CENTRE FOR BOREAL RESEARCH
TECHNICAL NOTE #30
PEATLAND RESTORATION - OCTOBER 2019

Hummock Transfer Technique (HTT) for reclamation of temporary access features in peatland

INTRODUCTION

Exploration of resources (i.e. oil and gas, forestry) creates numerous temporary access features, including seismic lines, winter roads, and oil sands exploration (OSE) wells in boreal peatlands[1]. Although construction is usually completed in winter under frozen ground conditions, the clearing of vegetation and repeated access of these features often leads to flattened surface topography, altered moisture regimes, and shifts in species composition compared to undisturbed peatlands[2,3] (Figures 1A and 1B). These changes can compromise critical functions and services such as wildlife habitat and long-term carbon sinks provided by natural peatlands[4,5]. Without active reclamation, many of these features will remain open with little woody vegetation and limited peat accumulation potential.

Figure 1A. A winter road through a treed bog.

Figure 1B. Sphagnum hummocks and lichen hollows in a continental bog - typical habitat for caribou.

KEY ISSUES TO ADDRESS:

- Cleared vegetation and disturbed ground layer, particularly mosses
- Soil compaction, flattened and simplified topography (loss of hummocks), elevated water table (closer to surface)
- Shift to herbaceous vegetation dominance and general lack of trees, shrubs and mosses
- Higher direct insolation and decomposition leads to an increased methane source
- Fragmented landscape and compromised habitat function

THE GOAL:

To introduce microsites and topographic features on flattened temporary access features. This increases structural and floral diversity, particularly woody vegetation and peat forming mosses, which in turn will promote the return of functions and services offered by natural peatlands.

HUMMOCK TRANSFER TECHNIQUE (HTT)

Here we present a new option to reclaim winter roads, seismic lines, and OSE well sites. It is called the "Hummock Transfer Technique". The goal is to collect intact hummocks (small trees, shrubs, herbs and mosses) from nearby natural areas and place them directly on temporary access features without flipping the hummocks. This is in contrast to the common practice of mounding and planting[6] where the living ground vegetation (herbs and mosses) are often inverted and buried and stock seedlings are planted on exposed, humified peat.

MACHINERY AND EQUIPMENT:

Figure 2A. Low ground disturbance tracked excavator.

Figure 2B. A digging bucket (1 yard) equipped with frost-teeth.

KEY STEPS:

This note will focus on temporary linear features as this technique has only been applied and tested on seismic lines and winter roads to date.

1. Walk the tracked excavator towards the end of the line and work backwards to avoid compaction after placement of hummocks.
2. Sit in the middle of the line and look for large, tall, well-developed hummocks with shrubs and small trees (Figure 3A).
3. Extend the arm into the natural peatland as far as needed to reach the backside of the hummock.
4. Sink the teeth at the far side of hummock without breaking through the frozen layer (approximately 50 centimeters below the top of the hummock).
5. Tilt the bucket so the teeth and flat edge (with rear wear strips) of the bucket is parallel to the ground.
6. Scoop along the base and pick up the entire hummock while maintaining its integrity (i.e. keep in one-piece) (Figure 3B).
7. Keep its position and drop the bucket until the teeth and rear wear strips are touching the ground (Figure 3C).
8. Gently tilt up and away from the ground so the hummock will slide out onto the surface, staying intact and upright, without flipping (Figure 3D).
9. Repeat the steps every 3 to 5 meters, depending on the availability of hummocks.
10. Hummock placement on the line should be random as opposed to placement directly down the middle of the line (Figure 3E).
11. Bend down random trees (dead and alive) from both sides at random or set distances (i.e. 1 stem/10 meters) to block access and add propagules (seeds) to the line (Figure 3E).

HTT BY STEPS

Figure 3A. A mossy hummock with trees, shrubs, and herbs.

Figure 3B. Collection of the hummock.

Figure 3C. Transfer of the hummock.

Figure 3D. Placing intact hummock.

Figure 3E. A reclaimed line with transferred hummocks and bent over trees with seed cones.

Figure 3F. Donor area after hummock collection. Note the roots, stems, rhizomes, and moss pieces left behind.

