

Intrusion of fine sediments into low mountain range creeks and associated influence on benthic invertebrate populations

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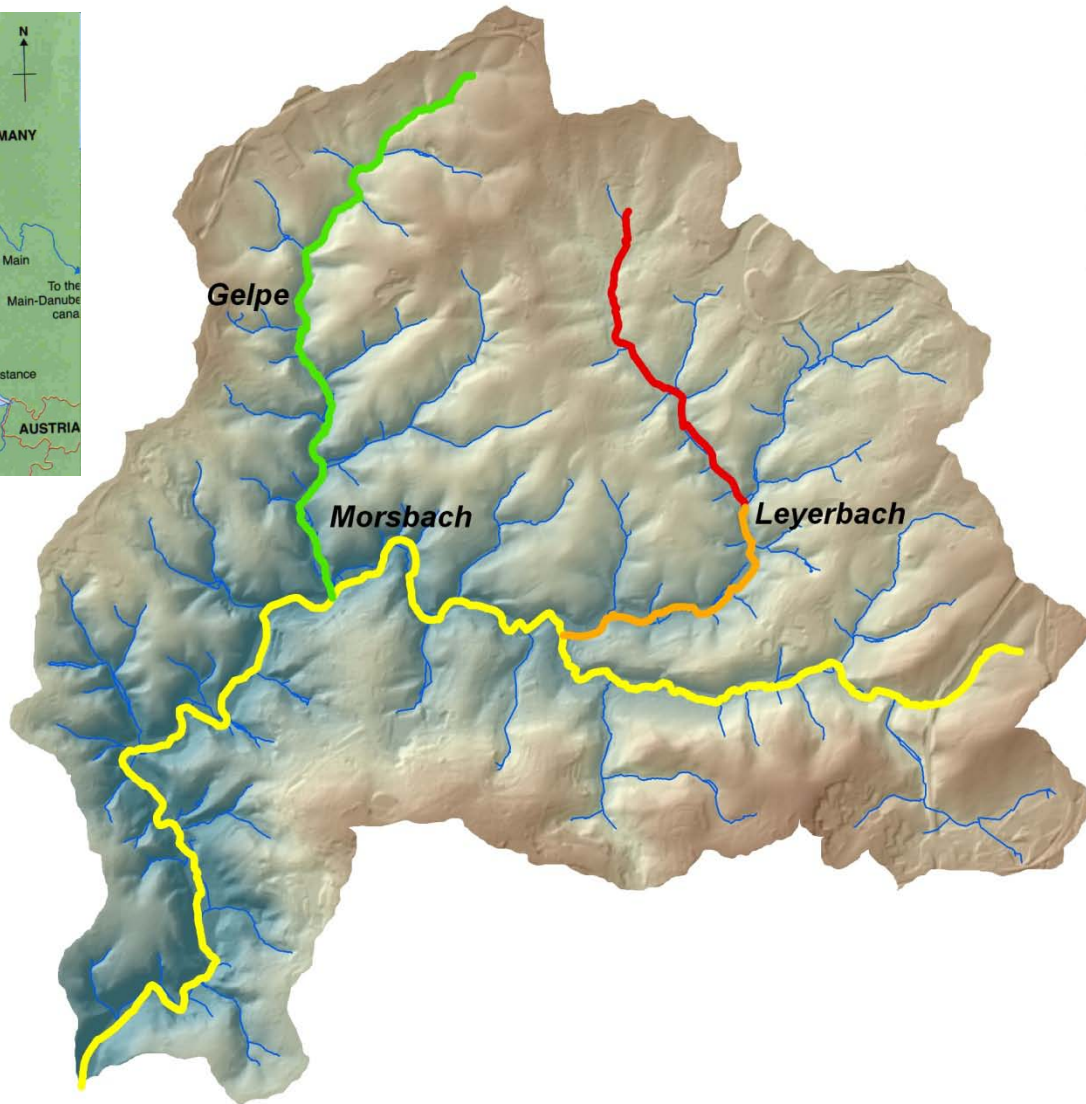
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³Water Board Wupperverband



