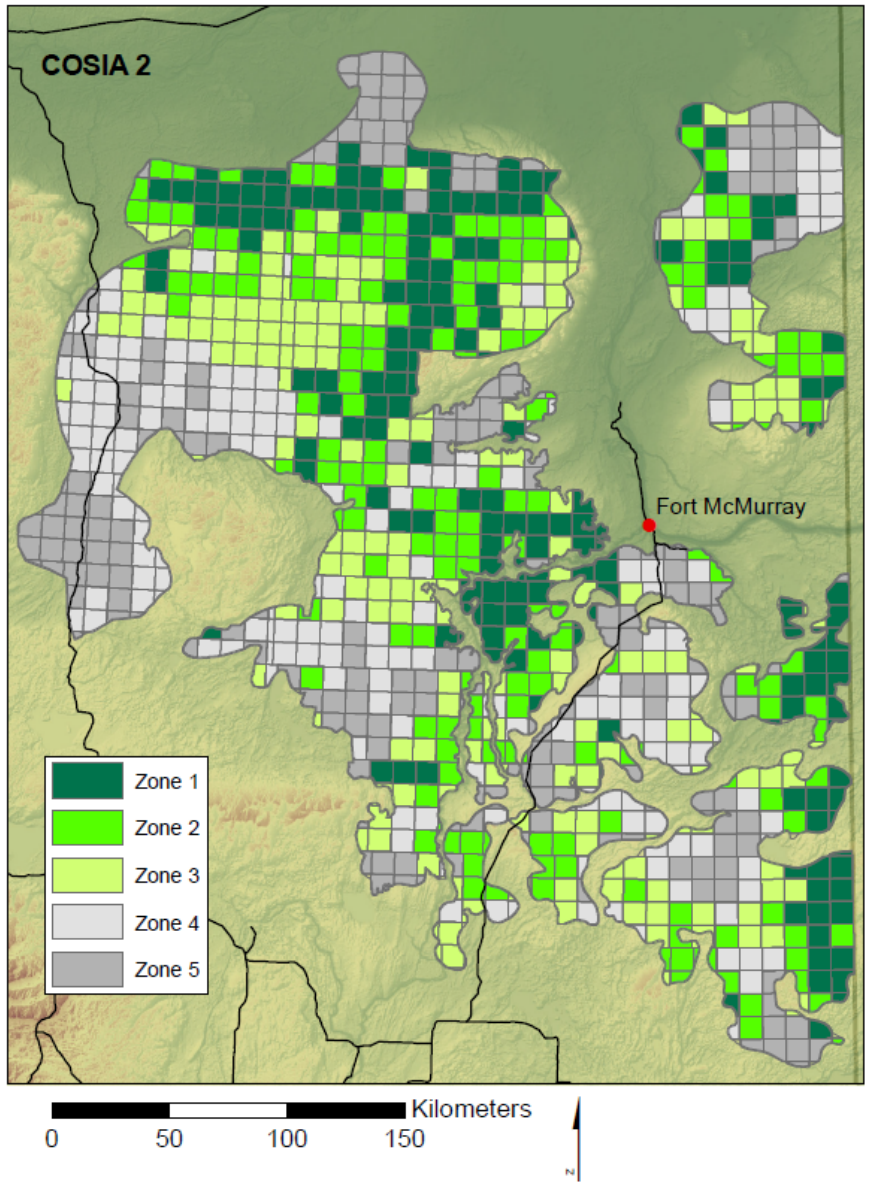
Example of Prioritizing in Alberta



But any weighting can be incorporated:

- Traditional Ecological Knowledge and land-use
- Future development potential
- Recreational value

Example of Prioritizing in Alberta


COSIA 2
Fort McMurray
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Kilometers
0
50
100
150
N

How do we evaluate success?

How do we evaluate success?

Vegetation

Predator line use

Predator abundance

Prey use of lines

Prey abundance

Recruitment

Warning!

Predator hunting efficiency and access to caribou habitat may only be effectively reduced when there is very low linear feature density in large patches of the range

You have to think big

Acknowledgements

RICC | Regional Industry Caribou Collaboration

cosia
CANADA'S OIL SANDS INNOVATION ALLIANCE

ABMI

UNIVERSITY OF ALBERTA

CMU | CARIBOU MONITORING UNIT

For more information about our projects, go to: https://cmu.abmi.ca/

Presentation by Golder; Presented by: Paula Bentham

GOLDER

Caribou Habitat Restoration a Practitioners Perspective

PAULA BENTHAM

BC OGRIS HABITAT RESTORATION WORKSHOP

APRIL 2018

Overview

- Habitat Restoration Projects: History
  - Restoration Treatment Options and Considerations (the What)
  - Toolkit
  - Monitoring
- Choosing Priority Areas: Criteria (the Where)
  - Between Range
  - Within Range
  - Site specific
- Steps in Restoration Program Design (the How and the Who)
- Missing Links, Gaps and Challenges

