

# The Kristineberg Case Study

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# Location & Landscape

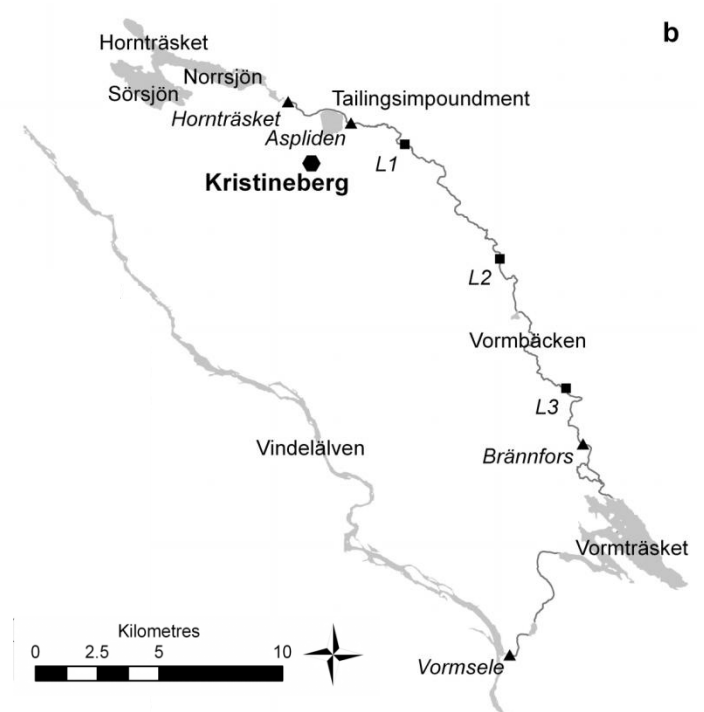


Population: 12,506 (564 km<sup>2</sup>)

Typical boreal landscape  
(dominated by forests,  
waterbodies, mires)



# Study area



# Aims Kristineberg

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1. Assess plant biodiversity along pollution gradient
2. Quantify plant biomass along the gradient
3. Evaluate if Cd, Cu and Zn in vegetation decrease along a longitudinal and lateral gradient
4. Evaluate the added value of UAS for environmental assessment

# Smartplanes SmartOne UAV

Flying wing

Autopilot

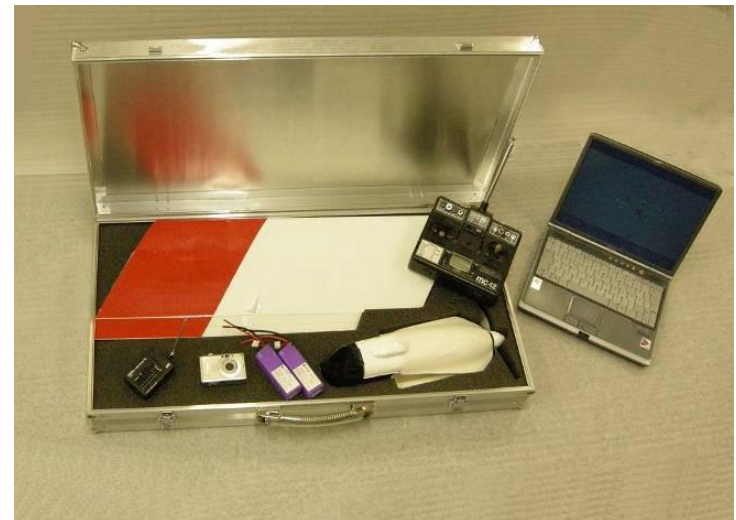
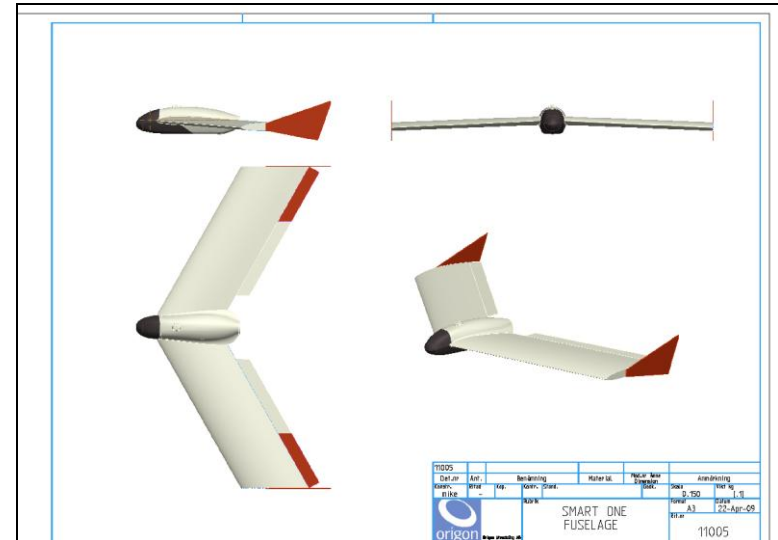
Take-off weight 1.1 kg

