FOCUSED STUDY ACTIVITY WORK PLAN

General Information

Work Plan Unique Identifier:	*B-MD-1-1718*	
Focused Study Activity Title:	Boreal Caribou Census through DNA Estimates	
Focused Study Category:	Monitoring Design and Method Improvement	
Geographic Location (*choose from drop-down menu. If Project Location is in more than one area choose from second drop-down***)**	Athabasca Oil Sands Region	Peace River Oil Sands Region Cold Lake Oil Sands Deposit
Monitoring Site(s) Coordinates *(latitude and longitude)*	The study area is outlined by woodland caribou ranges that overlap the oil sands region. This includes the Cold Lake, ESAR, WSAR, Red Earth, Richardson, Nipisi and Slave Lake caribou ranges.	
Project Leader:	Dan Farr	
Organization and contact information:	**Alberta Environment and Parks**	
Date Study initiated:	**2013**	
Monitoring Category: *(From OSM long-term plan; choose from drop-down menu)*	Biotic Response Monitoring	
Strategic Objective of Focused Study: *(From OSM long-term plan; choose from drop-down menu)*	Monitoring Design and Method Improvement	
Hypotheses: *(Briefly outline the specific hypotheses that your focused study is aiming to address)*	The objective of this Oil Sands Monitoring (OSM) Focused Study is to implement a robust non-invasive genetic sampling (NGS) program to estimate population size and composition of woodland caribou within the oil sands region through the collection of fecal pellet samples. Following the completion of the 2017-18 project activities, we plan to propose transition of this project to long-term monitoring.	
Deliverables: *What tangible goal (s) and/or product(s) will the monitoring produce and when?*	1. Woodland caribou population size estimates in the oil sands region of Alberta. 2. Improved capture mark recapture estimates for woodland caribou in Alberta. 3. Spatially-explicit capture mark recapture estimates for woodland caribou in the oil sands region of Alberta. 4. Sensitivity/power analysis of NGS field methods for	

	woodland caribou. 5. Standard operating procedures and QA/QC protocols for woodland caribou DNA collection and analysis.

Detailed Study Plan

(Please provide detailed information on the specifics of your focused study including – (**keywords, hypothesis and the assumptions and constraints behind your hypothesis**)

Provide a maximum of 10 key words that describe this project. Use commas to separate them:

Woodland caribou, *Rangifer tarandus caribou*, population estimate, non-invasive genetic sampling (NGS), species at risk,

Background:

Woodland Caribou (*Rangifer tarandus caribou*) are listed as a *Threatened* species in Alberta under the Wildlife Act, and in Canada under the Species At Risk Act (SARA). Habitat alteration resulting from industrial footprint, and in some cases forest fires, and subsequent increased predation rates are the primary drivers of caribou population decline in Alberta (Hervieux et al. 2013).

Alberta Environment and Parks (AEP) are responsible for delivering the enhanced woodland caribou monitoring component of the Biotic Response Monitoring Program under the OSM initiative. This program builds on current caribou monitoring done by AEP and is testing procedures and techniques to facilitate estimates of caribou population size and composition of woodland caribou within the oil sands region of Alberta.

The program is using non-invasive genetic sampling (NGS) methods and techniques developed by Ball et al. (2007) and Hettinga et al. (2012). These NGS methods were developed in Manitoba and Saskatchewan for boreal woodland caribou and present an opportunity to extend these methods to caribou populations in Alberta. Using the program MARK (White and Burnham 1999) and several years of DNA sampling, Hettinga et al. (2012) estimated encounter rates, apparent survival rates, rates of population change and population sizes.

Objectives :

1. Trial sight-resight methods for determining caribou population size and composition estimates through the collection of caribou fecal pellet samples.

2. Partner with Trent University's Natural Resources DNA Profiling and Forensic Centre (NRDPFC) to perform genetic analysis.

3. Estimate caribou population size and structure within the caribou populations that overlap the oil

sands region.

Methods:

a. Study Area: The study area consists of the 7 designated caribou ranges that overlap the oil sands region of Alberta, including:

East Side Athabasca River, Cold Lake, Richardson, West Side Athabasca River, Red Earth, Nipisi and Slave Lake (Figure 1).