Ecological status (EC-WFD) in research area



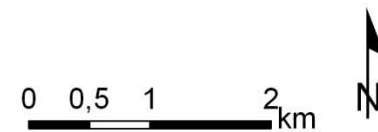
Water bodies: Ecological Status

- good
- moderate
- poor
- bad

Elevation



Watershed: 47 km²
Morsbach: 15 km



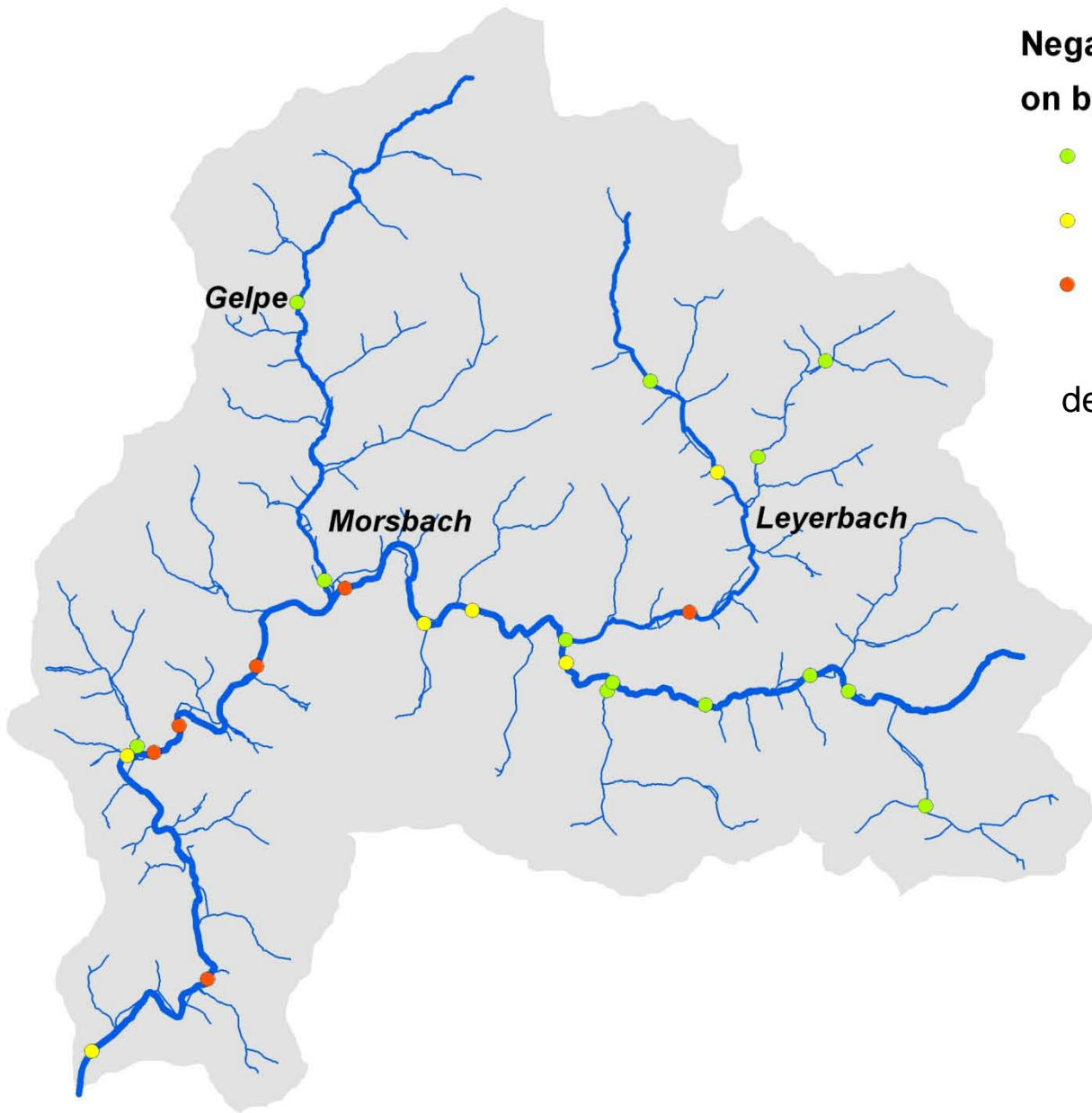
Major deficit in research area

- status of benthic invertebrates
- one assumed reason: negativ effects of fine sediment intrusion into river bed (Wupperverband 2008)
 - derived from interpretation of biological samplings
 - high occurance of deposit-feeding invertebrates compared to natural state
 - possible reason: increased (organic) fine sediment within river bed

Negative effects of fine sediments on benthic invertebrates

- very low
- low
- moderate

derived from biological samplings
(ube 2008)