Payload 250 g

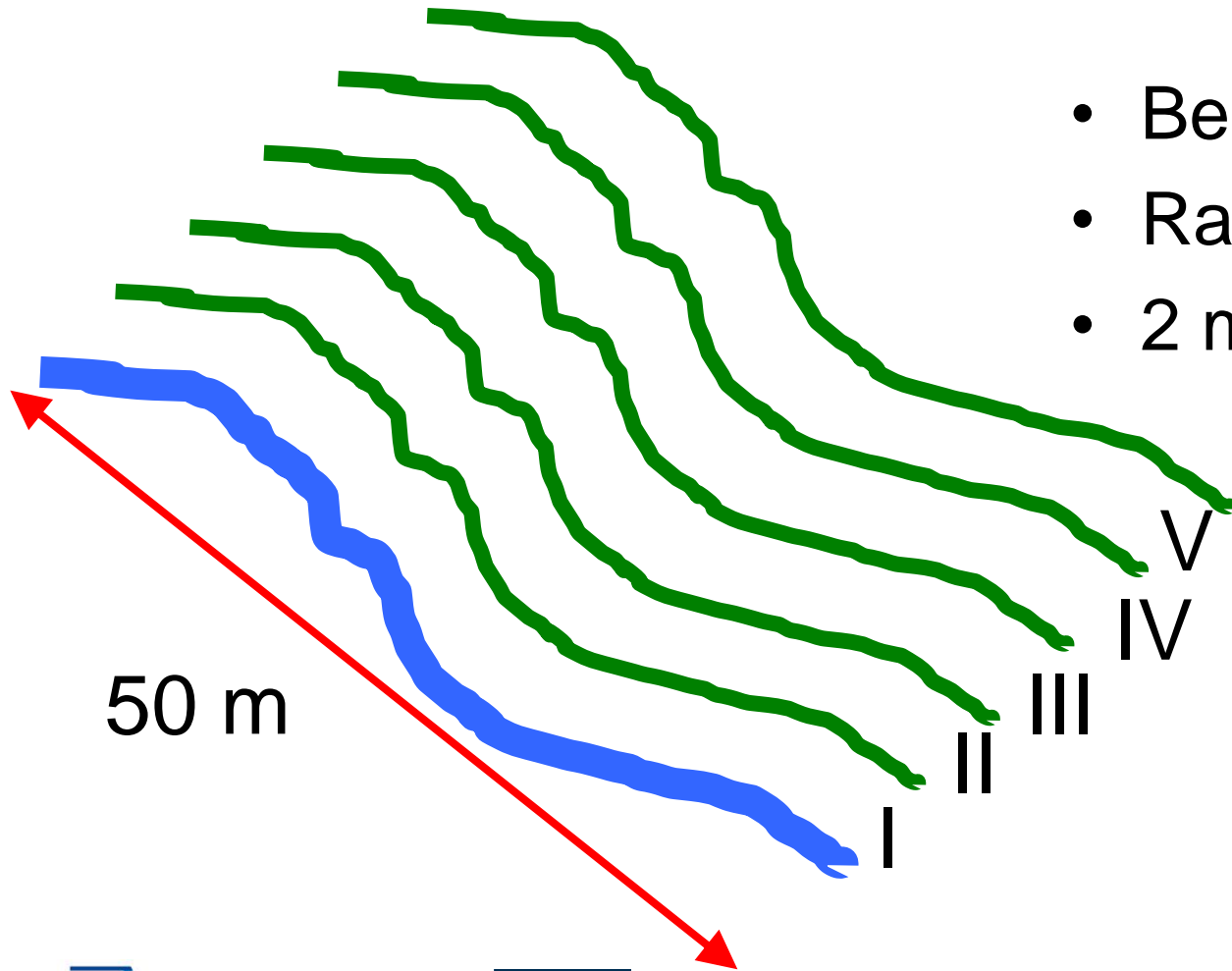
Electric motor, 35 min endurance

Mission altitude 100-300 meters

Data link 3 km range



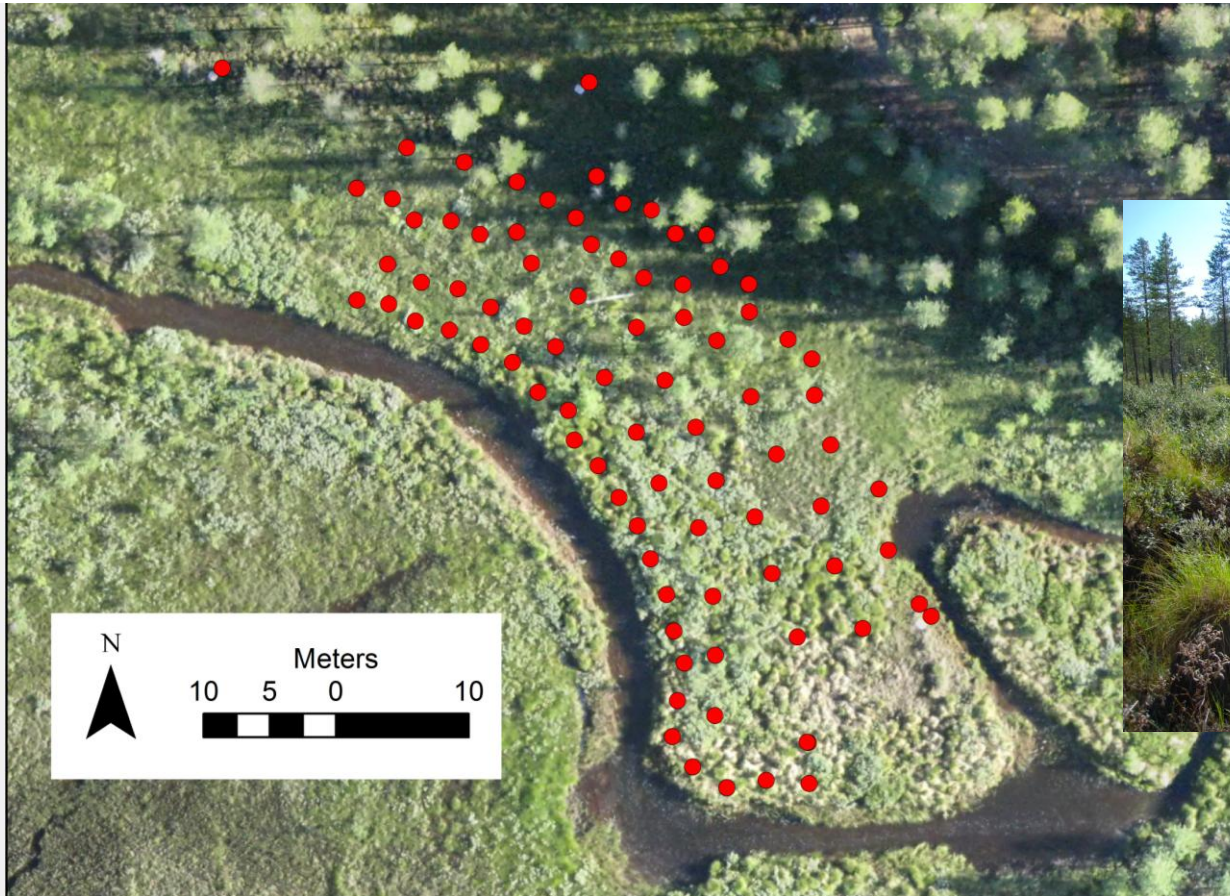