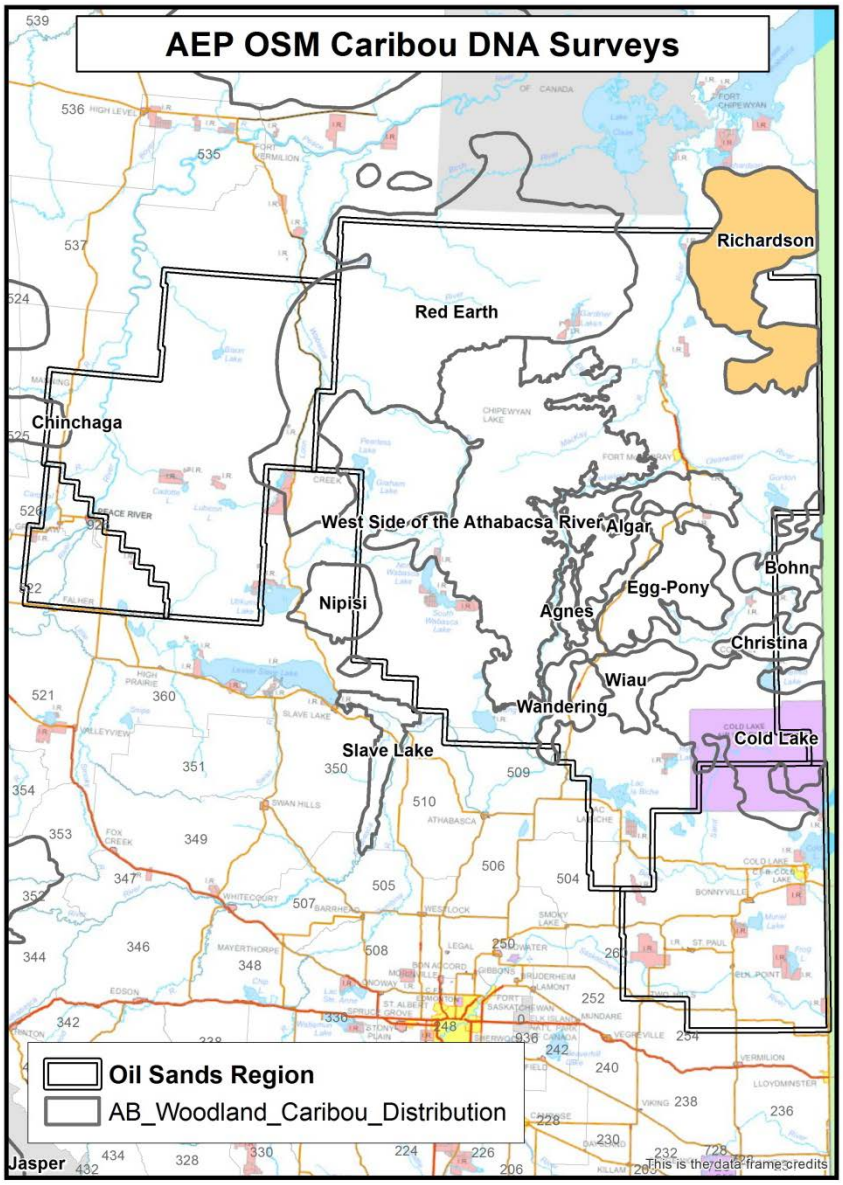

Figure 1. Alberta Environment and Parks OSM woodland caribou DNA survey map. The Richardson caribou range is planned for sampling in 2017-2018, however based on priority Nipisi and Slave Lake may be sampled instead.

Following the methods outlined by Hettinga et al (2012) and using techniques described by Ball et al. (2007 and 2010) we plan to sample the Richardson caribou range in 2017-18 using non-invasive survey methods.

b. Collection Sites: Caribou populations will be systematically surveyed by fixed-wing aircraft in the winter. The three sampling periods will occur roughly a month apart from December to March depending on weather conditions. Transect lines spaced 3 km apart are flown at 160km/hr and at 150-250 meters above the ground. Each fixed-wing aircraft will have 2 observers to record and map the location of caribou activity, including caribou sightings, tracks, and cratering sites. The estimated distance and direction from the mark location is recorded to help facilitate sample collection.

c. Sample Collection: Using a rotary-wing aircraft and a separate team of 2-3 biologists, collection sites identified by the fixed-wing crew are visited to collect fecal pellet samples. At each site, approximately 1.4 times more samples are collected than the number of caribou estimated to be present at the site, since 30% of the samples are likely to be replicates (Hettinga et al. 2012). A minimum of 12 pellets per sample are collected. Pellets frozen together in a patty are selected over collecting single pellets to reduce the potential of collecting pellets from multiple animals in the same sample. Samples are collected using disposable latex gloves and placed in sterile Whirl-Pak™ sample bags. At each site the site location, date, time, estimated number of caribou, time since presence of caribou, number of samples collected, and evidence of other ungulate species in the area are recorded. The samples are kept frozen and are stored in a cooler onboard the aircraft.

d. Sample Storage: All samples are stored in a freezer at -20°C. The samples are shipped frozen to the Natural Resources DNA Forensics and Profiling Centre at Trent University in Peterborough, Ontario for genetic analysis.

e. Genetic Profiling and analysis: Collaborative research continues with Dr. Paul Wilson at Trent University, a Canada Research Chair (CRC) in DNA Profiling of wildlife species. Drs. Wilson and Micheline Manseau of Parks Canada and the Natural Resource Institute (NRI), University of Manitoba, have maintained a 10-year collaborative research project on the conservation genetics of caribou.

