What is the best method to measure fine root production - comparison of ingrowth core, ingrowth mesh and minirhizotron methods in northern coniferous forests.

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This analysis is based on >20-yr long cooperation and on the results from different research projects in Estonia and in Finland: 708 core and mesh samples (+ minirhizotron study in Finland)

- 447 cores and meshes sampled from Estonia (8 forests), 261 meshes sampled from Finland (6 forests)
- 42 minirhizotron tubes (4 forests) (Ding et al 2021)

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The effect of research method – fine root production & turnover rate

Trees	Ingrowth cores		Ingrowth nets	Minirhizotrons
Cladonia (Calluna)	179 ±26	27 %	105 ±16	
Myrtillus	211 ±26	37 %	134 ±27	
Vitis-idae	**210 ±20**	15 %	**104 ±16**	
Polytricum	328 ±53	7 %	161 ±58	
Myrtillus	198 ±34	27 %	160 ±51	
Oxalis	186 ±70	17 %	143 ±32	
Calamagrostis alvar	148 ±29	21 %	164 ±89	
	161 ±25	**22 ±4%**	**145 ±12**	
Calluna (CTY)			1.1 (81.4)	1.1 (129.6)
Calluna (CT)			**1.0 (112.8)**	**0.4-0.5 (135.6)**
Myrtillus (MT)			0.97 (100.6)	0.7 - 0.75 (123.0)
Vitis-idea (VT)			1.1 (132.3)	0.75-1.0 (164.8)
			107 ±11	**23 ±5%** **138 ±9**

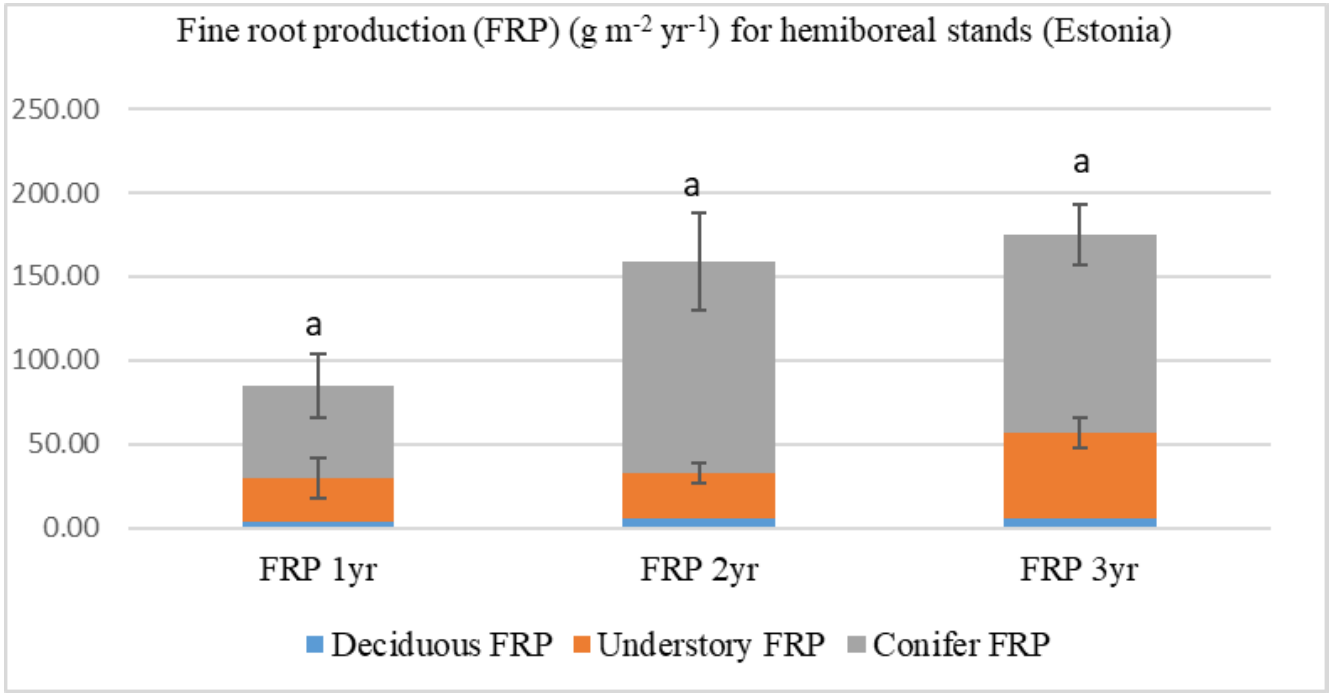
Total fine root production (trees+understory) and understory production were not significantly different measured by different methods