Habitat Restoration History

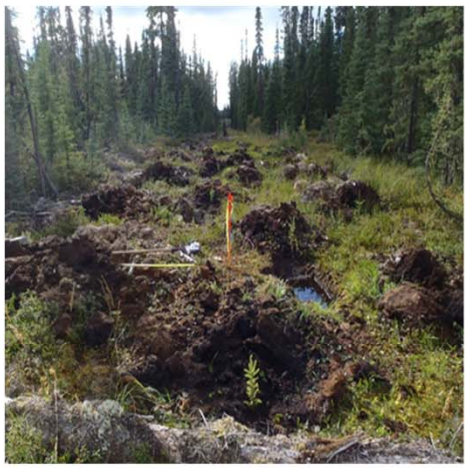
HISTORICAL CONTEXT

- Caribou Range Restoration Project (AB 2001-08)
- AEPEA Approval Conditions (Project Specific)
- Provincial Expectations for Project Approval (e.g., OGC)
- Industry – Voluntary (Larger Scale Initiatives)
  - Algar Range (2015) (www.COSIA.ca)
  - Cenovus Lidea (2014)
  - Cold Lake Regional Industry Caribou Collaboration
- Industry – Federal Approval Conditions
  - National Energy Board (pipelines)
  - Offsets
- Indigenous Community driven (e.g, Klinse-Za)

Habitat Restoration History

HISTORICAL CONTEXT

- Historical linear disturbance (seismic)
- Silviculture methods and knowledge (address site specific limiting factors, access control, enhancing recovery rate)



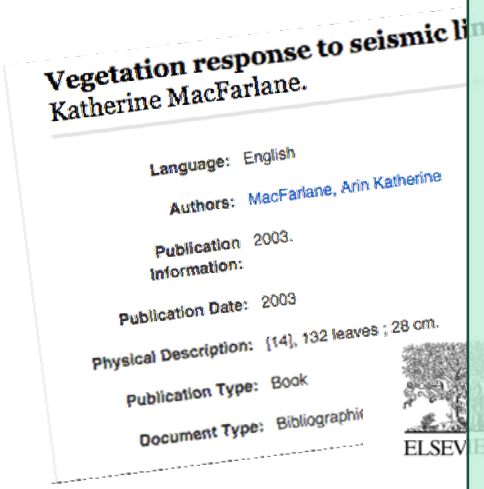
Stabilizing
0-5 Years

Recovering
6-50 Years

Sustaining
50+ Years

Past Studies

- Understanding naturally regeneration processes
- Remote sensing to map what lines are out there, current regeneration, and natural regen potential
- Use to plan program, map veg trajectories, and management
- Cutlines ≠ Cutblocks


Vegetation response to seismic li
Katherine MacFarlane.

Language: English
Authors: MacFarlane, Arin Katherine
Publication information: 2003.
Publication Date: 2003
Physical Description: [14], 132 leaves ; 28 cm.
Publication Type: Book
Document Type: Bibliographi

Persistence and developmental transition of wide seismic lines in the western Boreal Plains of Canada

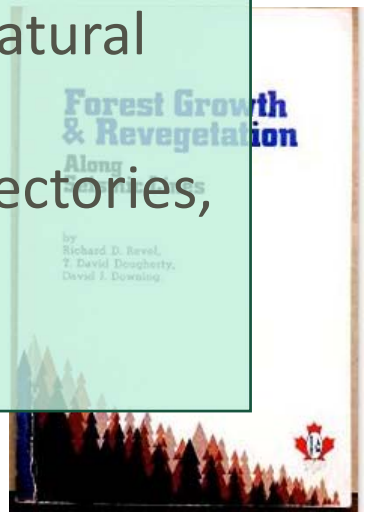
Philip Lee*[1], Stan Boutin[2]

Integrated Landscape Management Program, Department of Biological Sciences, University of Alberta, Edmonton, Alta., Canada T6G 2E9

Received 15 September 2004; revised 26 January 2005; accepted 21 March 2005
Available online 22 August 2005

Abstract

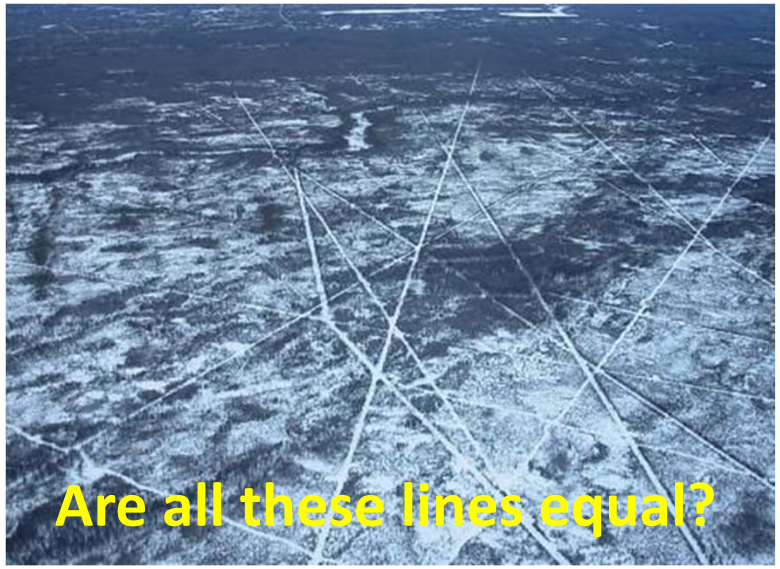
This study examined the fate of seismic lines utilized in oil and gas exploration in Canada's western Boreal Plains. It retrospectively