References:

Ball, M. C., L. Finnegan, M. Manseau, and P. Wilson. 2010. Integrating multiple analytical approaches to spatially delineate and characterize genetic population structure: an application to boreal caribou (*Rangifer tarandus caribou*) in central Canada. Conservation Genetics 11:2131-2143.

Ball, M. C., R. Pither, M. Manseau, J. Clark, S. D. Petersen, S. Kingston, N. Morrill, and P. Wilson. 2007. Characterization of target nuclear DNA from faeces reduces technical issues associated with the assumptions of low-quality and quantity template. Conservation Genetics 8:577-586.

Hervieux, D., M. Hebblewhite, N.J. DeCeasare, M. Russell, K. Smith, S. Robertson, and S. Boutin. 2013. Widespread declines in woodland caribou (*Rangifer tarandus caribou*) continue in Alberta. Can. J. Zool.

91:872-882.

Hettinga, P. N., A. N. Arnason, M. Manseau, D. Cross, K. Whaley, P. J. Wilson. 2012. Estimating size and trend of the North Interlake woodland caribou population using fecal-DNA and capture-recapture models. The Journal of Wildlife Management 76(6): 1153-1164.

White, G. C., and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46:S120-S139.

Data Management

If this work generates data please summarize your project-level data management plan.

Deliverables	Timeframe
Data Collection Period: *Field work*	Start : 2017-12-01 End: 2018-03-31
Data Analysis Period: *Laboratory analysis and QA/QC of data*	Start : 2018-06-01 End: 2019-03-31
Data Release Date: *Metadata and data consistent, complete and meet basic standard format for publication in Open Data; on or linked to OSM portal*	To be determined

Reporting and Publications

Provide information on the anticipated reports / publications. (Insert additional rows if needed)

Expected Subject/Titles of Publications or Reports	Short Description of Publication or Report	Expected Year of Publication
Woodland caribou population size estimates in the oil sands region of Alberta	Technical report on ESAR, Cold Lake and WSAR caribou DNA program, providing a summary of results to date on estimated caribou population size based on capture mark recapture (CMR) analysis.	2017
Improved capture mark recapture estimates for woodland caribou in Alberta.	CMR techniques will be evaluated by a Trent University Post-Doc to provide improved population estimates for woodland caribou in Alberta.	2018
Spatially-explicit capture mark recapture estimates for woodland caribou in the oil	Apply spatially-explicit CMR techniques to caribou ranges sampled to date.	2018

sands region of Alberta.		
Standard operating procedures and QA/QC protocols for woodland caribou DNA collection and analysis.	Develop SOP, QA/QC documents for DNA methods and analysis.	2017

Technical / Professional Roles and Responsibilities

Identify members of the monitoring team/organization, their roles and responsibilities. Identify monitoring organization leads if different from overall monitoring activity lead. (Insert additional rows if needed)

Role	Responsibilities	Resource Name/Organization
Principal Investigator	Project Manager: administration, human and resource allocation, timely delivery of outcomes, reporting	Dan Farr / AEP - EMSD
Principal Investigator	Project/Contract Management: Technical lead, and AEP caribou program liaison	Dave Hervieux / AEP - Operations
Project Coordinator	Logistics, planning and operational delivery of project, including data entry, proofing, analysis and report writing	Simon Slater / AEP - EMSD
Project Biologists	Conducting caribou surveys, data entry, proofing, analysis and report writing	Andrew Braid, Brett Sarchuk, Agnieszka Sztaba / AEP - EMSD

Deliverables (Year 1) If your Focus Study is longer than 1 year then complete **Appendix 3** for multi-year deliverables breakdown

Provide a summary of tangible quarterly deliverables. Identify major project areas (deliverables) and results that can be identified as a tangible goal. This could include: field work, lab work/ analysis, evaluation, data, reports, publications, SOPs etc. Do not define process as your Deliverable e.g. 'fly to Ft. McMurray to conduct fieldwork' or 'seek Director approval for report'.