0 0,5 1 2 km



Research area: Fine sediment sources

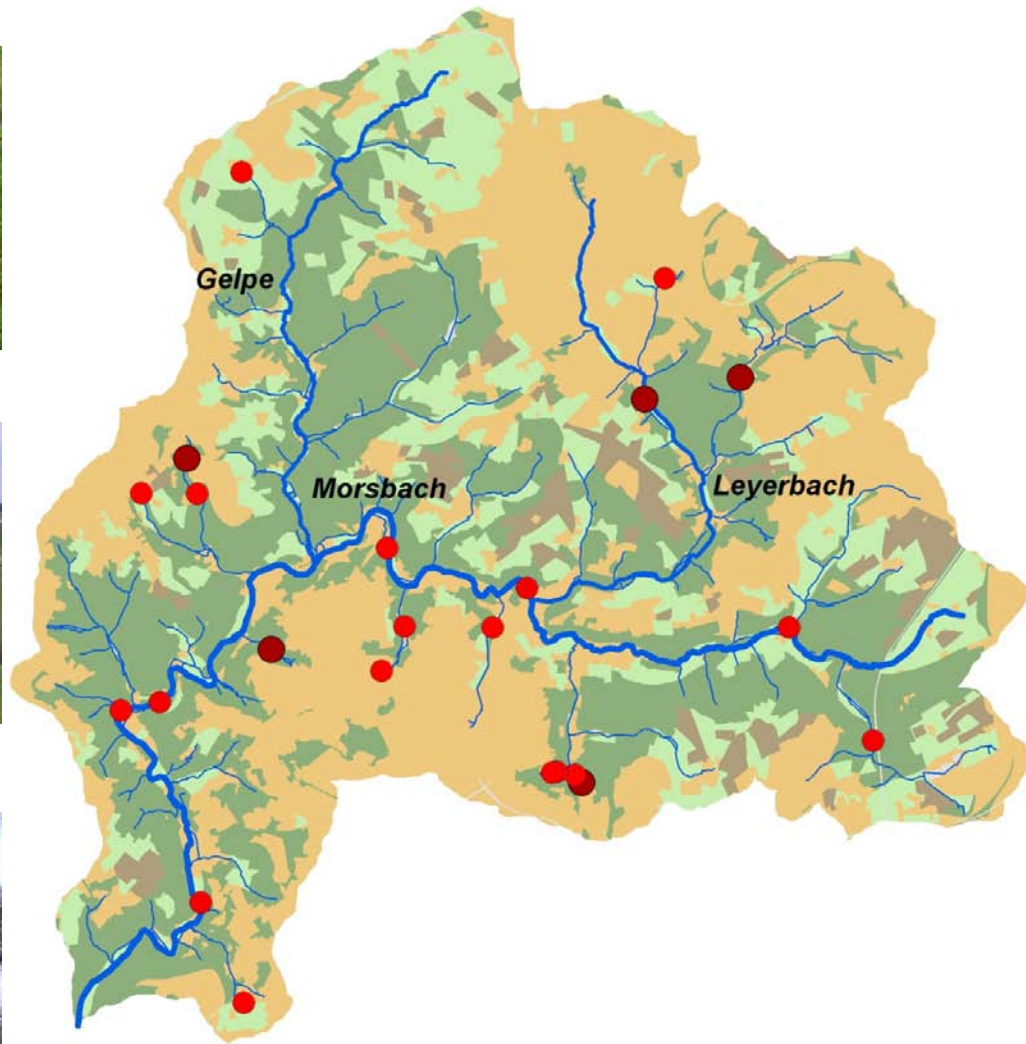
Sewage systems



Erosion



Roads



Major sources of fine sediments [t/a]

- 10 - 50
- > 50

Land use (% of total area)