Not All Lines Are Equal: When to Treat

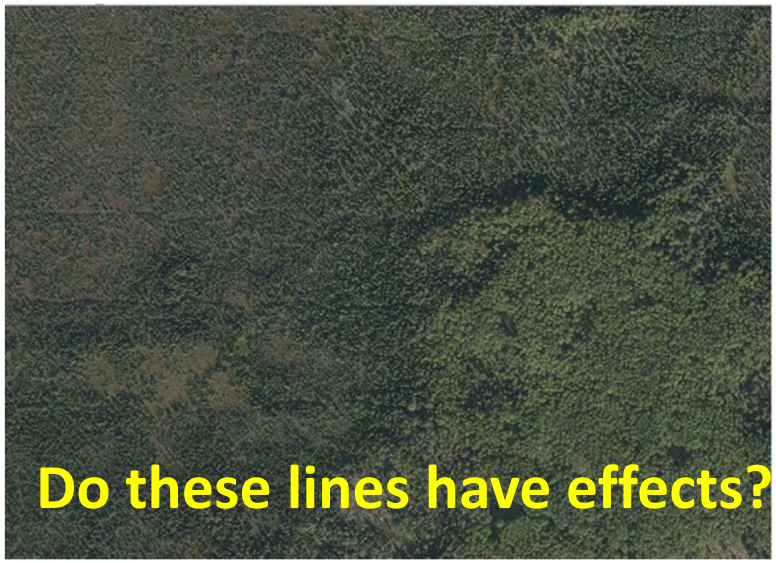
FOCUS ON LINES, BUT OTHER DISTURBANCES

Old Seismic



VS

New Seismic




Harvested in in 1977
Lineal disturbances naturally regenerated in 1940's and protected during harvest

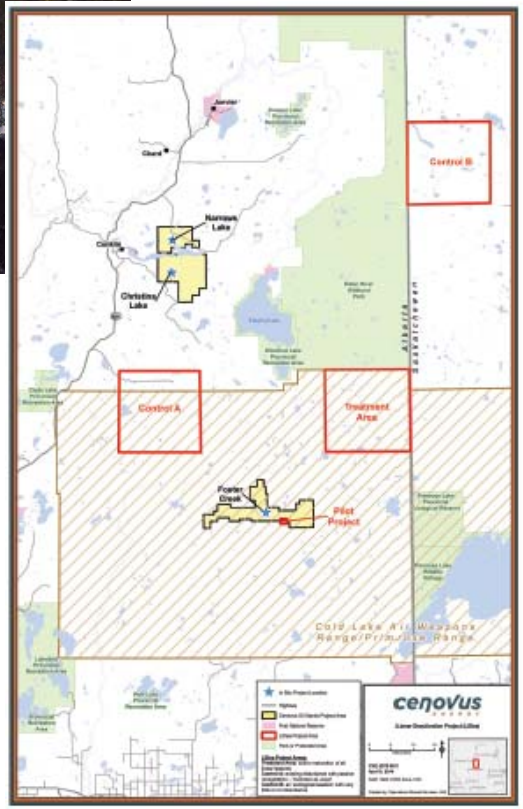
“Un-Restored” Caribou Habitat: Elevated Predation Risk

“Functionally Restored” Caribou Habitat

TREATMENT SELECTION


Planting
Slash
Mounding

Treatments



Restoring Functional Caribou Habitat: Testing Linear Feature Mitigation Techniques in Northeast BC

2014 Phase 1 Status Report

Prepared by:

