

Heavy metal concentrations in litterfall and soil in boreal forest

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Introduction

Foliar litter represents an important link between forest productivity and biomass and ecosystem process. Although much of the element content in foliar (leaves and needles) is translocated prior to senescence and leaf fall, litterfall (LF) is a key pathway for elements return to the soil in forests. The studies of LF have usually focused on concentrations of macronutrients, while there are fewer studies about heavy metals. Too high heavy metal concentrations in LF and soil can strongly impact the functioning of forest ecosystems due to their toxicity to organisms, furthermore elevated heavy metal concentrations can reduce the rate of litter decomposition resulting in its accumulation in forest floors.

Aims

We studied Cr, Cu, Ni, Pb and Zn concentrations in LF and soil in six ICP Forests sites in Finland.

Material and method

Two of the sites represent Scots pine, two Norway spruce and rest two Silver birch dominated stands. LF samples were taken between 2005 and 2007, when last analyzed soil samples were taken. Analyses were conducted according to the ICP Forests manual (LF, soil).

Results and discussion

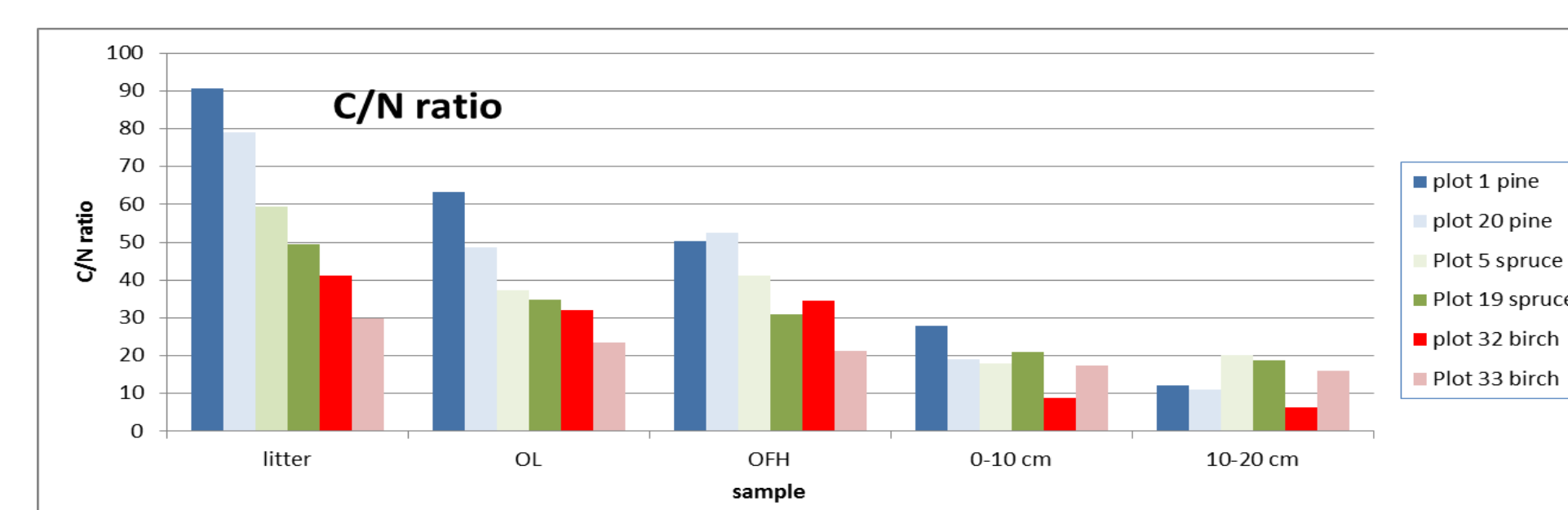
The study indicated that the highest heavy metal concentrations in LF were on the birch plot, with the exception of Cu and Ni, which concentrations were highest in the Sevettijärvi, pine dominated plot. The Sevettijärvi locates in northernmost Finland, close to Russian border. In a Russia, in distance of 100 km, locate Cu and Ni smelters, which emissions clearly have affected to the plot. When Cu concentration is > 20 mg/kg it can reduce microbiological activity of soil micro-organism, in case of Sevettijärvi in the upper soil layers Cu concentrations are near this value.

