CENTRE FOR BOREAL RESEARCH
TECHNICAL NOTE #42
PEATLAND RESTORATION - SYNTHESIS OF TECHNIQUE – MAY 2021

Donor Moss Transfer: How and When to Use in Peatland Restoration

CONTEXT

Natural ingress of peatland vegetation, particularly bryophytes, is slow on reclamation sites that are severely degraded, extensive in size or distant from appropriate seed sources. These sites require active revegetation strategies to introduce target species for desirable communities to develop. However, peatland bryophytes are not commercially available and difficult to deploy using traditional vascular species stock practices.

In response, the moss layer transfer technique (MLTT) was developed by Université Laval for harvested cutover peatlands. *Sphagnum* moss species are reintroduced by transferring small quantities of donor moss from nearby sources to reclaimed peat surfaces. The MLTT has the added benefit of reintroducing desirable vascular species from seeds and root fragments trapped in the donor material. NAIT has successfully adapted the MLTT to also reclaim in-situ features in peatland settings.

Peatland moss and vascular species established on a former mineral well pad reclaimed to peat surface six years after donor transfer.

Full site trials at the CNRL Peace River Complex have successfully introduced peatland vegetation communities onto reclaimed peat surfaces. These were reclaimed by complete pad removal and peat fluffing, partial fill removal and burial under peat, or complete fill burial under peat (see *Technical Note #37 Peatland Restoration by Burying: An Effective Option*). We also have new trials underway using a modified MLTT to introduce fen moss directly on saturated mineral fill.

Five years after restoring the peat surfaces, both the reclaimed sites and the harvested donor areas can pass the provincial peatland reclamation criteria. The ability for these donor sites to naturally regenerate if harvested under recommended protocols makes the MLTT an attractive revegetation strategy for in-situ reclamation in peatlands.

HOW AND WHEN TO USE MLTT IN PEATLAND RESTORATION

1. **MLTT can be used to transfer donor moss onto reclaimed peat or mineral surfaces** as long as the site is saturated, without prolonged inundation, for the entire growing season. Site preparation techniques to achieve a saturated surface will depend on the peatland setting, budget and disturbance type.
2. **Donor communities must grow in similar chemical conditions to the reclamation sites.** An appropriate target community should have similar porewater pH to the destination site's pH to ensure the transferred species can tolerate the new conditions. MLTT can be used to harvest fen moss communities (true moss dominated) or bog moss communities (*Sphagnum* moss dominated).
3. **MLTT paired with flat reclaimed surfaces to maximize moss to surface contact has been successful** to date, but we are also **exploring MLTT application with texturized surfaces** to increase ecosystem resiliency and diversity. Early results are promising and should be considered for future projects.
4. **MLTT can be successfully used under frozen or thawed conditions. However, operationally it is easier and more cost effective under winter conditions with deep frost, particularly in wet fen settings.** Harvest conditions do not affect donor site regeneration as long as no deeper than 10 cm of surface moss is harvested, and compression is minimized by using low ground pressure equipment appropriate for the weather.

KEY FINDINGS

- Transferring donor material on a flat peat surface using the MLTT resulted in a certifiable peatland community on a former mineral well pad site within five years.
- The MLTT promoted a diverse peatland community on the reclaimed site, including both vascular and moss species.
- MLTT executed under thawed or frozen conditions successfully restored the reclaimed sites, and all donor sites naturally regenerated.
- Properly harvested donor sites regenerated without assistance and were certifiable in a similar timeframe (4-7 years).
- Final costs were impacted most by machine mobilization rates, equipment availability, and transportation time between the donor and reclaimed site.

COST ANALYSIS

Most Cost-Efficient Moss Layer Transfer Technique to Date

Winter harvest and transfer under deeply frozen conditions

Considerations: The donor site lacked trees, was less than 1 km from the reclaimed site, had an existing cutline transportation corridor, did not require track packing to increase frost penetration ahead of time, and had snow partially cleared from the donor site to reduce transferred material volume and the resulting number of transport trips.

Site size: reclaimed site 1 ha, donor site 0.15 ha

Machines:

- 1 tracked excavator with serrated/ toothed clean-up bucket
- 1 gravel truck
- 2 tracked skid steers with wide snow buckets

Time:

- Snow clearing (skid steer) – 1 hr
- Moss harvest (excavator) and transport (gravel truck) – 1 day
- Moss spreading onsite (2 skid steers) – 1 day
- Straw spreading (by hand) – 1 day

Cost: ~$15,000 - total cost including mobilization, operators and straw

PRACTICAL RECOMMENDATIONS

DONOR SITE SELECTION

- Use a portable field meter to determine the reclaimed site surface water/soil chemistry (EC & pH) and select a donor site community with similar conditions.
- Determine donor conditions either by similar porewater measurements or vegetation indicators.
  - Example: reclaimed site porewater pH of 6-7 – select a moderately rich fen community
- Harvest from existing cutlines when possible. They are easily accessible transport corridors without large trees to remove, and often have greater desirable moss cover and less lichen than adjacent natural areas.

