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USE OF ^{14}C LABELLING TO MEASURE BELOW-GROUND BIOMASS OF MIRE PLANTS

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Below-ground biomass of dominating vascular plants on a mesotrophic fen and *Sphagnum fuscum* pine bog was estimated using ^{14}C labelling techniques. Preliminary results show that up to 90% of living biomass of *Carex rostrata* growing on the fen may be located below ground. Fine roots form the majority of below-ground biomass.

Keywords: Peatlands, production, root biomass

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INTRODUCTION

Root systems of vascular plants may comprise a major part of the living phytomass. Root dynamics — especially turnover of fine roots — is regarded as a key factor in carbon cycling of terrestrial ecosystems (Aerts et al. 1992).

Measurements of below-ground biomass using traditional harvesting methods (coring or excavation) are very laborious (Finér et al. 1992). Recent advances in carbon isotope techniques (Wallén 1983, 1986, Milchunas & Lauenroth 1992) offer new, more accurate indirect methods to study below-ground production of vascular plants. However, the flux of recently assimilated carbon through roots into the soil is a potential factor that may bias ^{14}C datings (Wallén 1986).

Data on below-ground biomass and production of natural mire plant communities and the responses of roots to assumed climatic changes is very scarce. In the course of the SUOSILMU subproject on carbon accumulation rate in peat layers (Tolonen & Vasander 1992, Tolonen et al. 1992), it became apparent that reliable data on primary below-ground production, including carbon input processes, in peatlands will be needed.

MATERIAL AND METHODS

Study sites

A herb-rich sedge fen community and a *Sphagnum fuscum* pine bog community on the Suurisuo mire complex, Janakkala, southern Finland (Grid 27°E 6766:381, 130 m a.s.l.) were chosen for the current study. *Carex rostrata* and *Potentilla palustris* are dominant vascular plants on the fen and *Empetrum nigrum*, *Rubus chamaemorus* and *Eriophorum vaginatum* dominate on the bog.

Below-ground biomass

The indirect ^{14}C labelling method described by Wallén (1986) was used to estimate the below-ground biomass of the dominant species. The above-ground parts of all species but one on 40 x 40 cm plots (5 replicates/species) were removed by clipping. Transparent cuvettes containing 300 µCi $^{14}CO_2$ were placed on the surface in June 1992. One week after labelling, the above-ground parts of the remaining single species were harvested and peat cores (8 x 8 x 50 cm) taken and divided vertically into subsamples. Root, peat, and homogenized peat-root samples were com-

busted and ^{14}C activity recorded using liquid scintillation counting. Root biomass was subsequently calculated using the equations given by Wallén (1986).

Below-ground production

The ^{14}C turnover method developed by Milchunas and Lauenroth (1992) was modified to estimate below-ground productivity. Five 1 x 1 m plots were labelled with 660 µCi $^{14}CO_2$ at both sites in July 1992 (Fig. 1). The turnover of ^{14}C label in living roots will be monitored for several years by periodically taking peat core samples and measuring ^{14}C activities. The first samples were cored ten days after the labelling and ^{14}C activities measured by liquid scintillation counting as described by Milchunas and Lauenroth (1992). Autoradiography is to be used as a parallel method to measure ^{14}C turnover times in living roots. Root production will be estimated by dividing average root biomass by ^{14}C turnover time.

RESULTS AND DISCUSSION

Preliminary results for *Carex rostrata* show that below-ground parts form the bulk of living biomass of the species (Fig. 2). Up to 90% of the phytomass of sedges may be located below ground. The majority of below-ground parts are located within the uppermost 25 cm. However, there were living roots even below 50 cm, which, according to Metsävainio (1931), is maximum

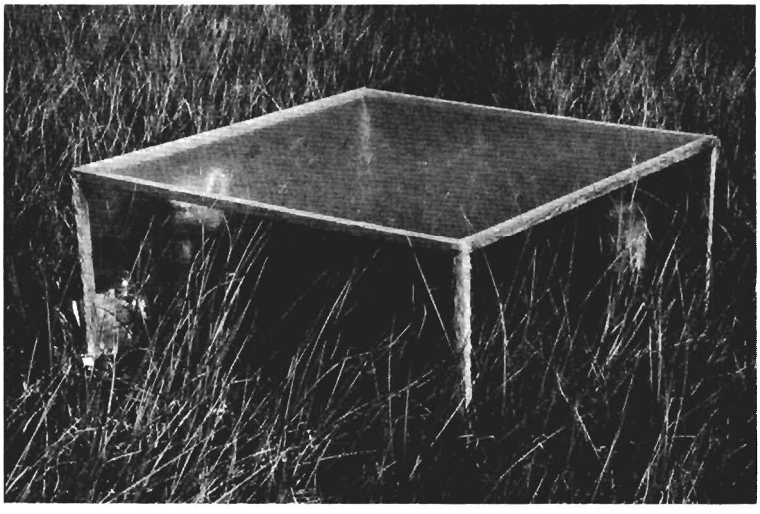

Fig. 1. ^{14}C labelling experiment on a herb-rich sedge fen with *Carex rostrata* and *Potentilla palustris* (Suurisuo mire complex, Janakkala, southern Finland, June 1992).

