EMPIRICAL EIA WITH LONG-TERM WILDLIFE MONITORING.

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Abstract

The effects of in situ oil sands development, characterized largely by linear anthropogenic features, on many wildlife species in the boreal forest are poorly understood. A long-term monitoring program was designed to understand the impacts of incrementally increasing in-situ oil sands development on winter-active wildlife species over the full life cycles of multiple projects. Since its inception in 2002, this monitoring has supported 4 separate project applications and EIAs, however its current temporal and spatial scale are now well beyond regulatory compliance. This paper presents over a decade of data on snow trail abundance for key mammal species in an area with intensive in situ oil sands development, but little to no commercial logging or fur harvest. Using standard winter tracking protocols, we replicated surveys 10 times over a 12-year period between 2002 and 2013. This ongoing program is one of the most robust wildlife monitoring programs in the in situ oil sands area, and has provided new insights into wildlife responses to this type of development. The paper highlights the important contribution of rigorous project-specific monitoring to support both project-specific EIA and more regionalized biodiversity monitoring. Ongoing monitoring results continue to provide an empirical source for understanding and assessing the effects of incremental project activities, and for developing effective mitigation measures.

INTRODUCTION

In-situ oil sands extraction projects include exploration, construction of above and below ground pipelines, steam generation and oil processing facilities. All in-situ oil sands projects larger than pilot level (10,000 barrels per day) in Alberta require the proponent to seek regulatory approval including the preparation of an Environmental Impact Assessments (EIA). Public, scientific and regulatory concern has been expressed regarding the potential fragmentation effects of in-situ oil developments on wildlife habitat in Alberta's oil sands (Schneider and Dyer 2006; Jordaan et al. 2009; Environment Canada 2011). The magnitude of immediate and long-term impacts of this form of development on winter-active boreal mammals are uncertain however, because of a shortage of focused empirical studies. This paper summarizes a sub-set of results of a long-term (2002 to 2012) research and monitoring study designed to understand the impacts of incremental in-situ oil sands exploration and production on boreal forest mammals. As this study was conducted in the context of several single-project regulatory applications, the paper explores linkages and synergies between baseline inventory for EIA, single-project monitoring and regional monitoring.

JACKFISH AND PIKE IN-SITU OIL SANDS PROJECTS

Devon Canada Corporation (Devon) entered the Alberta Oil Sands area in 1997 by acquiring the Alberta Oil Sands Technology Research Association Underground Test facility known as Dover. Since then Devon has purchased leases, and applied for and received regulatory approval for a series of contiguous in situ projects in an area encompassing approximately 1,000-km^2 and located 25-km south of Conklin, Alberta. The first application and EIA was for the Jackfish 1 Project area in 2002. This project was approved in 2004. The Jackfish 2 and Jackfish 3 projects were subsequently approved in 2008 and 2011. An application for approval was completed in 2012 for the Pike 1 project area, with approval pending. Each approval required an EIA including wildlife baseline inventories, impact assessments, and follow-up monitoring.

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BOREAL FOREST MAMMALS AS IMPACT INDICATORS

Forty-three species of mammals occur in the boreal forest of northeastern Alberta of which approximately half are active and their presence detectable during the winter months. Several of these species, including woodland caribou, fisher, lynx and wolverine, are provincially or federally listed species. Other mammals (e.g. moose, wolf, and marten) are of value to local and aboriginal residents for trapping and hunting. Mammals are generally considered to be useful indicators of land use impacts because of: 1) societal concerns; 2) economic value to hunters and trappers; 3) large home range requirements; and, 4) a general perception of sensitivity to human activities (Bayne et al. 2004). The above rationale led Devon as early as 2002 to select a subset of mammals as valued ecosystem components and to conduct baseline studies that would serve to monitor and assess impacts and their significance.

