Geophysical Research Abstracts
Vol. 15, EGU2013-13812-1, 2013
EGU General Assembly 2013


# Trialling a novel peat fuel extraction and reclamation technique: Vegetation recovery and peatland-atmosphere carbon fluxes

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Most existing methods for peat extraction are highly environmentally damaging and commonly convert extracted peatlands from slow but persistent sinks of atmospheric carbon to strong sources. Furthermore, the removal of the live moss surface during peat extraction greatly reduces these ecosystems' resilience and often prevents the successful re-establishment of peatland plants. We describe an experimental trial of a new extraction method, called the peat-block reclamation (PBR) method (also known as wet harvesting, the floating-block method, and the acrotelm-transplant method) that is designed to be less environmentally damaging.

The PBR method involves removing the upper 0.3 to 0.5 m of peat, including the live vegetation mat, and setting it aside. Peat is then extracted from below this depth and removed for processing. The conserved surficial peat blocks and the live vegetation are then immediately transplanted back into the extraction pit. We performed a small (12 × 12 m) experimental trial of PBR at a poor fen in northern Ontario, Canada. Usually the extraction pit is drained or pumped of soil water; instead we left the pit inundated so that the transplanted blocks float low in a shallow pool. We wished to investigate whether this alteration to the method would promote the post-extraction maintenance of a healthy moss layer and the re-establishment of vascular plants. We also monitored peatland-atmosphere carbon gas fluxes from the plot and compared them to a nearby unaltered reference plot.

Our measurements over two summers indicate mixed results. The wet conditions in the extraction pit appear to have suppressed $CO_2$ fluxes from the experimental plot (average net ecosystem exchange of 1.4 g $CO_2$ $m^{-2}$ $d^{-1}$), which were intermediate between those from hummocks (-1.5 g $CO_2$ $m^{-2}$ $d^{-1}$) and hollows (2.8 g $CO_2$ $m^{-2}$ $d^{-1}$) in the reference plot. The low $CO_2$ fluxes represent a major potential advantage for PBR over existing techniques, which commonly cause large increases in $CO_2$ flux due to deep water-table drawdown. However, average methane fluxes from the experimental plot (274 mg $CH_4$ $m^{-2}$ $d^{-1}$) were highly elevated compared to those from hummocks (18 mg $CH_4$ $m^{-2}$ $d^{-1}$) and hollows (44 mg $CH_4$ $m^{-2}$ $d^{-1}$) in the reference plot, representing a major drawback to transplanting into an inundated extraction pit. During the first summer immediately after extraction the transplanted moss community appeared healthy, even though many of the vascular plants had been killed. However, by the second year proportional coverage of moss in the experimental plot had declined from 63 % to 41 %, which contrasted with an increase in moss coverage in both hummocks and hollows at the reference plot. Nonetheless, *Sphagnum* growth in the remaining healthy communities was strong in the second year (156 g $m^{-2}$ moss) compared to the reference plot (104 g $m^{-2}$ moss).

Our findings indicate that PBR has great potential as a means for extracting peat without causing either i) irreparable damage to plant communities, or ii) elevated $CO_2$ flux. However, these potential advantages must be carefully weighed against the highly elevated $CH_4$ release from the transplant pit.