Figure 3G. Growing hummocks five months after transfer.

TAKE AWAY MESSAGE

1. It is critical to maintain the structure and orientation of the hummock throughout the collection and transfer process. This will promote survival of transferred plants and regulation of moisture by mosses within the hummock.
2. It is best to target large, pronounced hummocks with woody vegetation (i.e. increased species composition and diversity). The exact size will depend on the size of the bucket.
3. The gaps between teeth will ensure some roots, stems, rhizomes and mosses will be left behind for quick regeneration (Figure 3F).
4. Do not dig too far beyond the frozen ground layer. It will leave deep holes in the natural area that will regenerate slowly. Tall hummocks with highly decomposed peat at the base may not be able to regulate moisture as intended.
5. Surrounding peatlands can be used to decide the proper density of transferred hummocks.
6. Bending trees creates blockage along the line and can introduce additional propagules. The number of trees to be brought down can vary but does not need to be excessive. Too many downed trees can shade out growing trees and shrubs.
7. If operating in unfrozen conditions, specialized low-ground disturbance equipment may be required. The digging bucket should stay close to the water table without going too deep. A trial test should be carried out first to determine how far the bucket can penetrate.
8. If done properly, many of the hummocks will already have trees growing. Additional seeds from nearby peatland can supplement tree growth. Stock seedlings can also be planted on top of the mounds as needed (Figure 3G).

LESSONS TO DATE

The HTT was applied on several seismic lines and winter roads in a wet, treed fen complex during a warmer and wetter than usual year (2019). The lines had a high water table and the additional moisture throughout the growing season was beneficial to the survival and growth of the transferred plants. Under normal weather condition and in other peatland settings (i.e. shrubby fen or tree bogs), HTT should work well as long as the features are dominated by herbaceous species such as *Carex spp*. with a high water table (close to surface). However, more field trials are needed to prove this.

By the end of summer 2019, most hummocks retained their shape and showed little signs of stress from the transfer. Most living vegetation on the hummocks survived and grew while planted seedlings also survived (Figure 3G). Mosses started to grow out from the edge of the hummocks. Overall the transfer was very successful and showed great potential as an effective approach to introduce microsites, enhance woody establishment, and accelerate peat accumulation function recovery on temporary access features in peatlands.

REFERENCES

1. CAPP, Evolving Approaches to Minimize the Footprint of the Canadian Oil and Natural Gas Industry. *Canadian Association of Petroleum Producers*, (2004).
2. J. Lovitt, M. Rahman, S. Saraswati, G. J. McDermid, M. Strack, & B. Xu, UAV Remote Sensing Can Reveal the Effects of Low-Impact Seismic Lines on Surface Morphology, Hydrology and Methane (CH_4) Release in a Boreal Treed Bog. *Journal of Geophysical Research: Biogeosciences*, (2018). https://doi.org/10.1002/2017JG004232.
3. A. Dabros, H. E. James Hammond, J. Pinzon, B. Pinno, & D. Langor, Edge influence of low-impact seismic lines for oil exploration on upland forest vegetation in northern Alberta (Canada). *Forest Ecology and Management*, **400** (2017) 278–288. https://doi.org/10.1016/j.foreco.2017.06.030.
4. K. E. Pigeon, M. Anderson, D. MacNearney, J. Cranston, G. Stenhouse, & L. Finnegan, Toward the Restoration of Caribou Habitat: Understanding Factors Associated with Human Motorized Use of Legacy Seismic Lines. *Environmental Management*, **58** (2016) 821–832. https://doi.org/10.1007/s00267-016-0763-6.
5. M. Strack, S. Hayne, J. Lovitt, G. J. McDermid, M. M. Rahman, S. Saraswati, & B. Xu, Petroleum exploration increases methane emissions in northern peatlands. *Nature Communications*, (2019).
6. M. Pyper, J. Nishi, & L. McNeil, Linear Feature Restoration in Caribou Habitat : A summary of current practices and a roadmap for future programs. *Submitted to Canada's Oil Sands Innovation Alliance (COSIA). December 2014*, (2014).

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