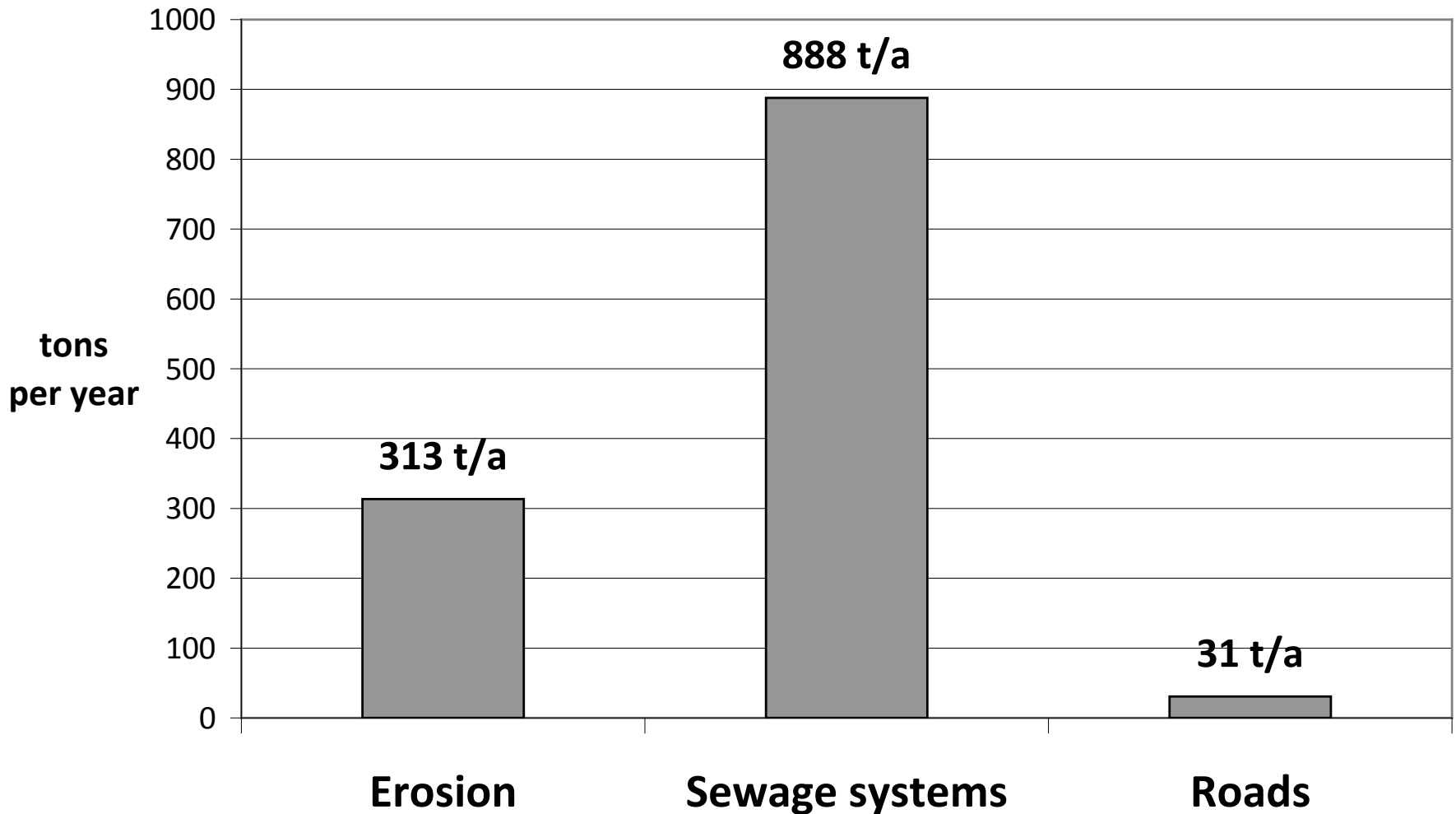
- Settlements (42%)
- Forest (36%)
- Grassland (18%)
- Cropland (4%)

0 0,5 1 2 km



(Source: Runoff and Pollution Load Model)

Research area: Fine sediment sources



(Source: Runoff and Pollution Load Model)

Research questions

- Is the fine sediment content in the river bed that high to negatively influence benthic invertebrates?
- Are there temporal and spatial variations of the fine sediment intrusion into the river bed?
- Is there a correlation between biological samplings (fine sediment pressure on invertebrates) and measured fine sediment intrusion?

Sediment Measurement Methods

- Method 1: Freeze Core Sampling
 - fine sediment content in river bed
- Method 2: Sediment Traps
 - temporal and spatial variations of fine sediment intrusion
 - correlation between biological samplings and fine sediment measurement

Method 1: Freeze Core Sampling

Step 1



Step 2



Step 3

Share of grain fractions [mm]