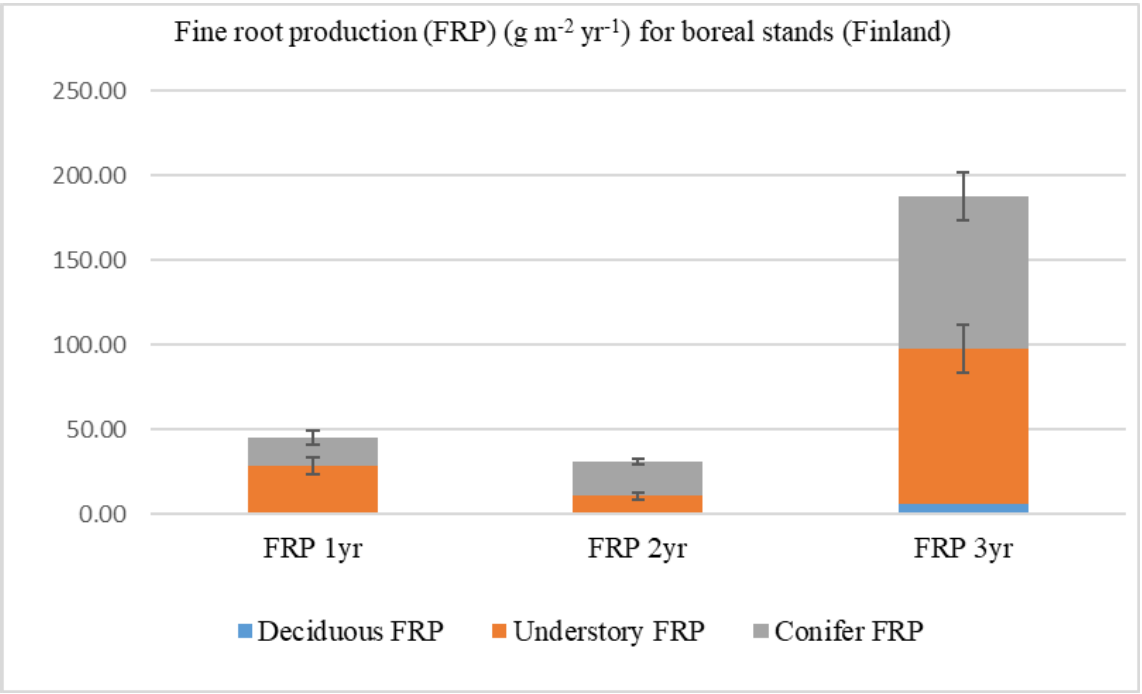
Two ingrowth mesh campaigns carried out in the same sites in 4-5 years (Estonia, n=7)

	Conifers	Understory	Total
2009 -2013	126±29	**27 ±6**	159 ±28
2015 -2017	145±12	**53 ±16**	208 ± 17

- The active temperature sum was significantly higher during the first campaign for two stands
- The amount of precipitation was similar for both study periods in all stands

Hemiboreal vs Boreal – ingrowth dynamic is different!





Conclusions

- All methods work
- Ingrowth mesh’s underestimate because of loosing dead root fraction (approx. 20%)
- Fine root production measured is stable at least for next 5-years, if any major disturbance does not happen
- Ingrowth dynamic is different along south-north gradient, longer time is needed in north