# Field sampling



- Belts of 4 m width
- Random plots
- 2 m distance

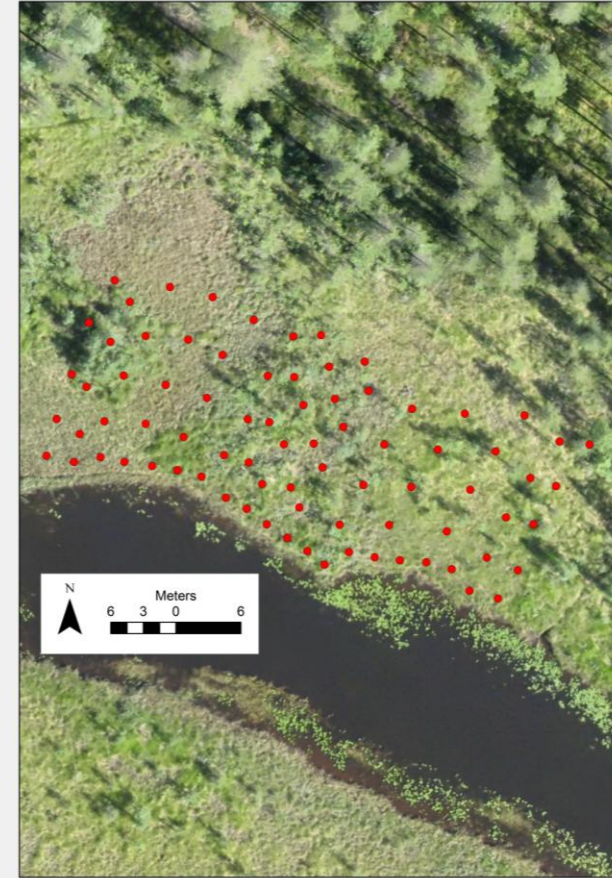
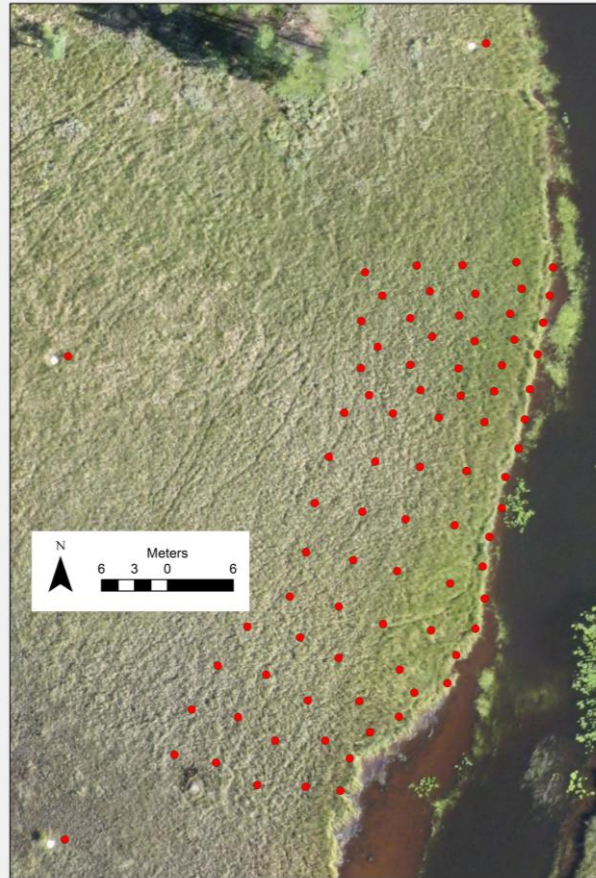
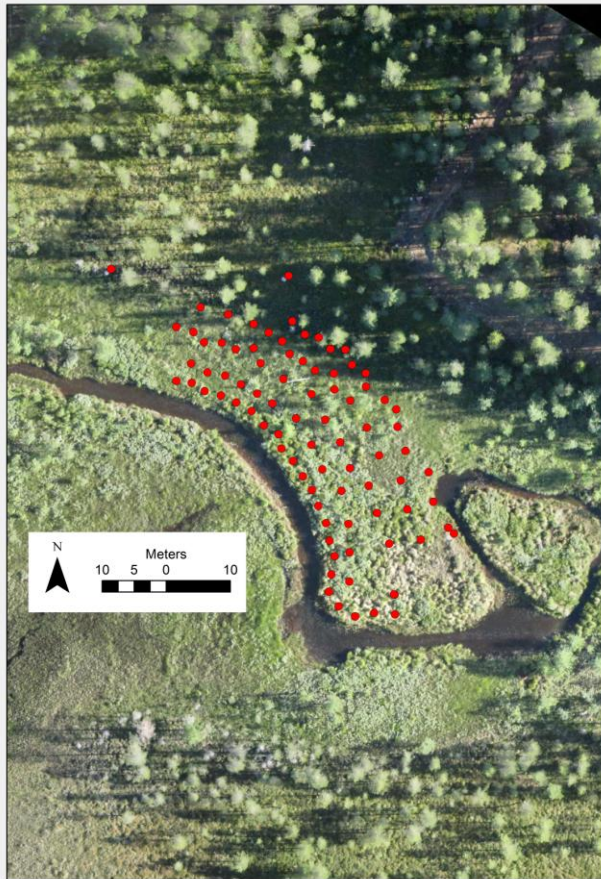