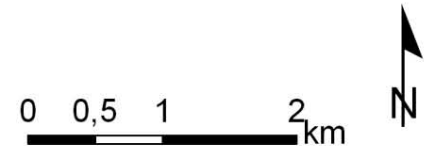
> 2,0

2,0 - 0,2

< 0,2



▲ Freeze core samplings



Number of samples: n = 6

Method 2: Sediment Traps

Step 1



Trap with cleaned
coarse gravel

Step 2



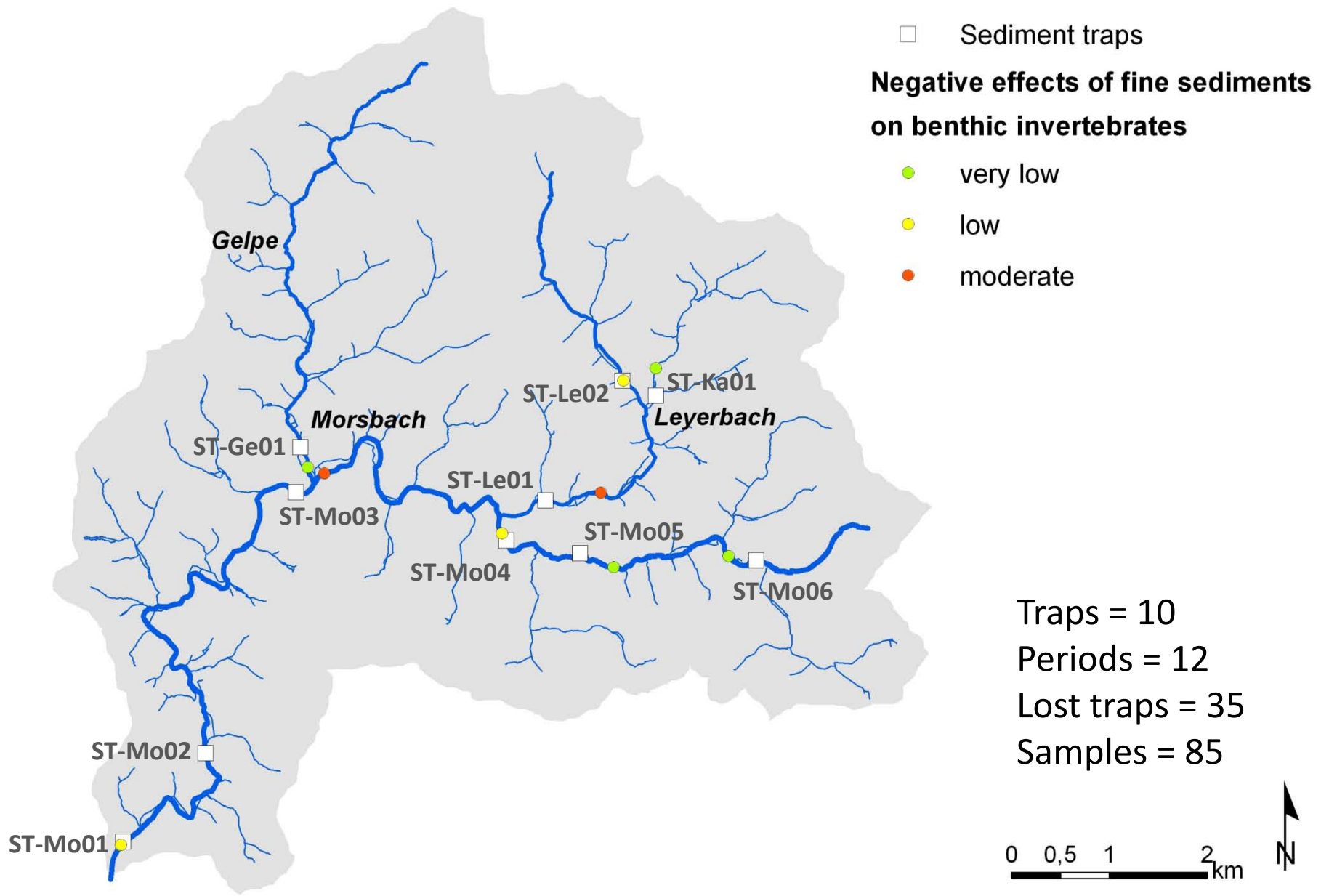
3 weeks exposure
in river bed

Step 3

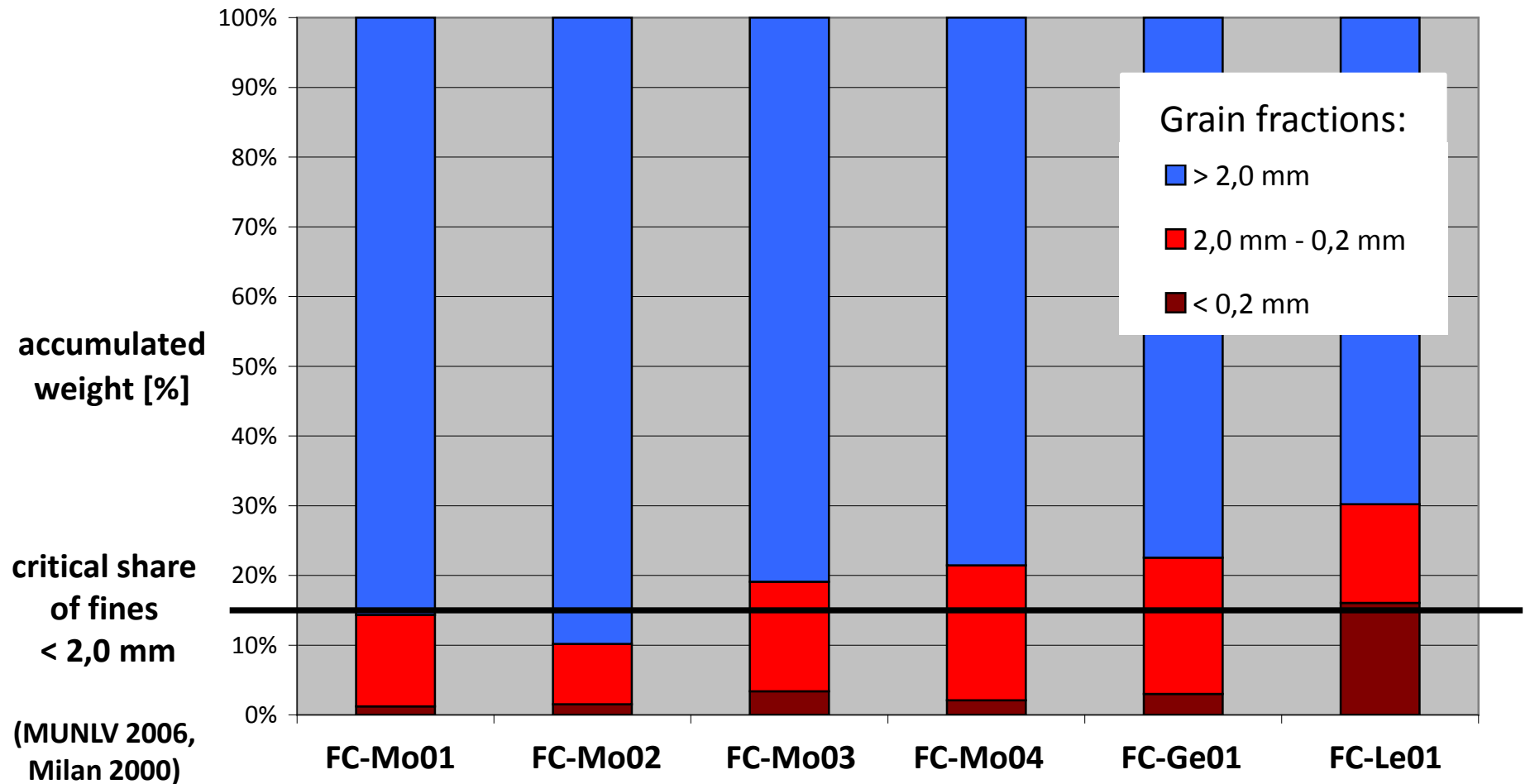


Share of
grain fractions [mm]