Rachel Dunham
Craig DeMars
Stan Boutin

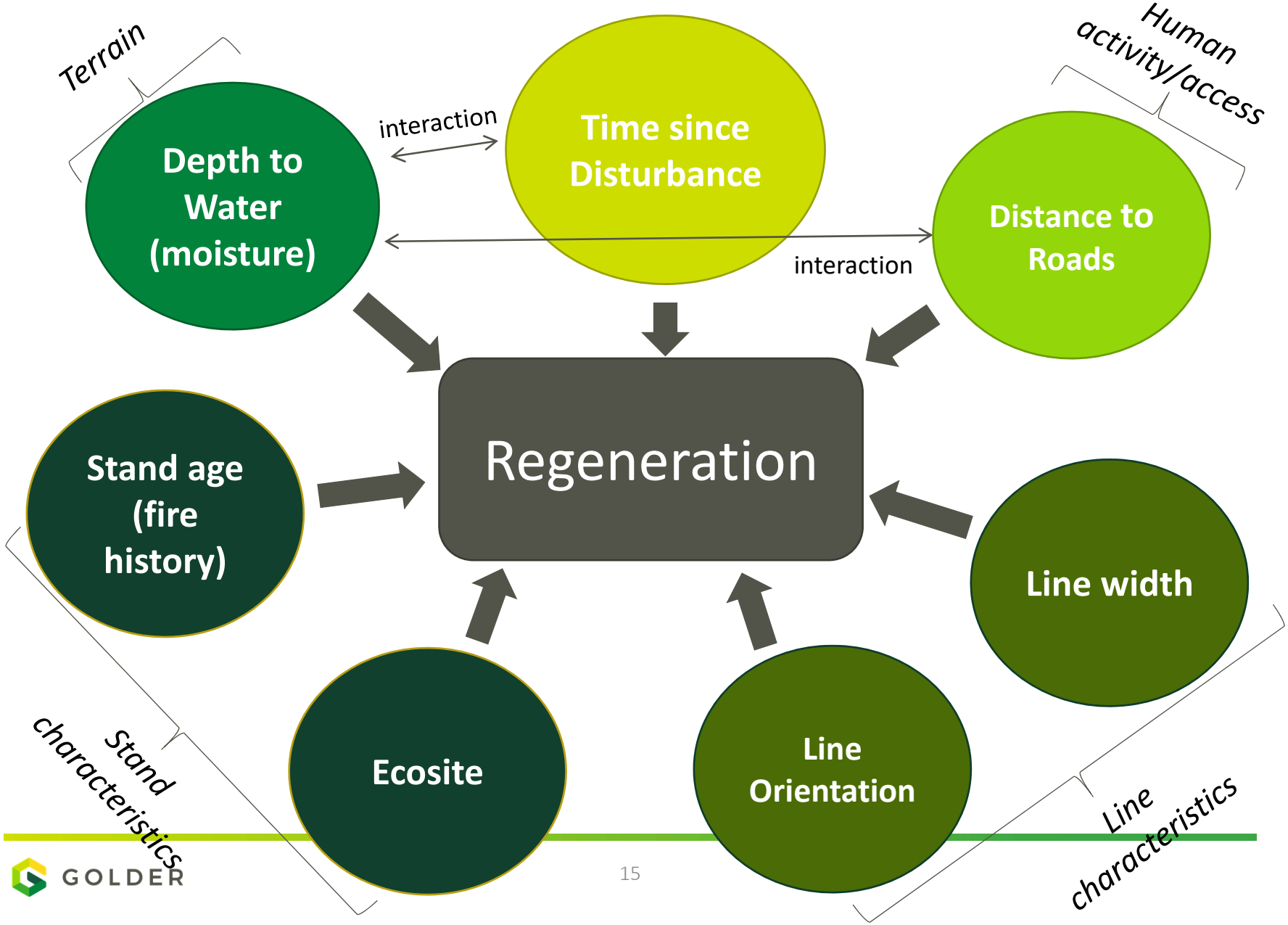
Treatments

TREEFELLING / MOUNDING / PLANTING

Treatments: When Not to Treat

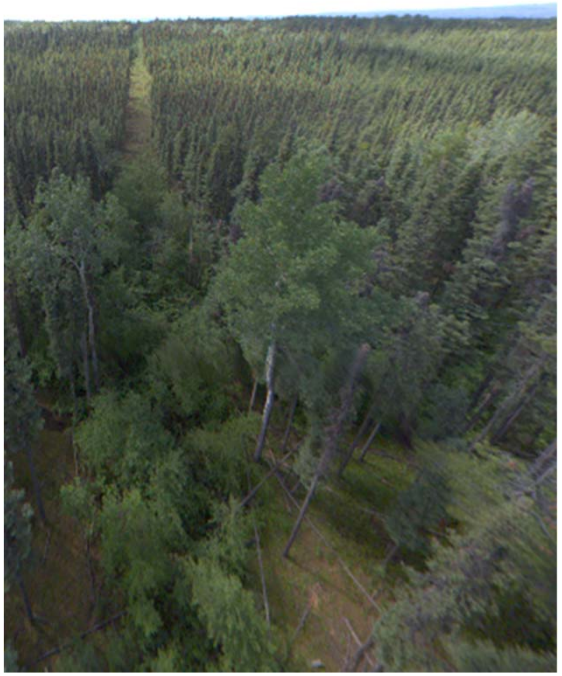
NATURAL VEGETATION RECOVERY

Probability of Regen - Passive



Other Considerations

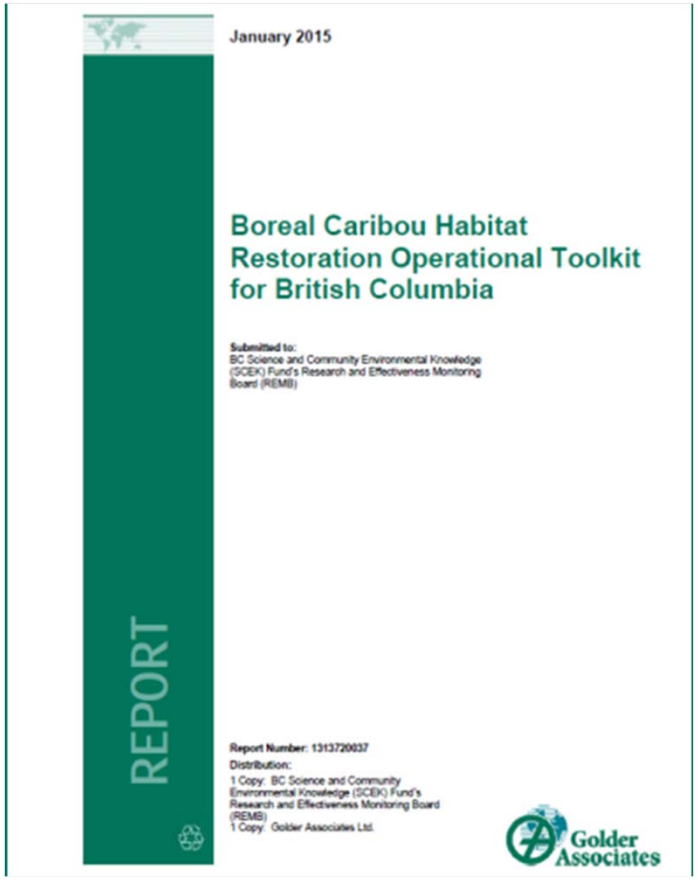
GAME TRAILS / UTV TRAILS WITHIN NATURAL REGEN



- No Treatment (active dispositions, recreational trails, trap line access, other stakeholders)
- Protection of cultural resources

BC Context (REMB)