- Heavy metal concentrations in soil were higher in the organic soil layer than in the mineral soil layer
- Concentrations in the organic layer were higher than in LF, excluding Zn concentration, which was mainly highest in LF.
- Heavy metal concentrations in LF and soil layer correlated well
- C/N ratio was highest on the plot with highest Ni and Cu concentrations. (excluding soil 10-20 cm)

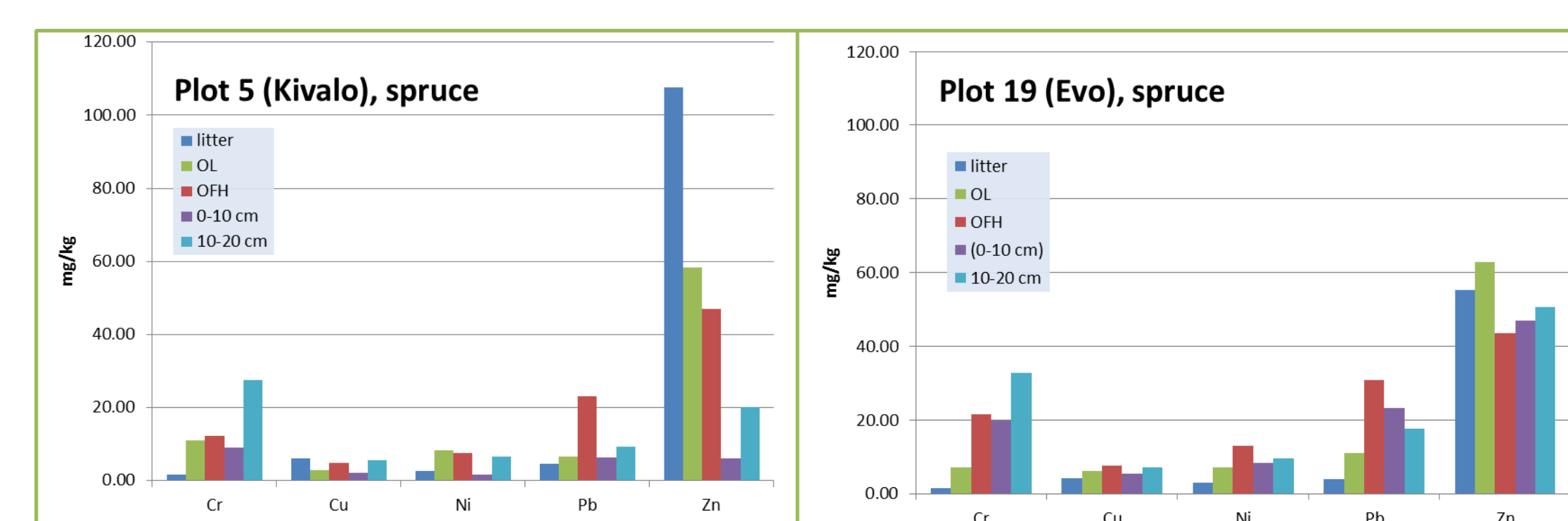


Characteristics of the sites

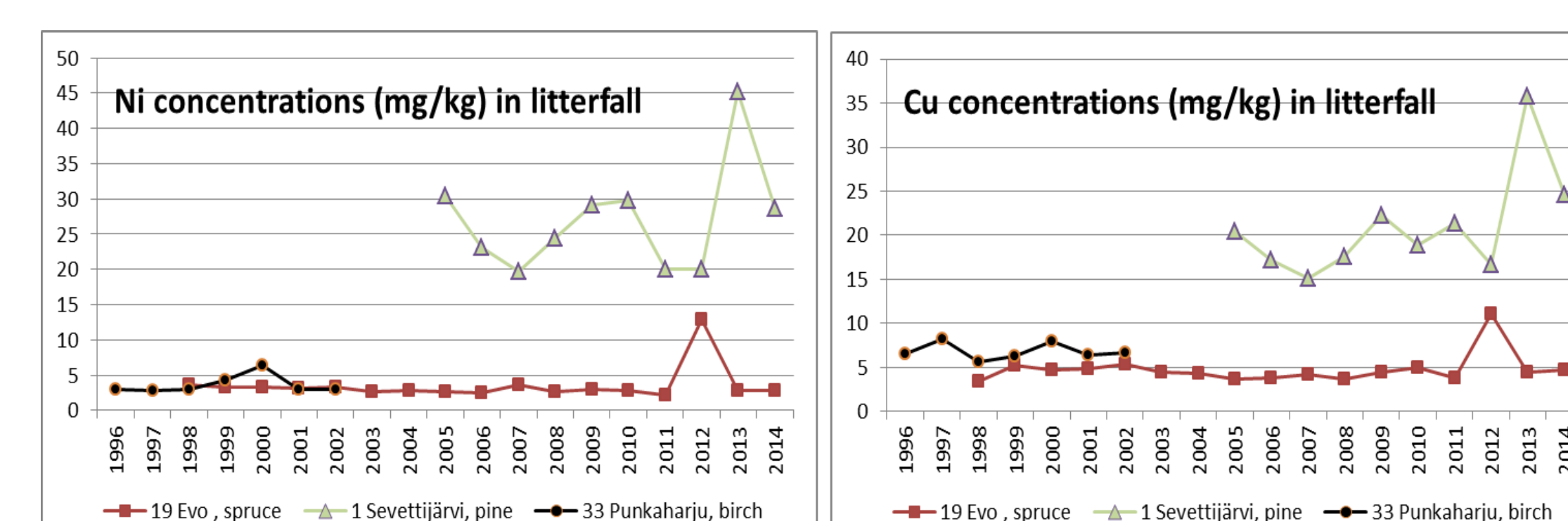