SNOW TRACKING METHODS

Snow tracking is a non-invasive inventory method that measures relative abundance of winter-active wildlife species over time and space (Long et al. 2008). The technique involves snowshoeing along pre-defined transects either systematically or randomly placed in a number of different habitat types and land use scenarios. The number of fresh (since last snowfall) trails per species are recorded at intervals along transects with the resultant metric being the number of trails per kilometer surveyed X number of days since last snowfall. In addition to recording fresh wildlife trails, we annually collected data on the number and type of human use intercepts (e.g. seismic lines, pipelines, well pads) at each 50-m interval along transects. Line transects were used in 2002 and 2003. From 2005 to 2012 transects were triangles (n = 20) with 3-km per side following monitoring approaches developed in Finland (Linden *et al.* 1996) and recommended by the Alberta Biodiversity Monitoring Program. The area of intensive monitoring measured approximately 18 km by 24 km (432 km^2).

LANDSCAPE CHANGE (2002 to 2012)

At the time of the 2002 EIA land use in the study area was limited to legacy natural gas infrastructure (conventional seismic lines and wells) from the 1980s, and preliminary low impact seismic exploration (for in situ development). Linear feature density in 2002 was 5.6 km/km^2 with industrial footprint comprising <5% of the area. By 2009 linear feature density had increased to 13 km/km^2 and surface footprint to 16%. The mean number of human use intercepts on tracking triangles increased by approximately 300% from 2006 to 2012. Based on this trajectory it is estimated that surface footprint as of 2012 is approaching 20%. All of the land use change from 2002 to 2012 is attributed to in situ oil sands exploration and production. No timber harvest has occurred in the study area to date. No significant fur trapping was observed in the study area from 2002 to 2012.

MAMMAL RESPONSE TO LANDSCAPE CHANGE

In spite of a 4-fold increase in industrial footprint and a 3-fold increase in linear feature density, all mammal species observed during the 2002 tracking inventory have persisted in the study area as of 2012. Prey species such as snowshoe hare, red squirrel, and grouse have exhibited natural population cycles and eruptions (Figure 1). Trail abundances of listed carnivores have remained stable (fisher) or are following the hare cycle (lynx) (Figure 2). Resilient generalist species such as coyote and white-tailed deer do not appear to be increasing because of fragmentation edge effects as was predicted in early EIA reports. To date the only mammal species that appears to be declining in abundance in the study area is moose. Moose abundance has also declined in the larger region surrounding the Devon in-situ leases (Devon 2012). Additional back-trailing and above-ground pipeline monitoring show that neither pipelines, roads, seismic lines, nor above-ground pipelines appear to be obstructing mammal movement (Devon 2012).