RESTORATION TOOLKIT, MONITORING FRAMEWORK, PILOT



- Habitat Restoration Toolkit (industry)
  - Restoration Objectives
  - Restoration Program Planning
  - Prescriptions / Treatment Selection (BEC units, site specific limiting factors)
  - ***Designed to be updated****
- Consistent sampling design approach and monitoring protocol for restoration treatment monitoring effectiveness in BC

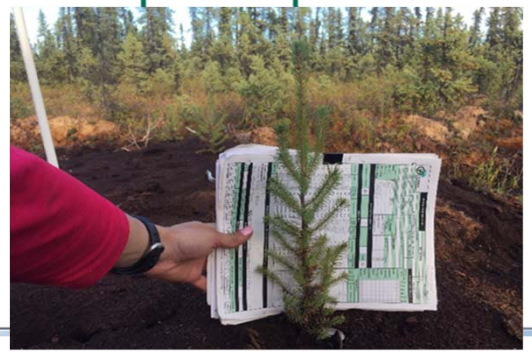
BC Restoration Monitoring Framework

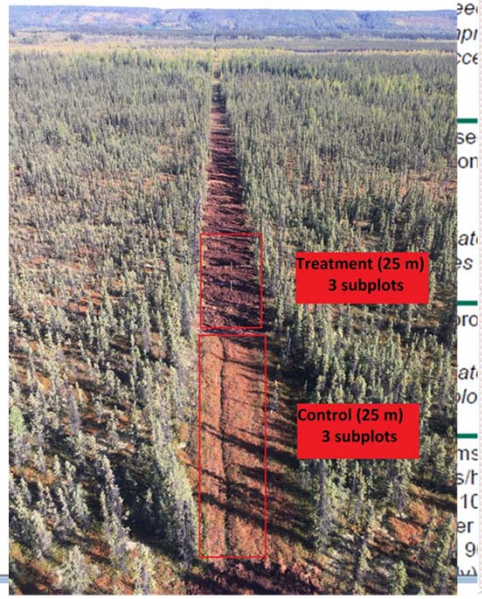
EVALUATION CRITERIA, INDICATORS, TARGETS