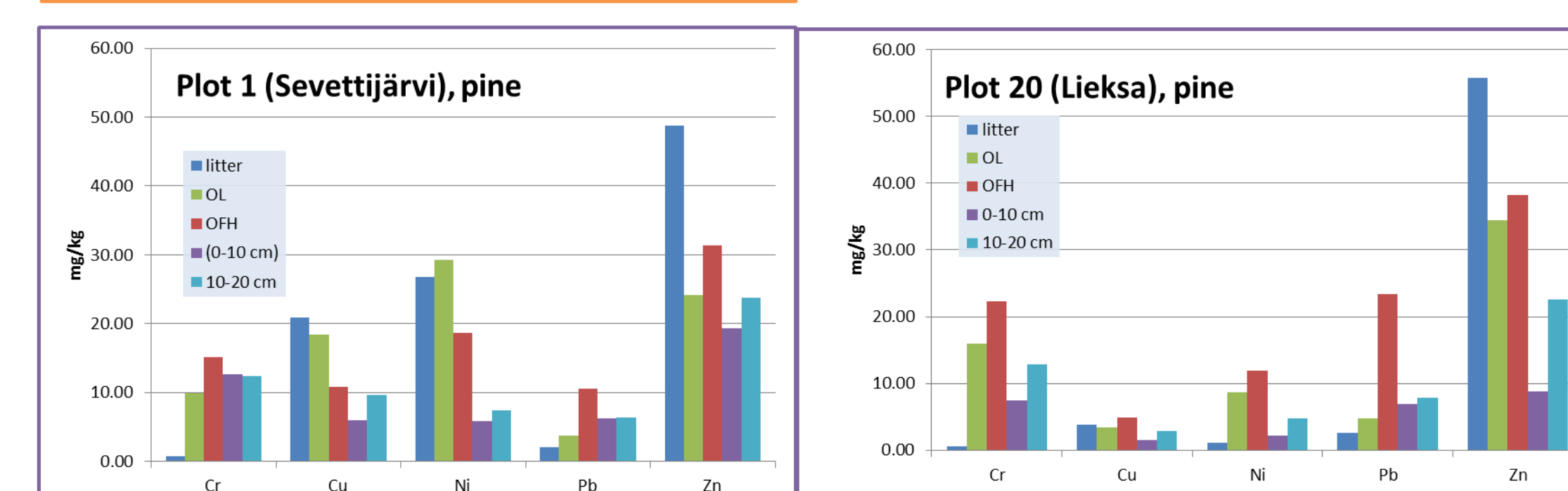
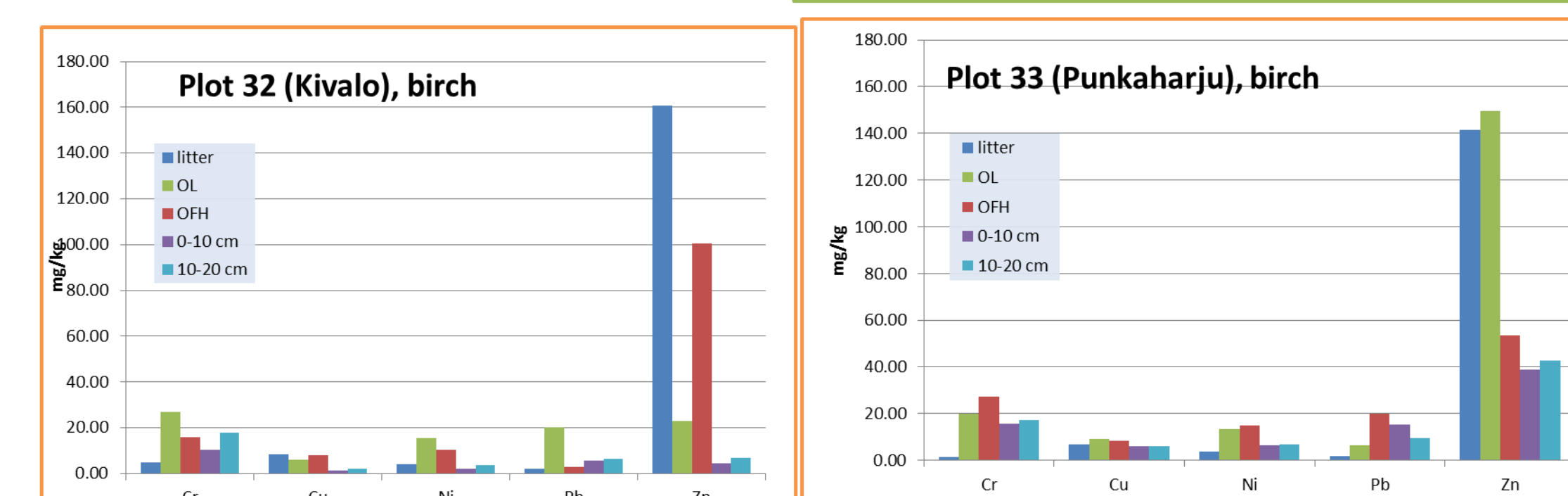
Plot nr	Name	Main species	Stems ha ⁻¹	Stem volume, m ³ ha ⁻¹	Basal area, m ² ha ⁻¹	Arithmetic height, m	Mean diameter cm, weighted with basal area	Thinning year	Stand age	Average litterfall amount 1996-2015, g m ⁻²	Cajander forest type
5	Kivalo	Spruce	1648	153	25	11	16		80	132	HMT
19	Evo	Spruce	1258	711	58	20	32		180	352	OMT
32	Kivalo	Birch	867	130	18	15	18		55	158	HMT
33	Punkaharju	Birch	1037	169	18	19	16		25	340	OMT
1	Sevettijärvi	Pine	350	82	14	11	28	2008	210	79	UVET
20	Lieksa	Pine	371	260	25	21	33		140	168	EVT



C/N ratio in litter, and soil samples: Litter, OL= undecomposed litter layer, OFH = organic humus layer, 0-10cm mineral soil, 10-20 cm mineral soil



Cr, Cu, Ni, Pb and Zn concentrations in litter and different soil layers in Norway spruce (Picea abies), Silver Birch (Betula pendula) and Scots pine (Pinus sylvestris) dominated plots.



Ni and Cu concentrations in total litterfall 1996-2014 at Sevettijärvi (pine), Evo (spruce) and Punkaharju (birch) plots.