Examining Industrial Logging and Cultural Landscape Change in Forest Management License 3, Duck Mountain, Manitoba

1.0 Introduction

Industrial logging in Forest Management License 3 (FML 3) in Manitoba has continued for over sixteen years without an approved forest management plan, contrary to The Forest Act and Treaty obligations (Pine Creek First Nation v. The Government of Manitoba and Louisiana-Pacific Canada Ltd., 2022). This lack of oversight and consultation has created a gap between claimed management practices (e.g., sustainable logging levels, spatial patterns, and adherence to provincial guidelines) and actual forest conditions. For example, provincial guidelines call for Indigenous and local involvement, public comments indicate that engagement in FML 3 has often been limited and insufficient (Manitoba Environmental Approvals Branch, 2018; 2021).

In FML 3, industrial logging has altered forest cover, contributing to declining moose populations and disturbance to culturally significant areas (Pine Creek First Nation v. Manitoba, 2022). Moose depend on a mix of mature and regenerating forest, and extensive logging reduces available cover and increase predation risk (Johnson & Rea, 2024). These changes have limited the ability of Indigenous communities to harvest moose, gather berries and medicines, and maintain long standing cultural relationships within the Duck Mountain landscape (Pine Creek First Nation v. Manitoba, 2022).

This project will use satellite imagery to assess how industrial logging has altered forest structure and spatial patterns within FML 3 since the license agreement was first issued in 1994. The objectives are to (1) map long term logging activity and spatial change, (2) quantify the size and distribution of logged patches to describe changes in landscape structure, and (3) evaluate how logging patterns align with provincial management guidelines and claimed industry practices.

2.0 Methods

2.1 Data Source and Preparation

This analysis will use disturbance data from the National Terrestrial Ecosystem Monitoring System (NTEMS), a Landsat based dataset that maps annual stand replacing harvesting in forested areas (Hermosilla et al., 2016). NTEMS harvest year data will be used to identify logging within FML 3 from 1994-2022. The logging raster will be clipped to the FML 3 boundary (Manitoba Government, 2025). For each year, pixels coded with the corresponding logging year will be reclassified into a binary layer. Logged areas will be assigned a value of 1, and all other pixels will be assigned 0. This process produces a series of annual logging rasters.

2.2 Landscape Pattern Analysis

The annual logging rasters will be used to calculate landscape metrics describing changes in logging extent, patch characteristics, and spatial configuration. Landscape metrics will be calculated for the logged class (value = 1) using the landscapemetrics package in R (Hesselbarth et al., 2019). Several class level metrics will be calculated for each year from 1994-2022 and compiled into a time series. A summary of each metric and its role in this study is provided in Table 1. A visual map of logging year and location will also be produced to show how logged areas relate spatially and to support interpretation of the metrics.

Table 1. Landscape metrics used in this study and how they contribute to describing industrial logging patterns in FML 3. This table summarizes the four class level metrics applied to yearly rasters and outlines what each metric measures and how it helps quantify annual logging extent, patch size, and general spatial patterns of logged areas.

Metric(s)	What it measures	What it indicates in this study
PLAND (percent logged)	Proportion of the landscape logged each year	How much logging happens each year and how logging levels change from 1994–2020
NP (number of logged patches)	Count of discrete logged patches	How logging is spread across the landscape, whether there are many small openings or fewer larger ones
AREA_MN / SD (mean and variability)	Average logged patch size and variation among patch sizes	The typical size of logged openings and whether patch sizes stay similar or change over time
CLUMPY (degree of spatial aggregation)	Degree of spatial aggregation	Whether logged areas form larger connected blocks or are more spread out across the landscape

3.0 Expected Results and Significance

This research is expected to provide both a detailed map of logged history and a time series of calculated landscape metrics. This will reveal how industrial logging has altered forest structure and spatial patterns in FML 3 from 1994 to 2022. The analysis will confirm that logging has been concentrated in specific areas, as shown in Figure 1. The landscape metrics in Figure 2 are expected to show a long-term shift toward more spatially concentrated logging. These trends reflect an increasingly continuous logging footprint within FML 3 and provide a basis for evaluating alignment with provincial expectations.

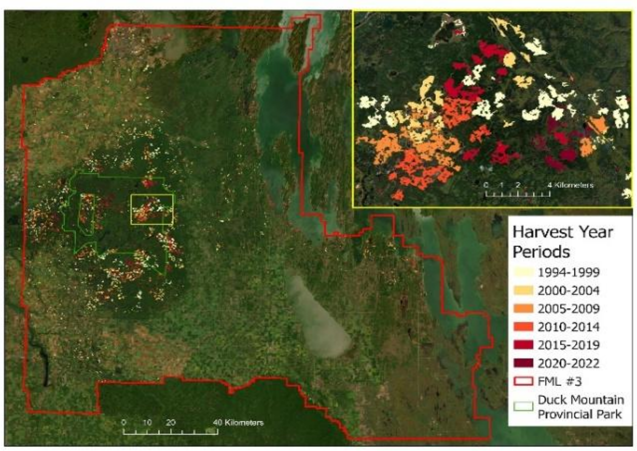

Figure 1 (left). Industrial logging patterns in FML 3. Illustrating the cumulative logged footprint over the 29-year study period, with distinct colors representing five-year periods, which illustrates the concentrated logged patches. The inset highlights areas where contiguous logged patches have formed.

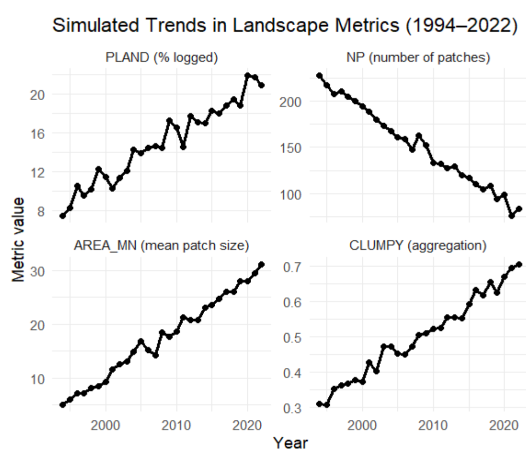

Figure 2 (right). Expected landscape metric trends for FML 3 from 1994–2022. The increasing metrics (PLAND, AREA_MN, and CLUMPY) indicate rising logging levels, larger and more variability in patch sizes, and growing spatial aggregation through time. In contrast, the decrease in NP suggests that logging has consolidated into fewer, more continuous patches.

These spatial patterns matter ecologically because industrial logging alters forest structure. This in turn reduces mature cover and shapes ecological and cultural relationships connected to the landscape. Documenting these long-term patterns will provide geospatial evidence for Indigenous communities, land managers, and policymakers. Understanding how logging has accumulated over decades is essential for evaluating whether practices align with provincial management guidelines and claimed industry commitments. This information can support discussions about ecological impacts and the stewardship of culturally important places.

References

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