# Locality 1



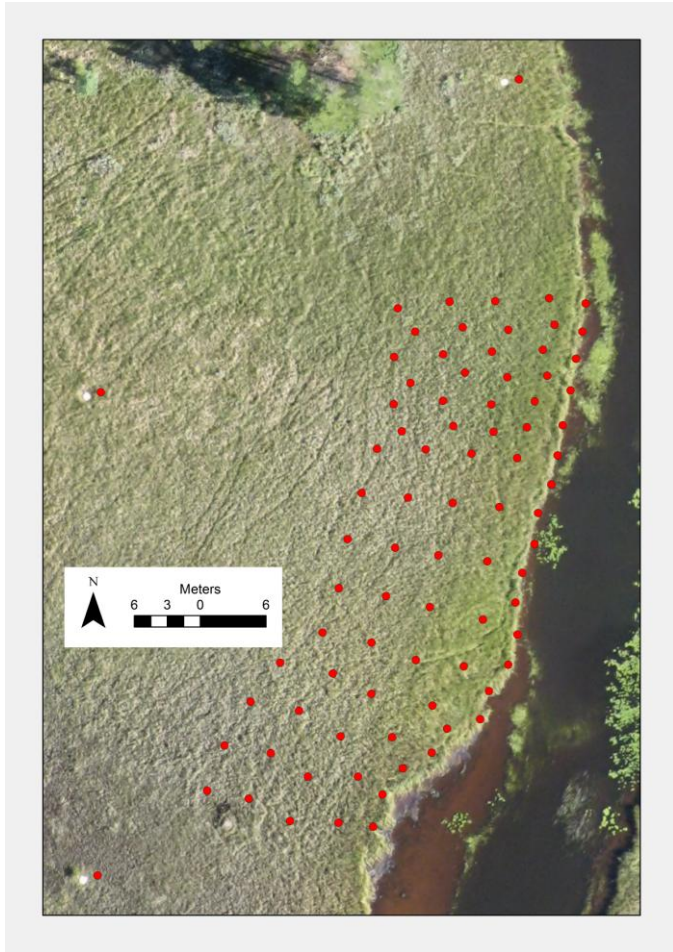


# UAS – Field sampling





# Locality 2



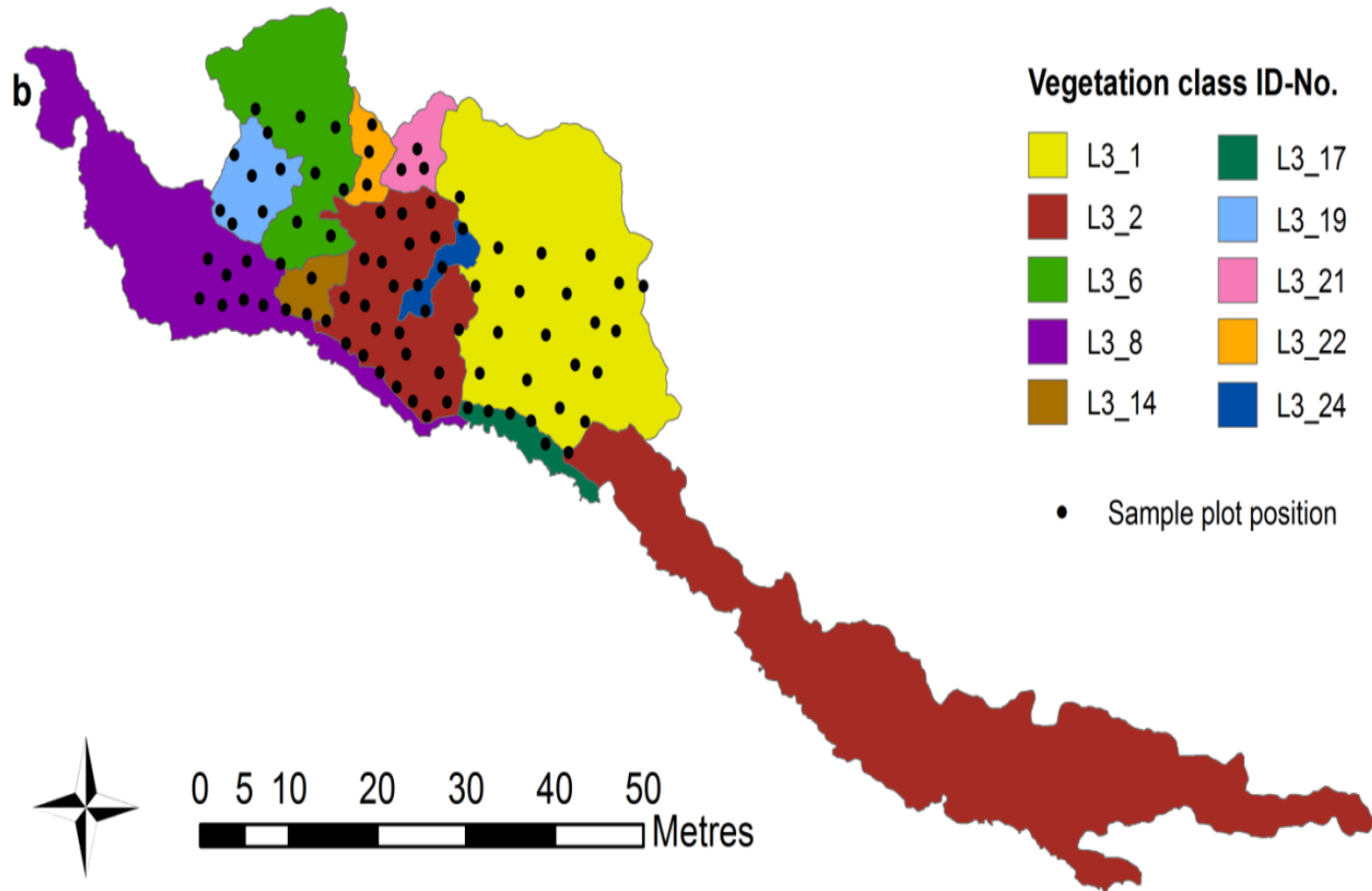
# Field sampling

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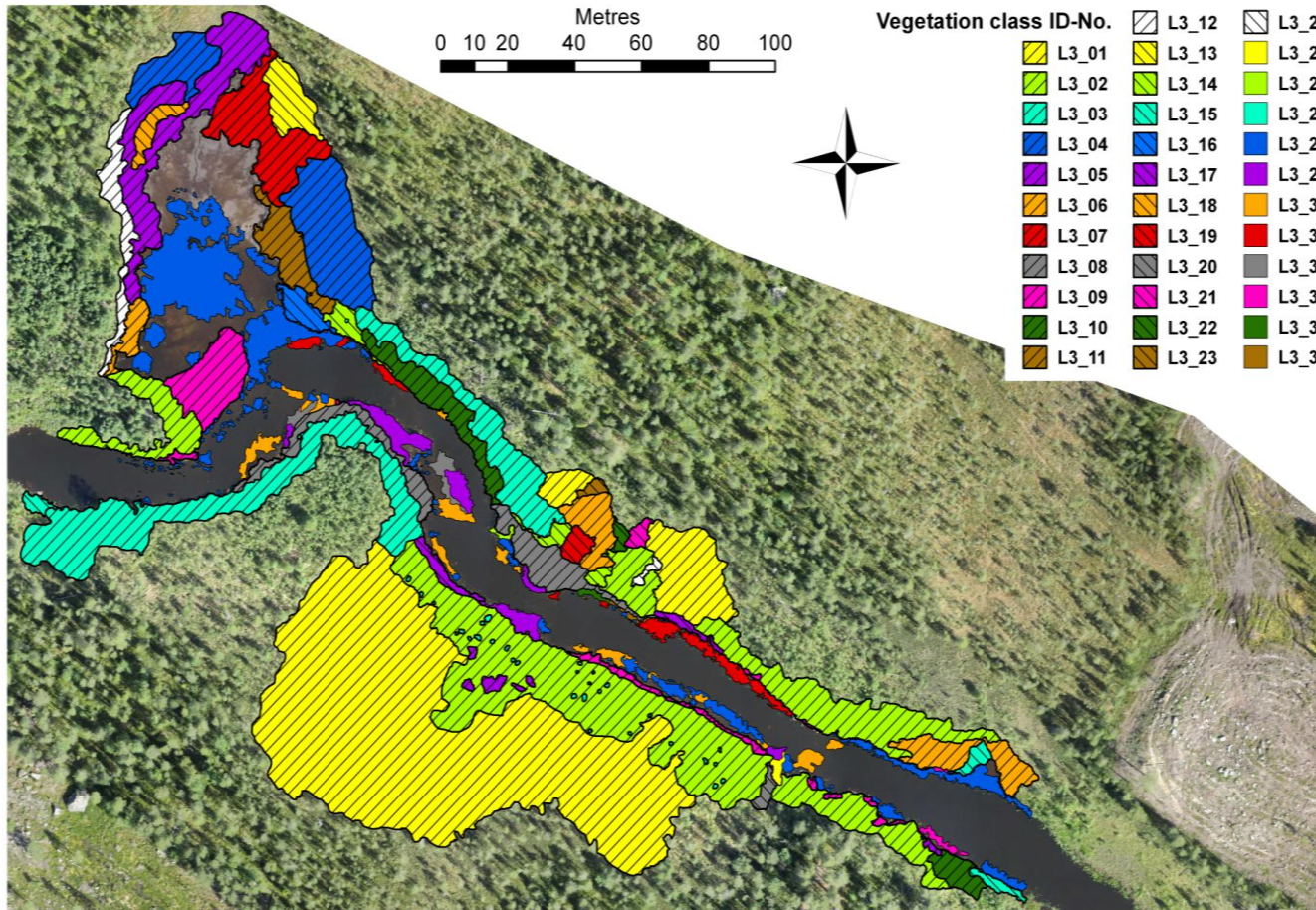


