Modified ingrowth core method plus infrared calibration models for estimating fine root production in peatlands

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Aims

Fine root production is a major carbon flux in many peatland ecosystems and least understood because of methodological difficulties. We aimed to develop a robust method for inventorying fine root production in peatlands.

Methods

The ingrowth core method was modified to reduce disturbance and facilitate faster colonization by developing a novel type of corer-installer that reduces cutting of roots during installation, and using smaller volume of initially root-free substrate. The number of cores needed for a reliable site-level mean was estimated based on the variation observed in the test sites. Infrared calibration models were constructed for estimating the mass proportion of roots in the ingrowth cores without manual separation (Figs. 1, 2).

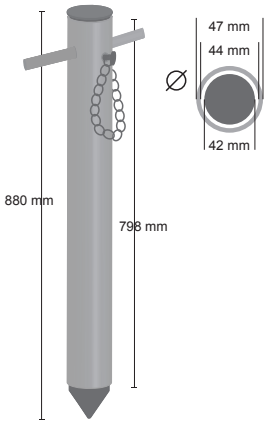

Fig. 1 The corer-installer. Inner tube in darker grey, outer tube in lighter grey, lock in black.

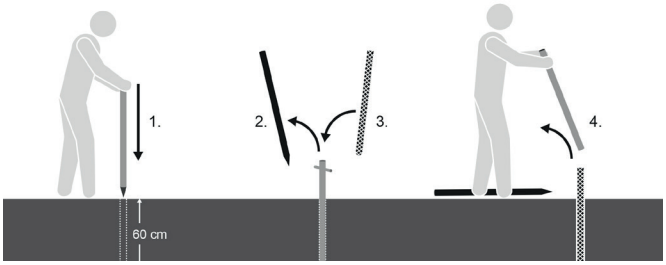

Fig. 2 Application of the corer-installer. The inner, closed and sharp-end tube pushes a hole in the ground (1). N.B. the hole is pushed, not cored or cut; this reduces disturbance. The flexibility and low density of the peat soil facilitates this. When the desired depth has been reached, the lock linking the two tubes is released, and the inner tube (2) is pulled out. The hollow outer tube then allows us to drop the ingrowth core (3) into the hole. The diameter of the core is chosen so that the core falls freely, but when the outer tube is pulled out (4), the displaced soil closes in tightly around the core.

Conclusions

We suggest that the methodology presented here saves time and manual labour and may be applied with a high number of replicates for inventorying fine root production in peatlands. Details of the methodology and practical guidelines for its application are presented in Laiho et al. (2014).

Results

We observed first-year production of 118, 216, 170 and 125 g m^{-2} yr^{-1} in the 0–50 cm soil layer for boreal drained bog forest, drained fen forest, wet sedge fen and dry sedge fen, respectively (Fig. 3). Between 10 and 30 cores per site was estimated to be enough for obtaining reliable mean estimates of production (Fig. 4). The infrared calibration models yielded high coefficient of determination and low standard error of prediction (Fig. 5).

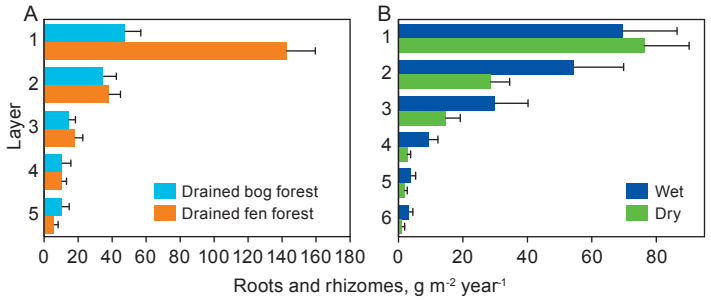

Fig. 3. Root production in A) two drained peatland forests, B) wet and slightly drained site conditions in a sedge fen. Error bars are standard errors of mean. Layer 1: 0-10 cm depth from moss surface; layer 2: 10-20 cm; layer 3: 20-30 cm; layer 4: 30-40 cm; layer 5: 40-50 cm.

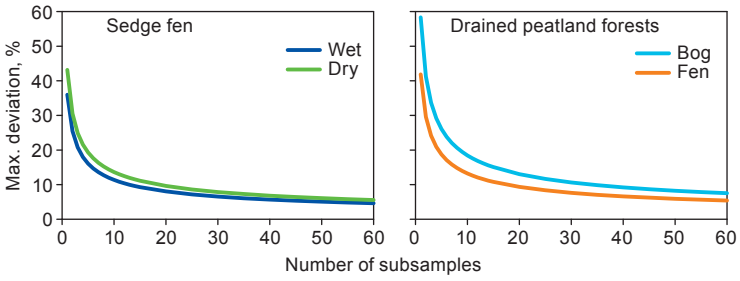

Fig. 4. Theoretical maximum deviation of sample mean from population mean, as percent of population mean, relative to the number of ingrowth cores constituting the sample.

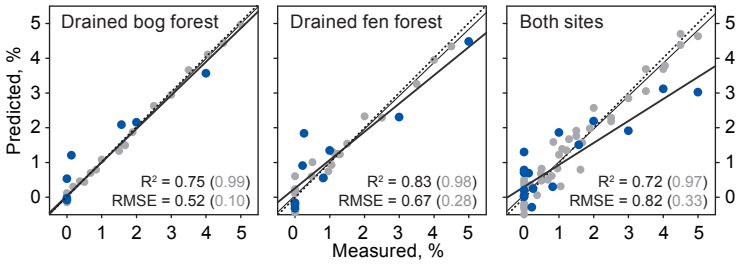

Fig. 5. Relationship between the actual mass proportion of roots in the ingrowth cores and the proportion predicted by infrared reflectance spectroscopy using partial least squares regression calibration. Coefficient of variation (r^2) and root mean square error (RMSE) of prediction are shown in blue numbers, and those for calibration in grey numbers.

References

Laiho R., Bhuiyan R., Straková P., Mäkiranta P., Badorek T. & Penttilä T. 2014. Modified ingrowth core method plus infrared calibration models for estimating fine root production in peatlands. Plant and Soil 385: 311–327. doi: 10.1007/s11104-014-2225-3.

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