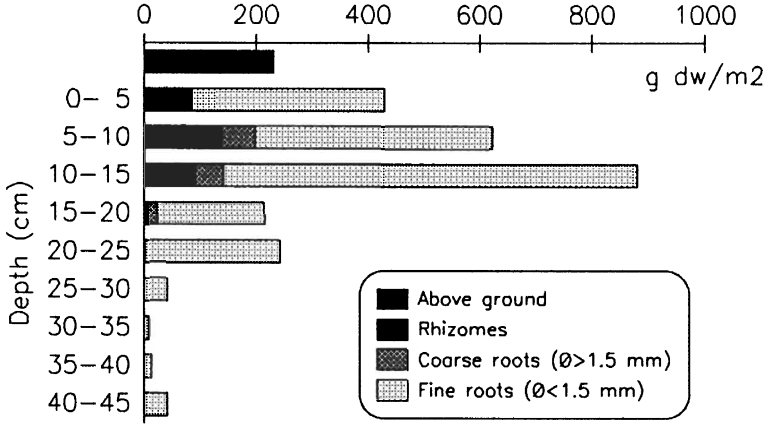

Fig. 2. Preliminary results of the distribution of biomass of *Carex rostrata* in a herb-rich sedge fen on Suurisuo mire complex, Janakkala, southern Finland.

depth for *Carex rostrata* roots. Fine roots account for most of the total and below-ground biomasses (Fig. 2).

The above-ground biomass of *Carex rostrata* in the present study (Fig. 2) is in good agreement with the results given by Liedenpohja (1981) on the same mire complex. The below-ground biomasses, however, are distincly higher than the values reported by Lindholm (1981), which were obtained by separating the roots manually from peat cores.

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REFERENCES

Aerts, R., Bakker, C. & Decaluwe, H. 1992: Root turnover as determinant of the cycling of C, N and P in a dry heathland ecosystem. — Biogeochemistry 15:175–190.

Finér, L., Laine, J. & Halko, L. 1992: Fine root production on peatlands. — In: Kanninen, M. & Anttila, P. (eds.), The Finnish research programme on climate change. Progress report. Publ. Acad. Finland 3/92: 211–213.

Liedenpohja, M. 1981: Avosoiden kasvillisuus, kasvibiomassa ja tuotos Janakkalan Suurisuolla. (Summary: Vegetation, biomass and production of fens in Suurisuo mire, Janakkala, southern Finland.) — Suo 32:100–103.

Lindholm, T. 1981: Suppasuon kasviyhdyskuntien perustuotanto-ominaisuudet. (Summary: Patterns of primary production of plant communities in a small kettle hole mire.) — Suo 32:104–109.

Metsävainio, K. 1931: Untersuchnungen über das Wurzelsystem der Moorpflanzen. — Ann. Bot. Soc. 'Vanamo' 1(1): 1–422.

Milchunas, D.G. & Lauenroth, W.K. 1992: Carbon dynamics and estimates of primary production by harvest, ^{14}C dilution and ^{14}C turnover. — Ecology 73:593–607.

Tolonen, K. & Vasander, H. 1992: Rate of net accumulation of carbon in peat layers, with special emphasis on the past few hundred years. — In: Kanninen, M. & Anttila, P. (eds.), The Finnish research programme on climate change. Progress report. Publ. Acad. Finland 3/92: 226–230.

Tolonen, K., Vasander, H., Damman, A.W.H. & Clymo, R.S. 1992: Rate of apparent and true carbon accumulation in boreal peatlands. — Proc. 9th Int. Peat Congress, Uppsala, Sweden 22–26 June 1992, Vol. 1: 319–333.

Wallén, B. 1983: Translocation of ^{14}C in adventitiously rooting Calluna vulgaris on peat. — Oikos 40:241–248.

Wallén, B. 1986: Above and below ground dry mass of the three main vascular plants on hummocks on a subarctic peat bog. — Oikos 46:51–56.