# Vegetation map of core area

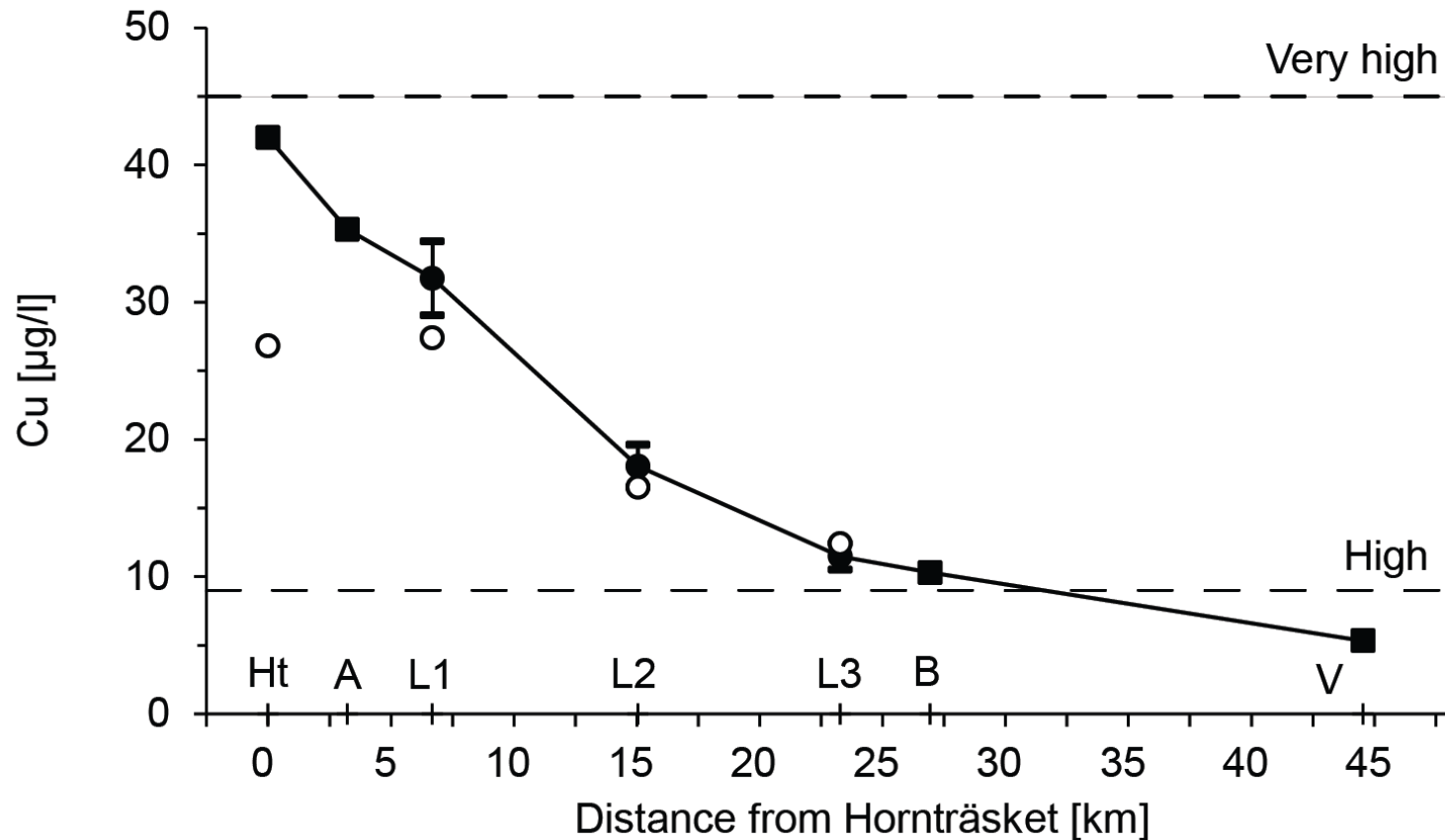




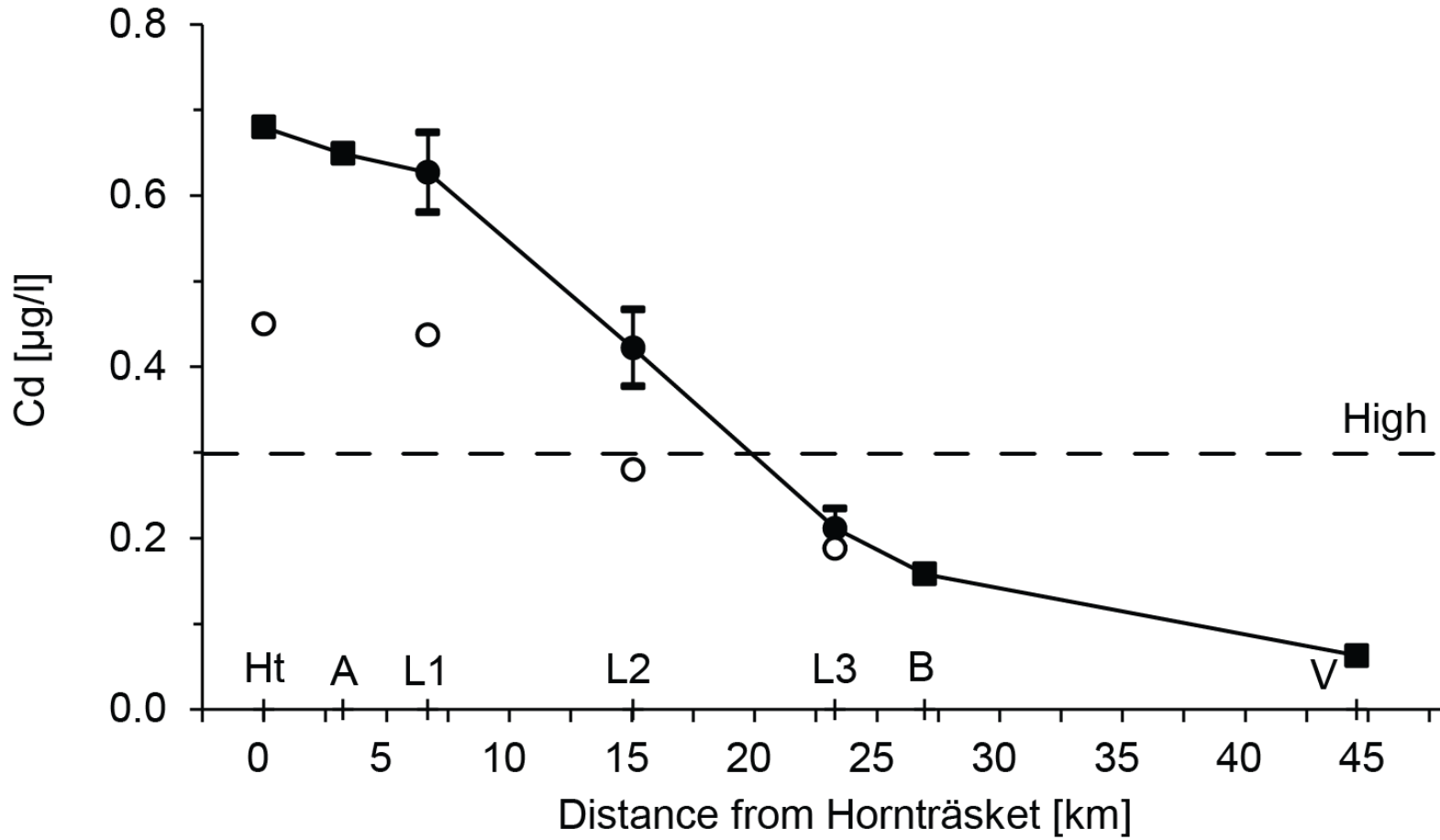
# Vegetation map of riparian zone



# Cu along pollution gradient

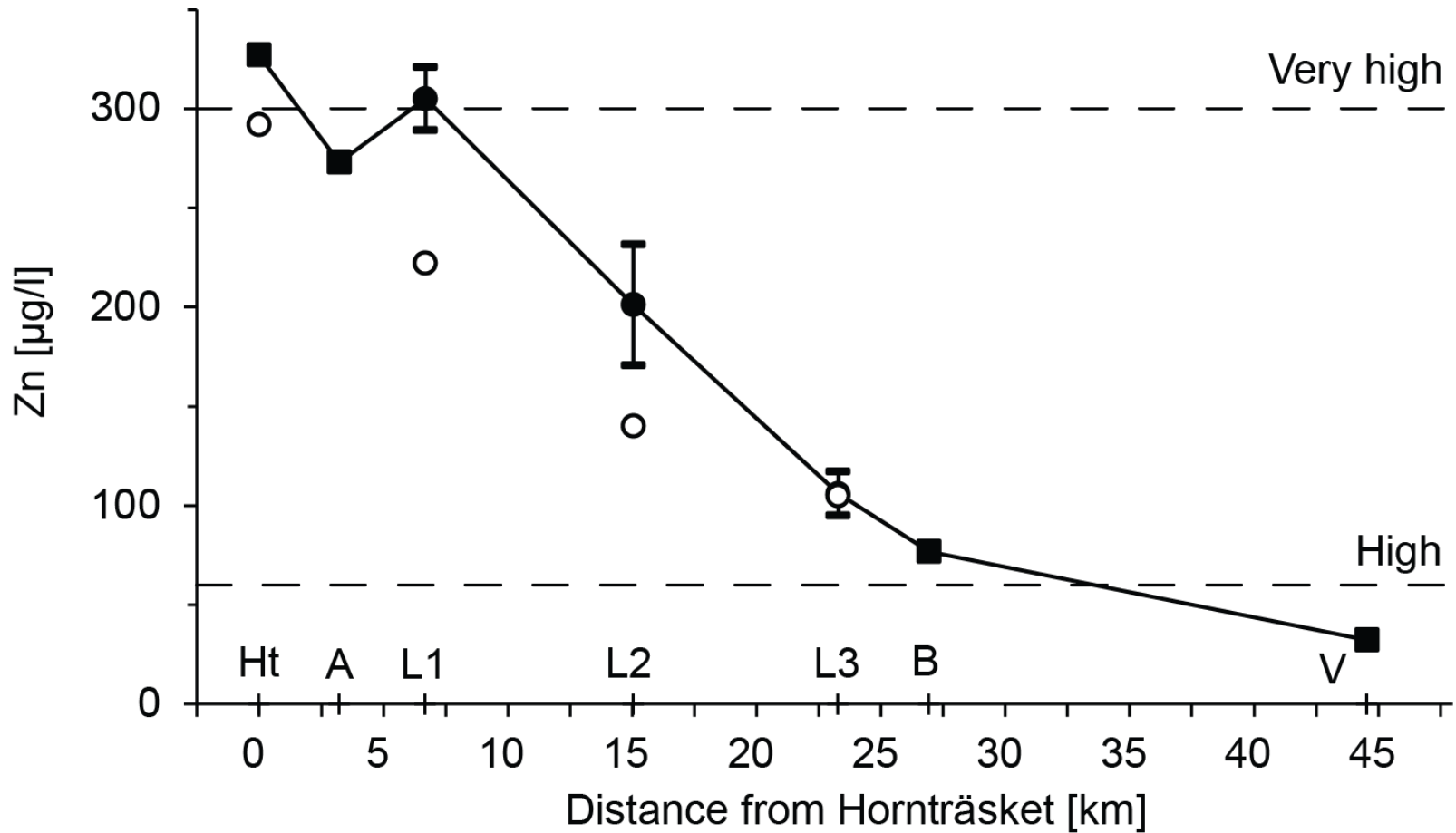


# Cd along pollution gradient





# Zn along pollution gradient



# Cd, Cu, and Zn (kg) transported