Deliverable(s) (please provide enough information to support status reporting)
Q1 – April to June
Organize laboratory analysis and ship 2016-17 caribou DNA samples to Trent University.
Prepare summary report for caribou range surveyed in 2016-17
Q2 – July to September
Draft RFQs and RFPs
Draft work plan for program delivery, including schedules for all personnel
Q3 – October to December
RFPs and RFQs reviewed, air charter companies selected for each survey
Aviation fuel purchase and stocking caches for identified as high use
1 Caribou fecal DNA survey (weather permitting)
Q4 – January to March
2-3 Caribou fecal DNA surveys (weather permitting)
Data entry and processing (data QA/QC)
Aviation fuel purchase and re-stock of remote caches as necessary

Detailed Financial Breakdown – Year (2017-2018)

Also complete **Appendix 2** for the multi-year financial breakdown

Budget requirements – List areas that require budget expenditures: (ADD OR DELETE BUDGET CATEGORIES AS REQUIRED)	OS Funding	External Funding (*outside JOSM*)
O&M - Operations and Maintenance:		
Aircraft Costs	**$228,000**	**$**
Field Costs (vehicles)	**$8,000**	**$**
Data Management	**$0**	**$**
Internal Lab Analysis	**$0**	**$**
Consumable Materials & Supplies	**$5,000**	**$**
Sub-Total	**$241,000**	**$0**
O&M - Travel		
Field Work	**$50,000**	**$**
Conferences (*North American Caribou Workshop*)	**$3,000**	**$**
Meeting (*program meetings*)	**$2,000**	**$**
Sub-Total	**$55,000**	**$0**
O&M - External Contracts :		
Goods and Services Contract (*describe contractor*)	**$**	**$**
External Lab Analysis – Trent University	**$**	**$80,000**
Sub-Total	**$0**	**$80,000**
Salaries:		
Principal Investigator - Dan Farr	**$**	**$**
Science Expertise - A. Braid, B. Sarchuk, S. Slater, A. Sztaba	**$34,000**	**$**
Science Expertise - AEP Operations Biologists (in-kind support)	**$**	**$10,000**
Science Expertise - Trent University Post-Doc Position	**$**	**$60,000**
Science Expertise – Analysis and Reporting support	**$60,000**	**$**
Field Staff Overtime - A. Braid, B. Sarchuk, S. Slater, A. Sztaba	**$50,000**	**$**
Field Staff Overtime - AEP Operations Biologists (in-	**$**	**$40,000**

Budget requirements – List areas that require budget expenditures: (ADD OR DELETE BUDGET CATEGORIES AS REQUIRED)	OS Funding	External Funding (*outside JOSM*)
kind support)		
Sub-Total	**$144,000**	**$110,000**
Total Salaries	**$144,000**	**$110,000**
Total O&M	**$296,000**	**$80,000**
2017-2018 GRAND TOTAL*	**$440,000**	**$190,000**

Appendix 1 - Approvals

Project Submitted by:		
Name:		
Organization:	Signature:	Date:

Project Approved by:		
Dr. Monique Dubé (AEP)		**Dr. Kevin Cash (ECCC)**
Signature 		Signature 
Date		Date

APPENDIX 2 – Detailed Multi-year Financial Breakdown (Complete the following detailed financial breakdown; add or delete categories as required)

Budget requirements	Year 1 (201X- 201Y)		Year 2 (201X- 201Y)		Year 3 (201X- 201Y)	
	Cash	In-kind	Cash	In-kind	Cash	In-kind
1) Salaries and benefits						
a) Investigators						
b) Technical/professional assistants						
c) Field Staff						
d)						
2) Operations and maintenance						
a) Facilities						
b) Equipment						
c) Lab analysis						
d) Data management						
e) Field work						
3) Consumable Materials and supplies						
a)						
b)						
4) Travel						
a) Conferences and meetings						
b) Field work						
c) Project-related travel						

5) Dissemination & Engagement						
a) Publications/Reports						
b) Translation (if required)						
c) Communications						
d) Stakeholder Engagement						
e) Indigenous Peoples Engagement						
6) External Contracts						
a)						
Grand Total						

APPENDIX 3 –Years 2 and 3 Deliverables (Complete the following detailed breakdown. Provide a summary of tangible quarterly deliverables. Identify major project areas (deliverables) and results that can be identified as a tangible goal.)

Year 2 (201X- 201Y)
Deliverable(s) (please provide enough information to support status reporting)
Q1 – April to June
Q2 – July to September
Q3 – October to December
Q4 – January to March

Year 3 (201X- 201Y)
Deliverable(s) (please provide enough information to support status reporting)
Q1 – April to June
Q2 – July to September
Q3 – October to December
Q4 – January to March