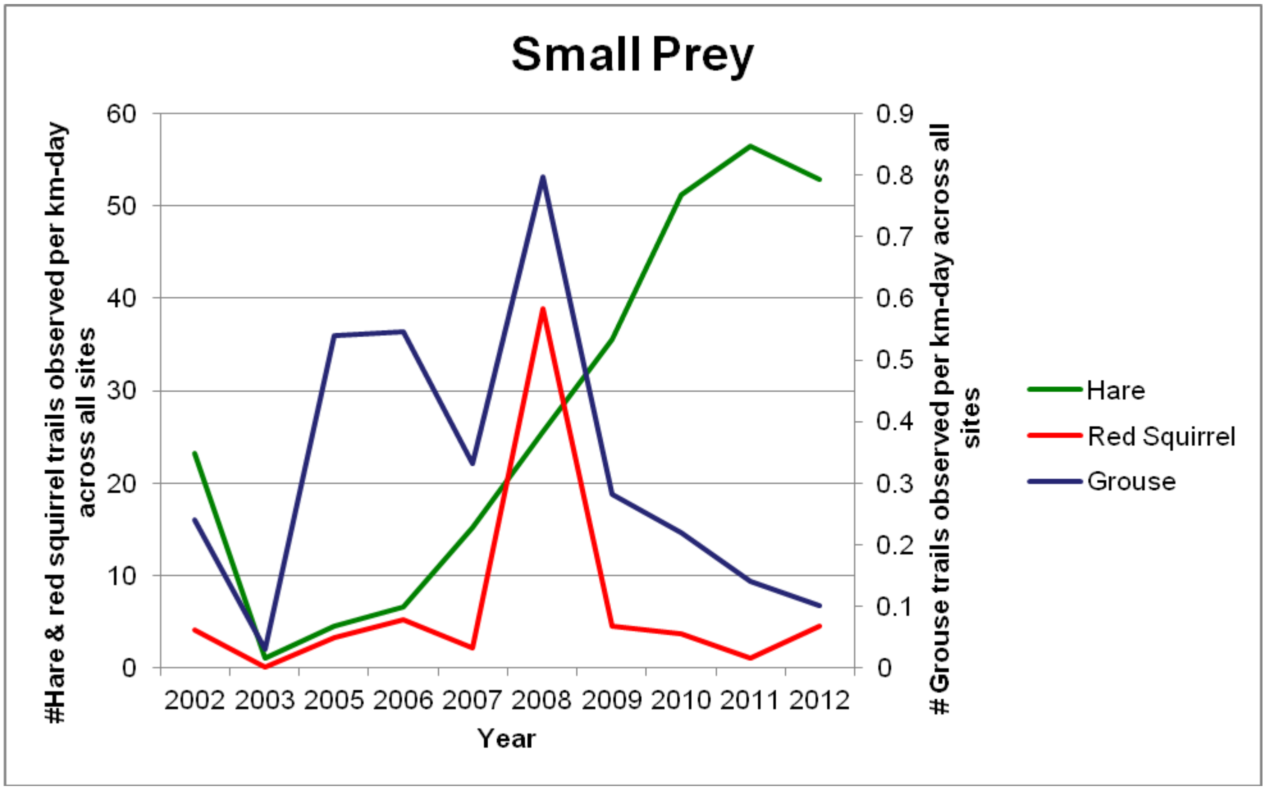

Figure 1. Small prey trail densities 2002 to 2012.