> 2,0
2,0 - 0,2 } organic /
< 0,2 } inorganic

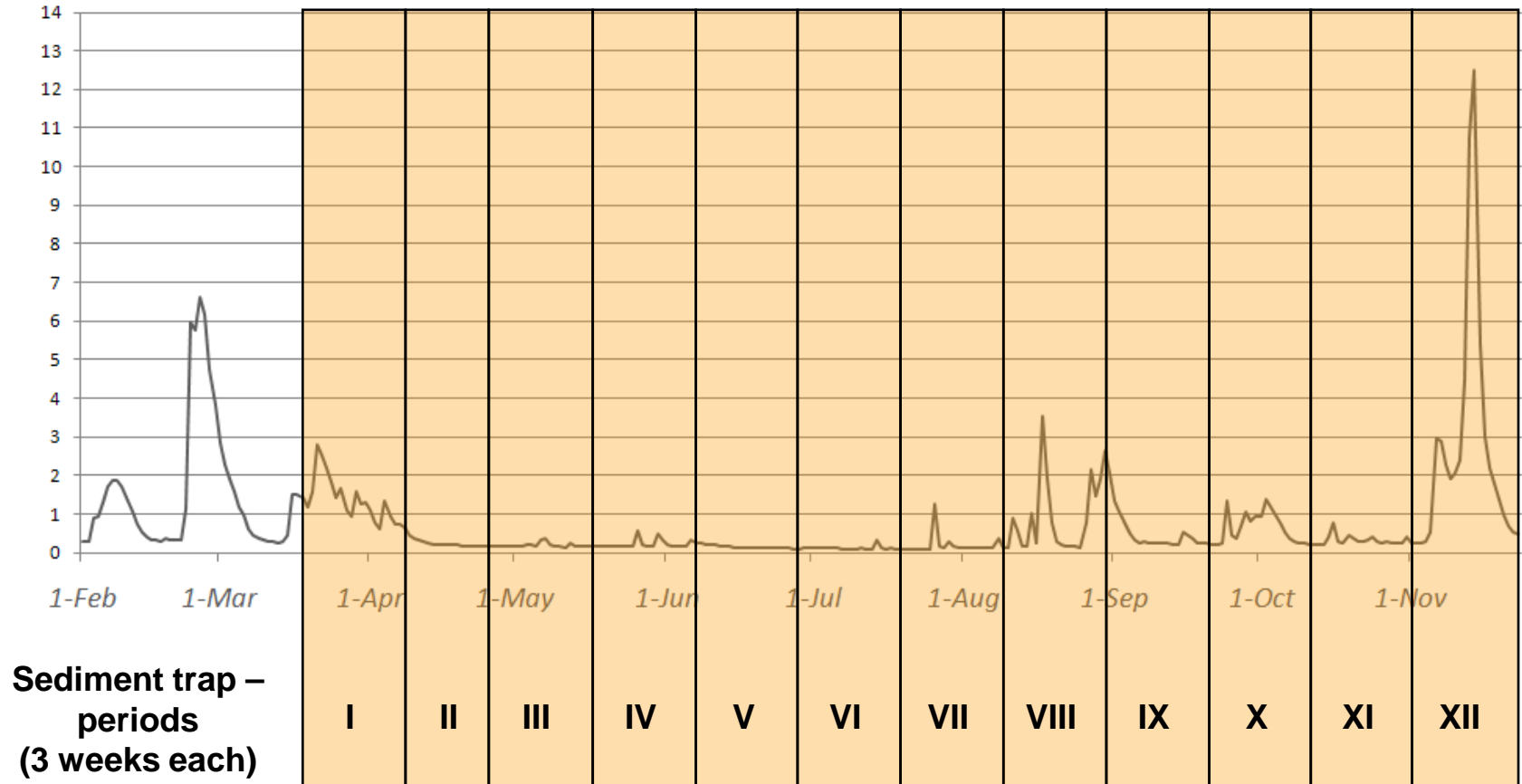


Fine sediment content in river bed (Freeze Cores)