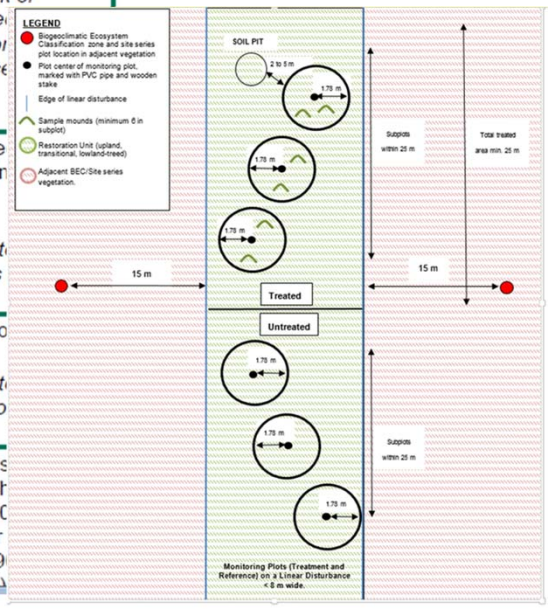
Table 2: Recommended Evaluation Criteria, Indicators and Targets for 1st and 5th Growing Seasons

Restoration Objective	Restoration Unit	Evaluation Criteria	Indicator	1st Growing Season [1]	5th Growing Season[1]

Vegetation Establishment	Upland and Transitional	• Density of live seedlings (stems/ha) of planted seedlings and naturally regenerating seedlings (i.e., from seed ingress or suckering)
		• Percent cover of live seedlings
		• Vigour of live seedlings
		• Vegetation community composition including percent cover and species present:
		  • Conifer
		  • Deciduous tree
		  • Palatable shrub
		  • Non-palatable shrub
		  • Herb/graminoid
		  • Non-vascular (mosses and lichens)
		  • Introduced (non-native, weed, invasive
			% of surviving planted or naturally re-established seedlings	At least 70% of seedlings/ ha surviving (when seedlings planted in winter[2, 3, 4]); at least 90% of seedlings/ha surviving (when seedlings planted in summer [4, 5])
				
				Identify any immediate issues such as seedling mortality due to poor seedling stock or
					At least 50% of seedlings/ha surviving.
					
					Tree seedlings (planted and/or natural regeneration) demonstrate sustained growth trends (seedling height and leader growth) between 1st and 5th monitoring periods.







http://www.bcogris.ca/sites/default/files/bcip-2016-02-restoration-monitoring-framework-final-dec151.pdf

Choosing Priority Areas: Criteria for the Where

ECOLOGICAL

- Core Habitat Areas[1] / High Value Caribou Habitat[2]
- Calving habitat[2,3,4]
- Caribou locations, high use areas[2,3]
- Predators location/numbers and overlap with caribou[3] (biologically meaningful area such as a wolf pack territory area[4])
- Seismic density[5]
- Mortality event locations
- Existing Natural Vegetation Recovery ("Leave for Natural")
- Large area to create intact habitat patches

LOGISTICAL

- Footprint inventory and natural reveg recovery
- High Cost (mounding/seedlings $12,000/km)[4]
- Accessibility
- Availlable Seed Source and Seedlings (Timeline)
- Ground Conditions
- Available sites (polygonal and linear disturbances not under active disposition, designated trails, and not falling under existing reclamation requirements)
- Predicted Natural Recovery (fine scale attributes; vegetation height/cover, wetness, nutrients, distance to road, forest stand)[3,7,9,10]
- Archeological potential[3,7]
- Stakeholder engagement

REGULATORY / LAND USE / DISTURBANCE

- Current level of disturbance
- % Gain-in-Undisturbed habitat[2,3,5]
- Protected Areas[2]
- Low Economic Value Resource Areas[3,5]
- Provincially-designated land with potential for less future disturbance (WHA, UWR, Parks, OGMA)[2] (with noted exceptions, not protection) 7
- Resource Review Areas[3]
- Outside Fire Areas < 40 years[3,5,7]
- Disturbance under Active Dispositions on Crown Land 'No Treatment', consider reclamation requirements[3,7]
- Outside Future harvest management plan areas[2,3,7]
- Outside mountain pine beetle current distribution and susceptibility ranking[7]
- Limited future development potential[3,5,7]
- Limited stakeholder conflicts[7]
- Type of Disturbance (conventional seismic, LIS, pipeline, etc.)[3]