DONOR SITE HARVESTING

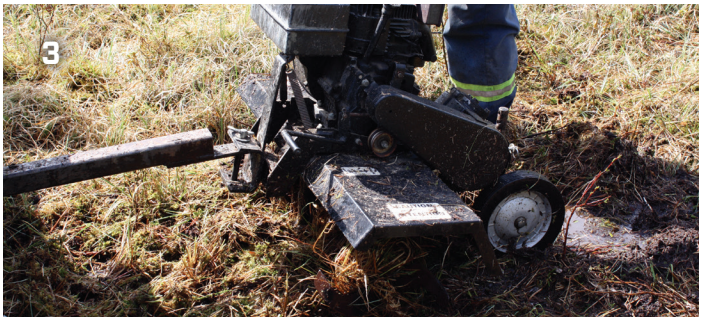
- Donor moss can be harvested during thawed or frozen conditions.
- In summer conditions, harvest donor site with a tracked ARGO and rototiller, transport to prepared site with the ARGO or a helicopter and spread using the ARGO with a manure spreader attachment at a rate of ~1:10 moss to bare surface.
- In winter conditions, harvest donor site using an excavator, transport to the prepared site with a Hägglund, rock/ gravel truck or skid steer, and spread onsite with a skid steer or ARGO with a manure spreader attachment at a rate of ~1:10 moss to bare surface.
- When harvesting in frozen conditions, ensure at least 1 m of frost is present to reduce donor site damage. Thin frost layers will peel directly off the lower thawed peat layers during surface scraping. This will remove more material than intended and significantly impair donor site regeneration.
- Only the upper 10 cm of moss is viable material – underlying peat does not contribute to vegetation establishment on the reclaimed site. If more moss is needed, harvest a larger area, not a deeper depth.

DONOR SITE RECOVERY

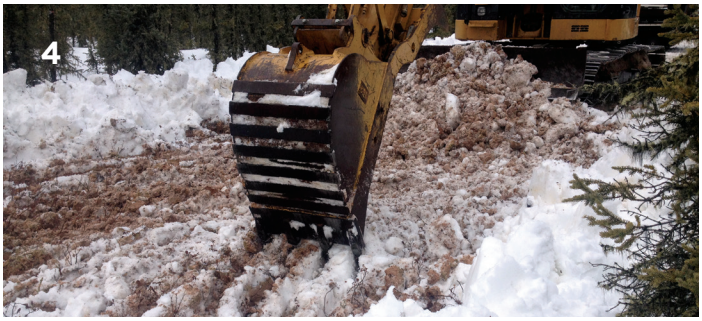
- Damage to all areas (donor, reclaimed and transportation corridor) is minimized during frozen conditions.
- Harvesting deeper than the recommended top 10 cm of living moss can impair the donor site's natural recovery and may require additional reclamation.
- Donor sites are subject to evaluation with the Reclamation Criteria for Wellsites and Associated Facilities For Peatlands. If harvested carefully, they can pass the criteria within five years, in step with target timeframes for reclaimed site certification.

Harvest only the upper 10 cm of living moss layer. Deeper harvest impairs donor site recovery and reduces the reclaimed site's success.

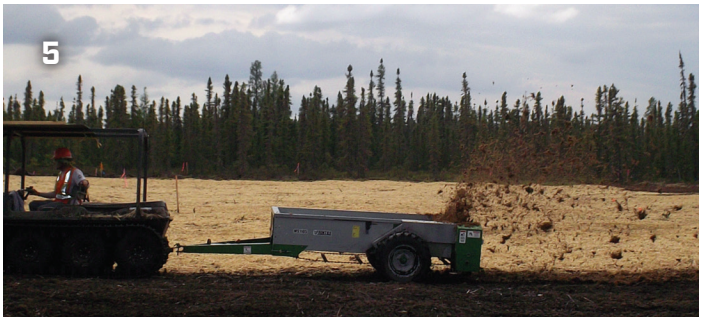
After proper harvest, roots and moss fragments remain that will naturally regenerate the area.



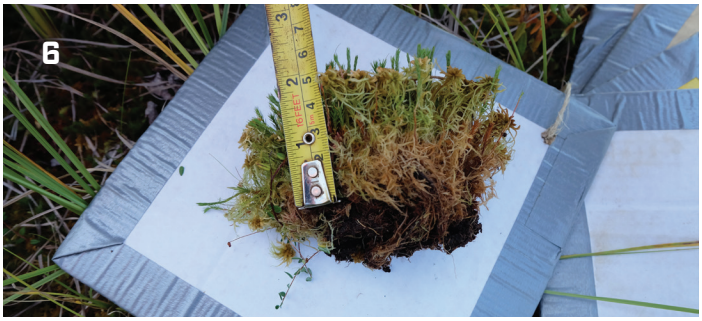
Thawed moss harvest uses a rototiller attachment behind a tracked ARGO to cut the top 10 cm of moss.



Frozen moss harvest uses excavator bucket teeth (15 cm) to scrape up to top 10 cm of moss with snow. More than 1 m deep frost is needed to prevent over-harvesting.



Donor material is spread on the prepared surface of the reclaimed site (1 m^2:10 m^2). Straw mulch and rock sulphate fertilizer follow.



Example of moss layer established at the reclaimed IPAD site. A 5-15 cm deep moss carpet developed across the site six years post transfer.

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Photo credits: Peatlands Team, Centre for Boreal Research, NAIT

Thank you to Canadian Natural Resources Limited (CNRL) and Natural Sciences and Engineering Research Council of Canada (NSERC) for financial support.