by Vormbäcken, growing season 2011

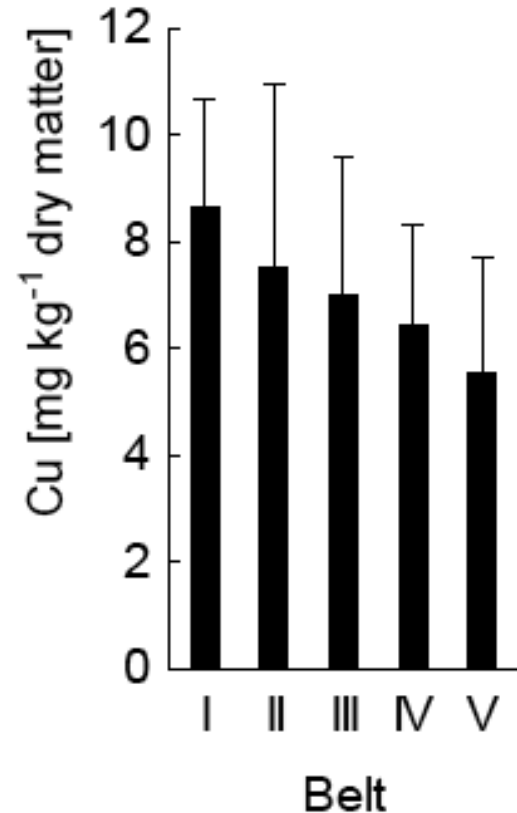
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Element	L1	L2	L3
Cd	4	5	4
Cu	187	196	237
Zn	1799	2182	2194

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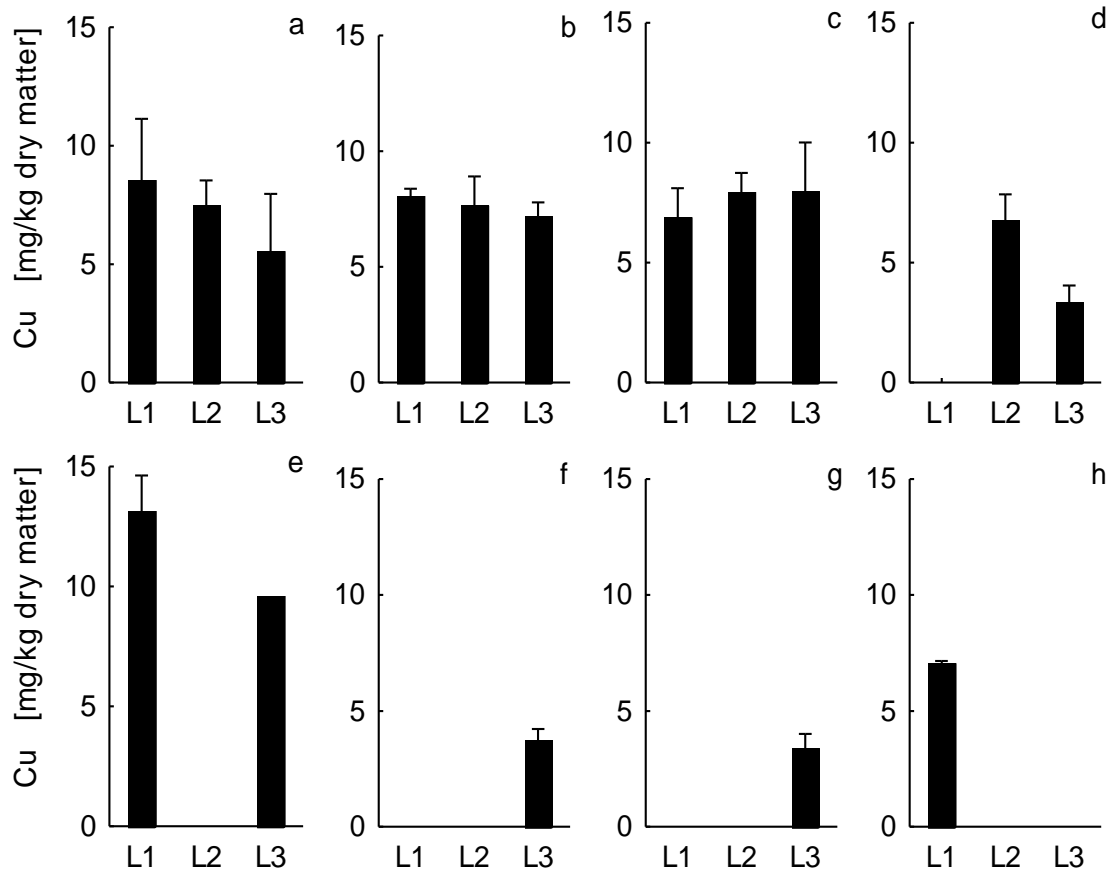
# Cu in riparian vegetation – lateral gradient