CULTURAL

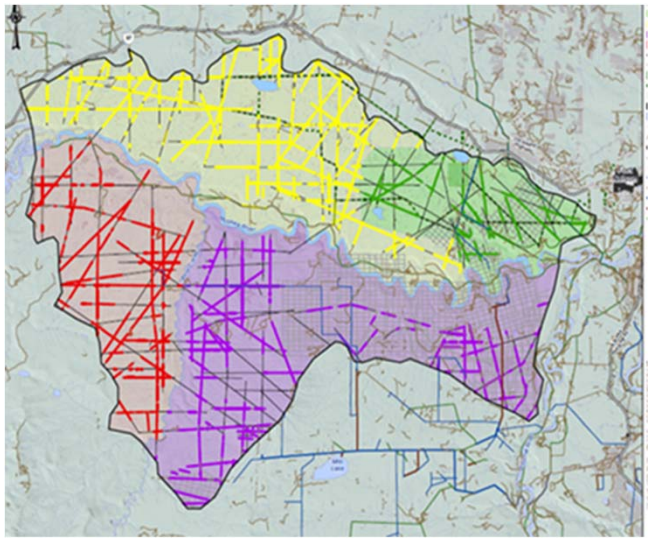
- Protection and Restoration Zones[2]
- Oral history[6]; high value caribou habitat
- TEK (knowledge holders, previous studies, studies) [important caribou environmental features, critical areas, observations, kills]
- Spring calving habitat [muskeg, bog, fen, treed fen with access to water to avoid predators]
- Winter foraging areas [stands of large spurce/pine with ample ground lichen loads; south facing slopes with early green-up]***fine resolution forage potential in winter with BRFN territory based on BRFN IK.[6]
- Fall rutting habitat (< calving and late winter)[6]
- Ecological restoration on linear in calving and winter habitat, include measures to restore lichen loads[6]
- Critical Cultural Interest Areas[6]
- Important caribou habitat may be located outside of provincial and federal defined caribou range boundaries based on TEK[2,6]
- Avoidance of, or mitigating impacts from treatments to, archaelogical sites or high potential sites[3]

Criteria – the Where

BETWEEN RANGE PAST CRITERIA TO DEFINE PRIORITY AREAS

- Limited; Project Area Focus
- Collaboration, range scale
- Herds in greatest decline (AB Little Smoky)
- Herds where other recovery levers are being pulled (predators, penning)
- Low future footprint, feasible
- Science based approach

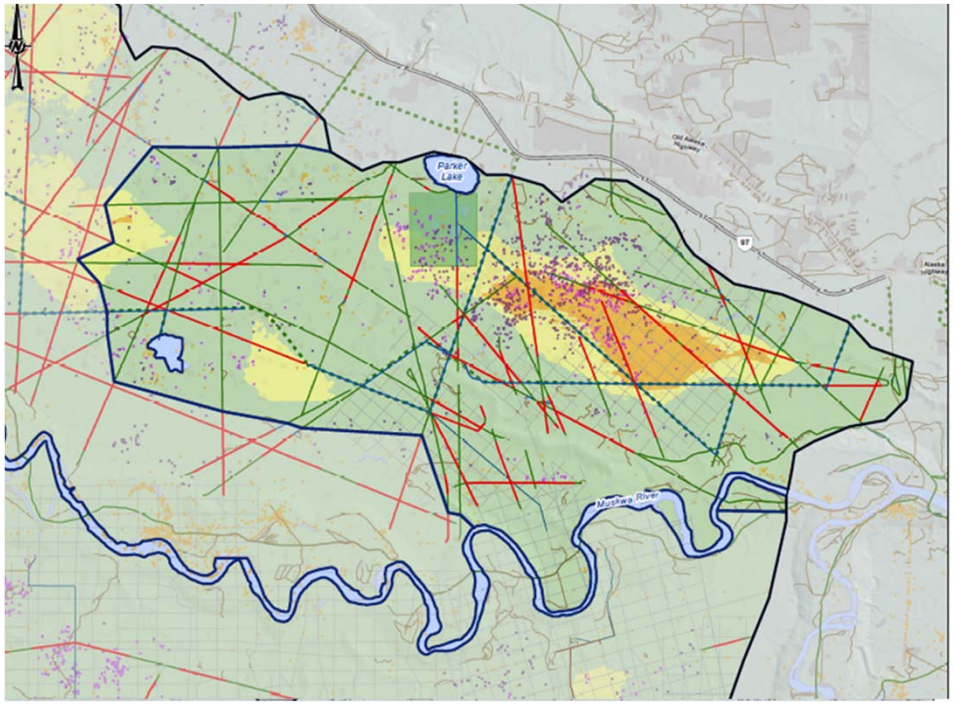
  (e.g., Parker Range Pilot)



Criteria – the Where

WITHIN RANGE DECISION CRITERIA

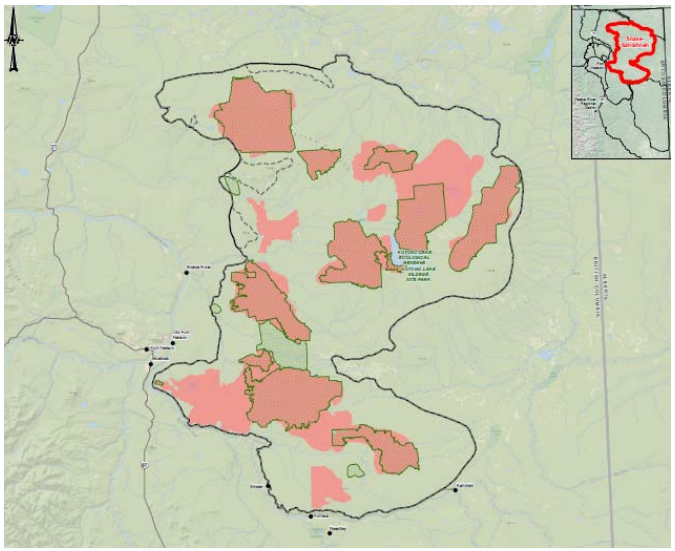
- Where are the caribou?
- Overlap with predators?
- Creation of larger areas of intact habitat
- Critical habitats – calving
- Seismic density
- Probability of Regen
- Access, feasibility, costs, ‘protection’