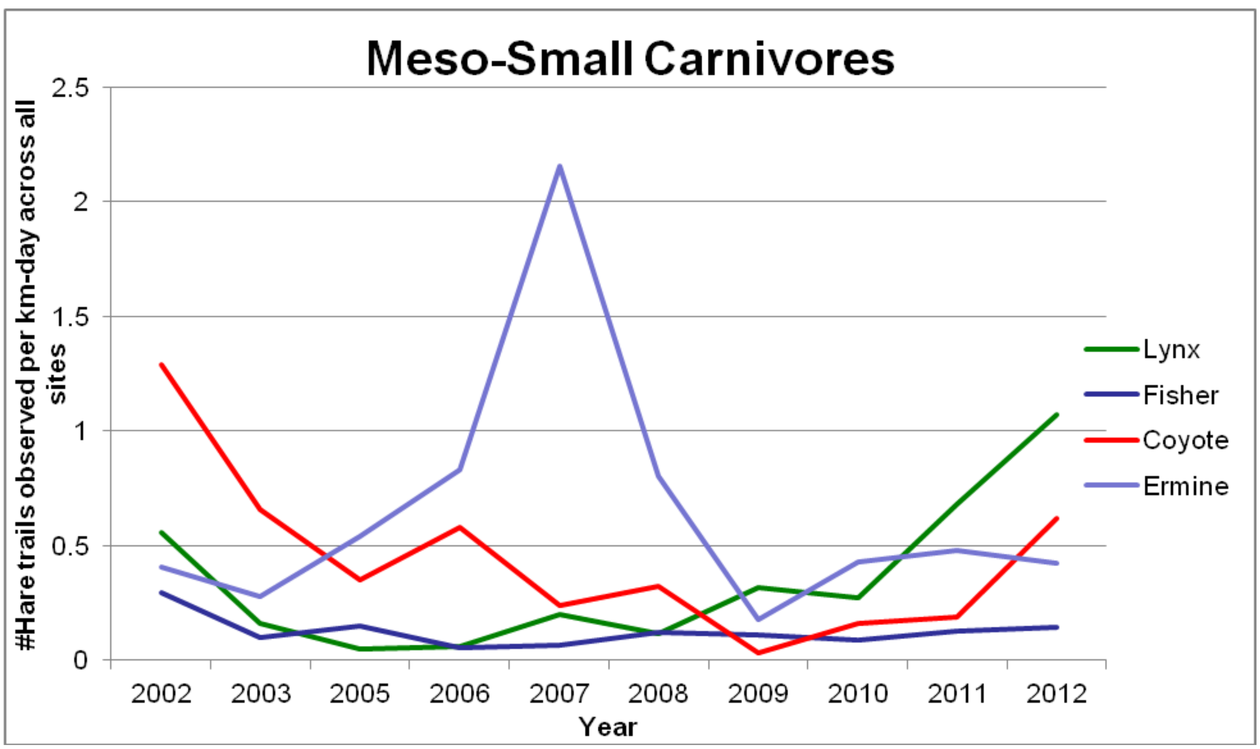

Figure 2. Small to mid-sized carnivore trail densities 2002 to 2012.

APPLYING FINDINGS TO EIA

At the time of the 2002 EIA little or no published empirical information was available for predicting the impacts of in situ exploration and production on mammals in the area. As such the confidence of impact significance predictions for the 2002 EIA was limited, and led to impact hypotheses based on behavioral research studies conducted in other regions. One example was the hypothesis that increased edge effects of in situ development would lead to increased inter-specific competition (and even predation) between the generalist coyote and the specialists lynx and fisher. The uncertainty associated with early impact predictions led to the voluntary initiation of the long-term winter monitoring program by Devon in 2003. Regulatory approval conditions aimed at monitoring cumulative effects on biodiversity also served to maintain the monitoring program over time. As the annual monitoring program continued, the responses of various mammal species to the growing incremental in situ footprint became more clear, and the confidence of impact predictions increased. For example, the decline in moose trail abundance was noted in between the completion of the J2 and J3 EIAs. This led to a regional aerial survey program to place local moose declines in a broader regional context. Mitigation planning measures to more fully understand and halt local and regional moose declines are under consideration.

MONITORING AND IMPACT SIGNIFICANCE DETERMINATION

Impact significance determination is recognized as a fundamental and critical component of EIA (Lawrence 2007). EIA demands that discipline specialists make a judgement on the significance of project-specific and cumulative impacts on valued ecosystem components under their purview. EIA practitioners have a professional responsibility to use best available scientific knowledge to determine significance. A range of methods exist for supporting impact significance determinations, including:

- case studies as analogues or references;
- quantitative mathematical models and calculation;
- empirical measurements of existing effects;
- quantification of footprint environmental effects (as measure of magnitude);
- best professional judgement supported with field reconnaissance; and
- a combination of some or all the above.

For the Jackfish EIA in 2002 we were forced to rely largely on best professional judgement as informed by behavioral response studies in other regions to determine significance. These early determinations were generally of limited confidence. Spatial modeling (e.g. disturbance buffers) was not considered because scientific evidence to weigh disturbance coefficients and assign buffer widths were not available or validated. The replicated winter monitoring approach provided a scientifically defensible basis for impact significance determination in future EIAs in 2006, 2011 and 2012. Because subsequent EIAs were in nearby areas with similar ecology and land uses, we were able to apply knowledge gained from early EIAs to subsequent "step-out" projects.

UTILITY OF PROJECT-SPECIFIC MONITORING

The importance of ecological monitoring programs in the Alberta oil sands is clearly recognized by provincial and federal governments and numerous initiatives are planned or on-going (AEMWG 2012, Minister of Environment 2012). The current focus on monitoring in the oil sands is toward large regional programs aimed at understanding cumulative impacts of multiple projects and industries. While the role of large regional monitoring programs is clear, there is also a need for project-level and sub-regional monitoring programs that address finer scale and single industry impacts.

Nesting intensive monitoring programs at finer scales within larger regional programs may help to understand threshold relationships that cross scales. For example, regional monitoring data shows that lynx winter trail occurrence is lower at the southern edge of their range in the Alberta oil sands and that density of roads is the main limiting factor (Bayne et al. 2008; Nielsen et al. 2007). Devon's Jackfish/Pike leases lie in the central portion of the Bayne and Nielsen's regional study area, and lynx occupancy and trail densities appear to be unaffected by current land use levels in this area. Continued monitoring and comparison to the larger regional data set will help to understand road density thresholds, as well as the influence of multiple land uses.

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