

Mountain pine needles as a bio-monitor of potentially toxic elements in higher elevations

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Background

Pine needles are considered useful bio-monitors. Their waxy surface allows them to accumulate various air pollutants. Furthermore, long-term studies are possible, since the needles can reach an age of up to ten years. Mountain pines (*Pinus mugo*), locally called Latschen, grow in the Alps in a height of approx. 1000 m to 2200 m. Thus, they seem appropriate specimens to monitor air pollution by potentially toxic elements in higher elevations.



The metal content in plants depends on various parameters, such as:

- soil composition
- level of contamination
- methodology
- organism tested
- uptake route
- ageing of soil
- sampling time
- element

Experimental

Needle samples were collected on the northern slopes in the Lower Inn Valley (Tirol, Austria). Different sampling sites were selected between Münster and Innsbruck, the altitude ranging from 1200 m to 2000 m.



Map of Tyrol: sampling area marked in red

From each sample tree fresh needles, one-year-old and two and more year old needles were taken. The contents of

Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Rb, Se, Sr, Te, Tl, U, V, Zn

were determined using inductively coupled plasma mass spectrometry after microwave assisted acid digestion.

Results & Discussion

The table below shows the results obtained for the mountain needles as mean values from all sampling sites and altitudes.

Elemental content in mg/kg dried matter (mean values and standard deviation)

content in mg/kg		Ca	Cd	Cr	Cu	Fe	K	Mg	Na	Ni	Pb
<i>Pinus mugo</i>	content	3060	0.043	0.15	3.6	36	4010	765	12	1.5	0.13
	SD	1200	0.024	0.15	1.8	17	2600	23	7	1.2	0.09
<i>Pinus densiflora</i> *	content	8273	0.16	0.73	3.57	76.6	2800	1603	75.6	0.44	0.18
	SD	79	0.10	0.08	0.10	3.7	67	9	9.2	0.06	0.03
<i>Pinus nigra</i> *	content	2312	0.024	0.99	6.37	43.5	2517	1543	102	0.53	0.14
	SD	14	0.005	0.06	0.95	0.6	99	21	9.3	0.04	0.06
<i>Pinus sylvestris</i> *	content	8409	0.264	<LOQ	3.40	66.0	2399	1381	131	1.27	0.37
	SD	100	0.006	---	0.26	4.9	89	60	9.2	0.05	0.02
<i>Pinus thunbergiana</i> *	content	3309	0.068	0.065	1.52	27.5	2098	1207	89.2	0.55	0.31
	SD	18	0.030	0.022	0.24	2.3	35	32	9.9	0.08	0.21

*Arboretum University of Zagreb; I. Juranović Cindrić et al, 2019: <https://doi.org/10.1007/s13762-018-2096-x>

Compared to the metal needle contents of pines needles from species growing at lower altitudes, differences were mainly found in the contents of essential macro elements, but less regarding potentially toxic elements, such as Cd, Cu, Cr, Ni, Pb.

Further studies will focus on the influence of needle age and altitude on needle elemental contents.