Criteria – the Where

LAND USE, DISTURBANCE LEVELS

- Inventory and mapping (natural regen, trails)
- Natural disturbance projections and risk e.g. Fire History, Mountain pine beetle
- Forest industry “spatial harvest sequence”
- Predictive industrial development plans (potential of losing restoration investments)
- Land use designations (WHA, UWR)



Criteria - Key Learnings

- Move away from Project specific
- Landscape level is critical
- Multi-sector, multi-stakeholder Collaborative
- Indigenous Community Engagement has been lacking. Contracting opportunities only
- Logistical (e.g., seed sourcing, stakeholder consultation) and Cost Considerations
- Provincial Frameworks and Urgency
  - Offsetting frameworks
  - The need to focus on Priorities

Implementation: The Who

BUILDING LOCAL CAPACITY

- Local Aboriginally Owned Contractors
- First Nations Monitors, Environmental Technicians
- Local business
- Health, Safety and Environment Plan and Support

Missing Links, Gaps and Challenges

SUMMARY

1. High desire for First Nations engagement and collaboration

- Early Engagement: in planning process (range selection), TEK incorporation on the where, what, how, who
- Indigenous Community Partnerships. Not just commercial opportunities. Consider concept of the Land

2. Establishing criteria for selecting priority areas among ranges

3. Roles & responsibilities for planning and implementation of restoration have not been explicit, and coordinated

Missing Links, Gaps and Challenges

SUMMARY

- lack of long term funding
- limited effectiveness monitoring for increasing caribou populations
- regulatory uncertainty
- uncertainty on protection of restoration investment


Thank you
pbentham@golder.com

Other Presentations:

We did not get permission to use the presentation from Katherine Capot-Blanc, Fort Nelson First Nation (FNFN) and Rachel Holt, Veridian Ecological before we finalized the summary notes but the Medzih Action Plan can be downloaded from the FNFN website: http://www.fortnelsonfirstnation.org. The presentation by Susan Leech on behalf Blueberry River First Nation is confidential, as the content is still preliminary in nature.

APPENDIX C

Wildlife Habitat Areas and Ungulate Winter Ranges within BC Boreal Caribou Ranges

Table C-1: Wildlife Habitat Areas (WHAs) And Summary of Associated General Wildlife Measures (GWMs) in BC Boreal Caribou Habitat that May Affect Timber Harvesting Overlap with Restoration Activities (refer to the legal order for complete details and requirements)

WHAs	Caribou Herd	Legislation	Summary of GWMs
9-074 to 9-088 (inclusive)	Snake-Sahtaneh	FRPA	▪ No construction of new roads, trails, or other linear features ▪ No timber harvesting ▪ No disturbance from May 01 to June 01
9-089 to 9-096 (inclusive)	Chinchaga	FRPA, OGAA	▪ No new access structures ▪ Do not conduct timber harvest or silvicultural activities ▪ Do not disturb caribou form March 15 to June 30 and September 15 to October 31
9-101	Snake-Sahtaneh	FRPA, OGAA	▪ No construction of all-weather, high-grade roads ▪ Minimize disturbance to caribou from March 15 to May 15 ▪ Maintain connected forest cover ▪ Minimize growth of early seral species (see order for list of species) ▪ Activities must not adversely affect key terrestrial lichen (see order for list of species) ▪ Avoid harvesting in black spruce bogs, large bog-fen complexes, or lake clusters ▪ Maintain natural drainage patterns during harvesting and silvicultural activities ▪ Complete timber harvest in as short a timeframe as possible
9-009 type A	Chinchaga	FRPA, OGAA	▪ No timber harvesting or silvicultural activities ▪ Do not disturb caribou from February 1 to April 15
9-009 type B	Chinchaga	FRPA, OGAA	▪ Minimize primary forest activities during periods that require snow removal ▪ Minimize disturbance to caribou form February 1 to April 15 ▪ Activities must not adversely affect key terrestrial lichen (see order for list of species) ▪ Avoid harvesting in black spruce bogs, large bog-fen complexes, or lake clusters ▪ Maintain natural drainage patterns during harvesting and silvicultural activities ▪ Complete timber harvest in a short timeframe as possible
9-010	Prophet, Parker, Maxhamish, Snake-Sahtaneh, and Calendar	FRPA	▪ Activities must not adversely affect key terrestrial lichen (see order for list of species) ▪ Complete timber harvest in a short timeframe as possible

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