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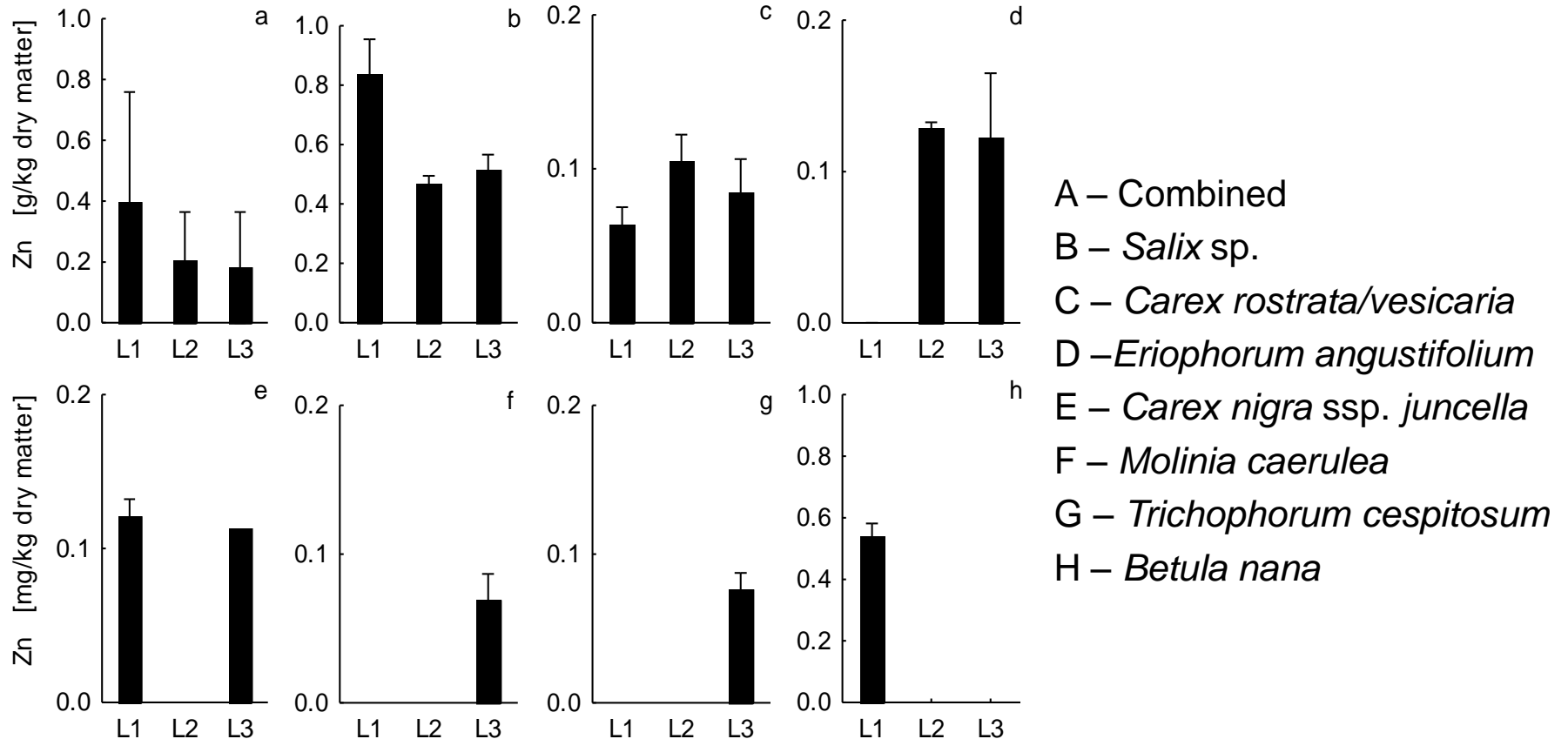


# Cu in vegetation – longitudinal gradient

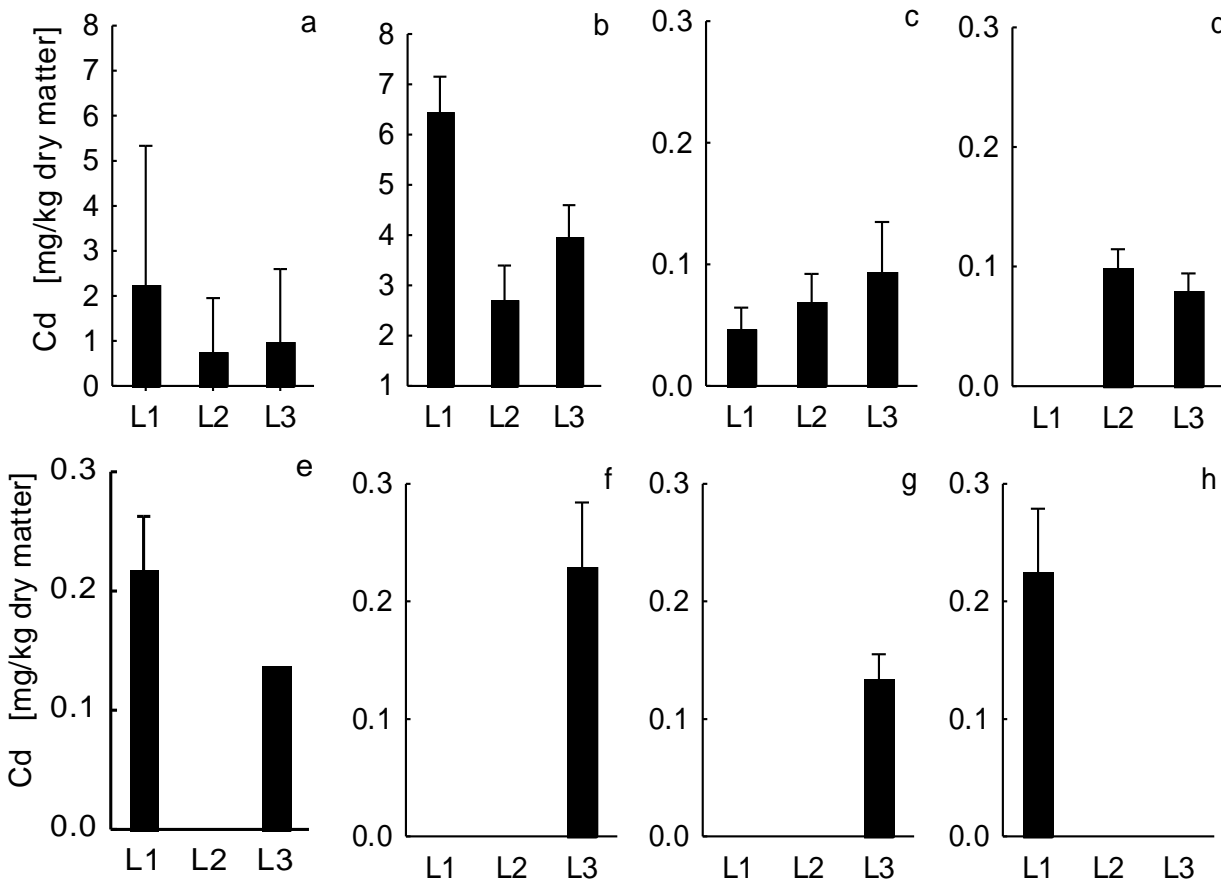


- A – Combined
- B – *Salix* sp.
- C – *Carex rostrata/vesicaria*
- D – *Eriophorum angustifolium*
- E – *Carex nigra* ssp. *juncella*
- F – *Molinia caerulea*
- G – *Trichophorum cespitosum*
- H – *Betula nana*

# Zn in vegetation – longitudinal gradient



# Cd in vegetation – longitudinal gradient



- A – Combined
- B – *Salix* sp.
- C – *Carex rostrata/vesicaria*
- D – *Eriophorum angustifolium*
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# Biomass and Cd, Cu and Zn

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Locality	Bm [t]	Cd [g]	Cu [g]	Zn [g]
L1	12	24	46	3488
L2	175	6	664	8828
L3	42	3	91	1304
Total	229	33	801	13620



# Inter-species differences

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- *Salix* species
  - 3 % of biomass
  - 73 % of Cd
  - 24 % of Zn
- *Carex rostrata/vesicaria*
  - 80 % of biomass
  - 85 % of Cu
  - 66 % of Zn



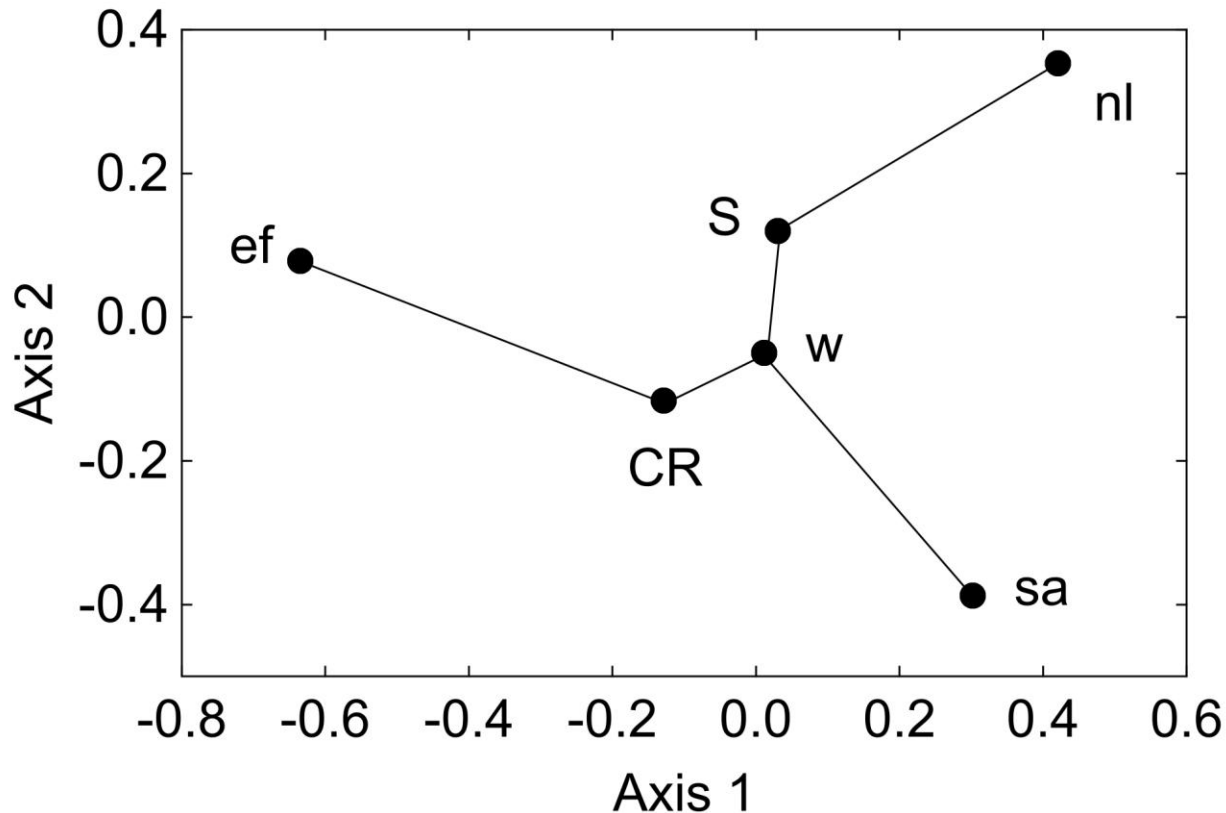
# Cd, Cu and Zn (%) stored in vegetation in relation to transport in Vormbäcken

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Element	L1	L2	L3
Cd	0.66	0.13	0.07
Cu	0.02	0.34	0.04
Zn	0.19	0.40	0.06

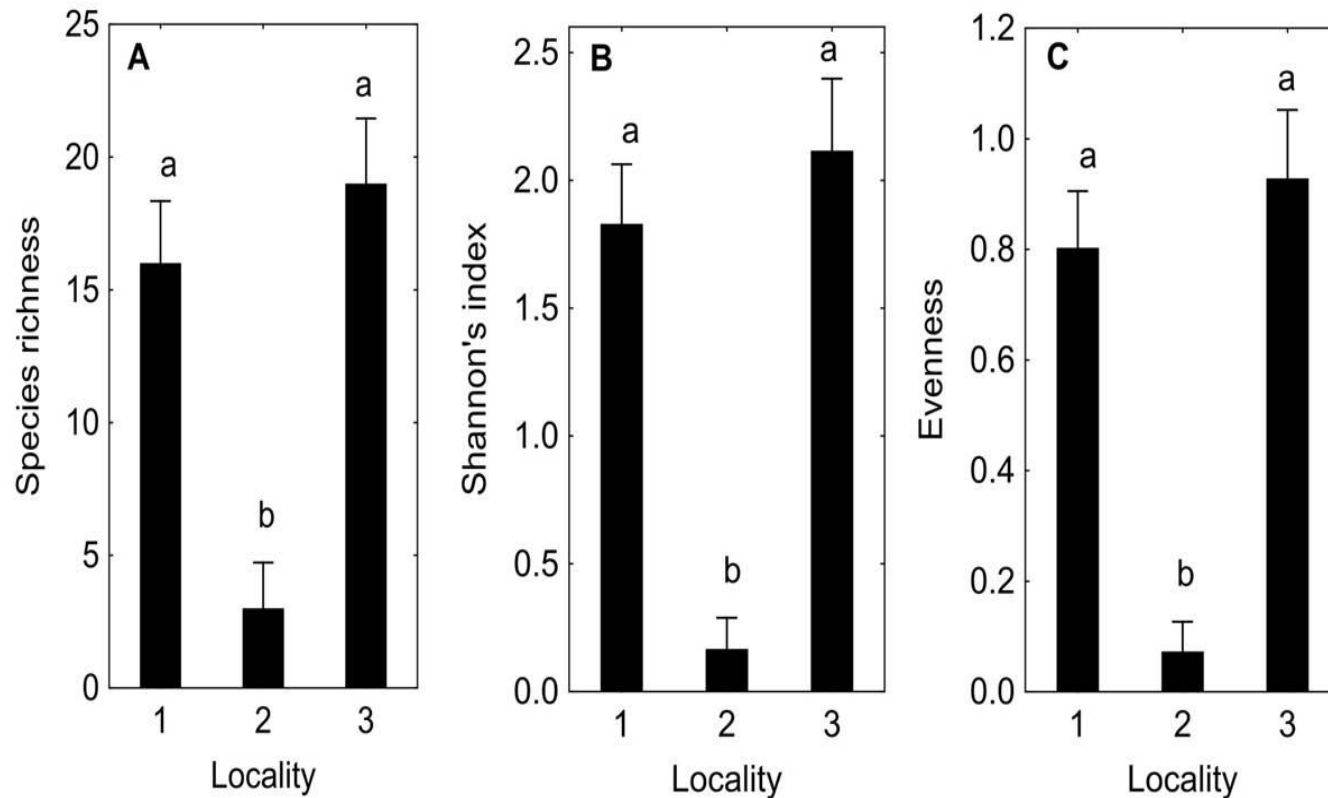
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# Multidimensional scaling



W – water  
CR – Carex r.  
ef – Equisetum fl.  
S – Salix  
sa – Sparganium a.  
nl – Nuphar l.

# Biodiversity





# Conclusions

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- Vormbäcken is heavily polluted by Cu, Cd and Zn
- Closed mines upstream are source of pollution
- High inter-species differences in bound elements
- Plant diversity appears to be unaffected by the pollution
- UAS can be used for environmental assessment

# Thank You!