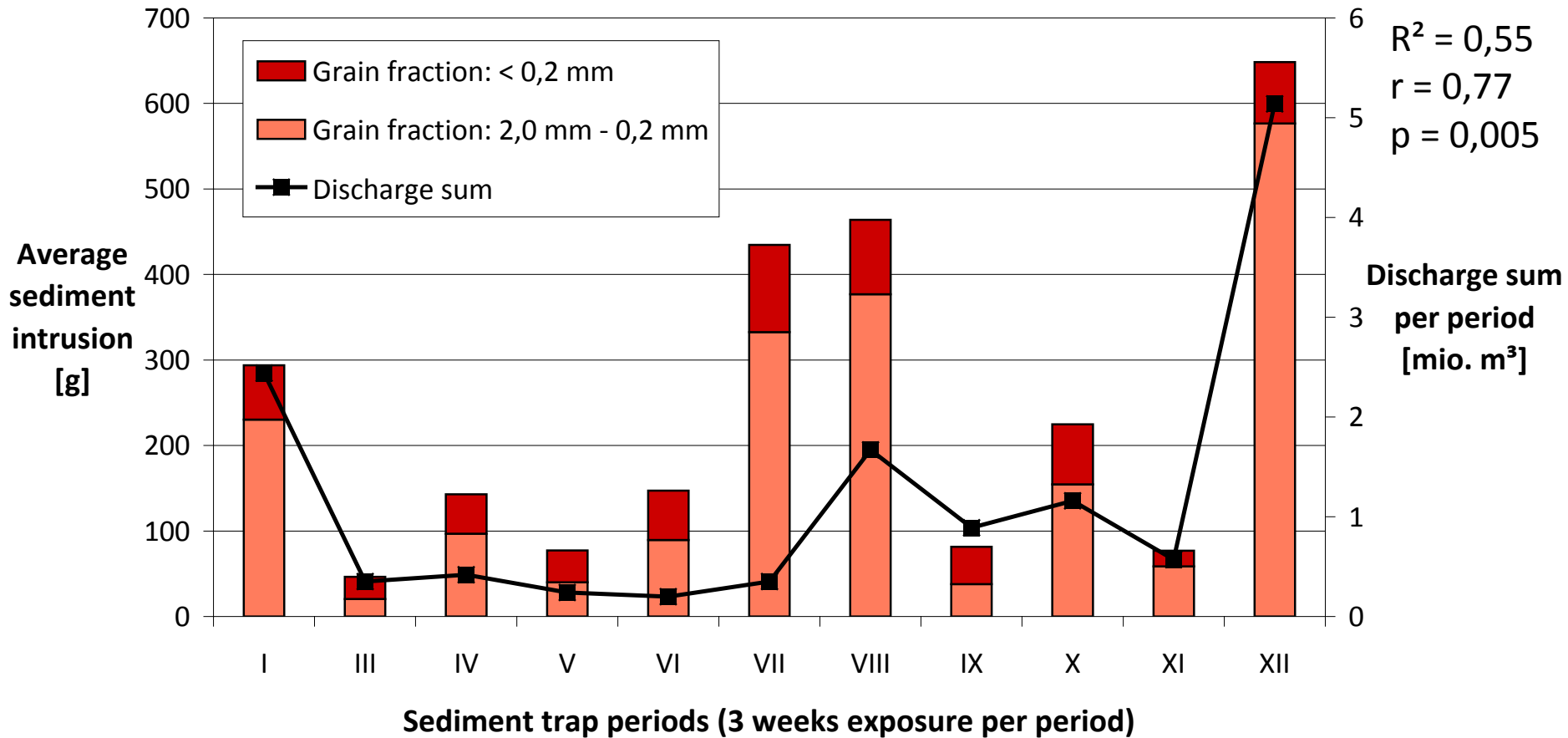
Discharge during sediment trap periods

Discharge at Morsbach river mouth [m^3/s]: March - November 2010

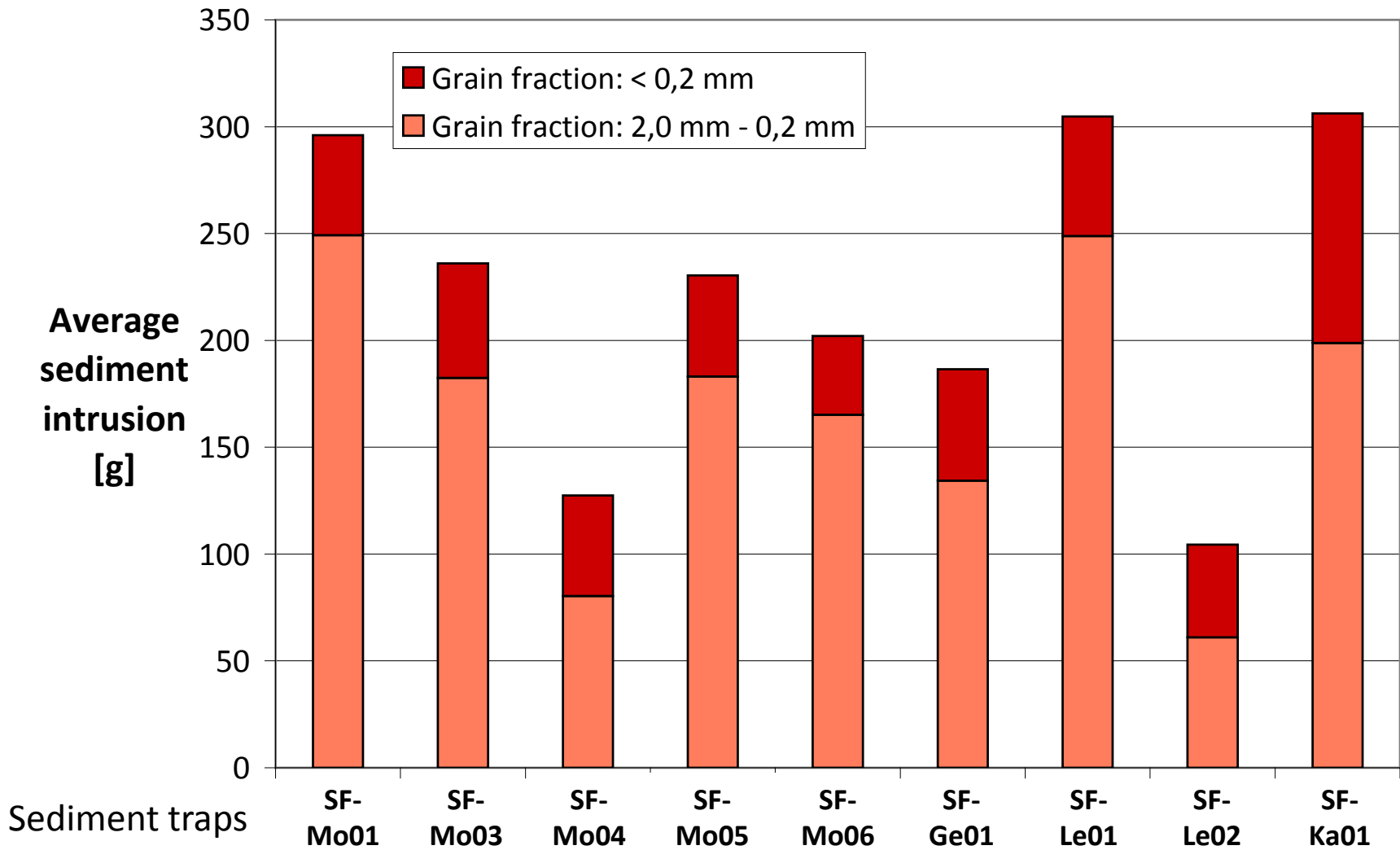


**Sediment trap –
periods
(3 weeks each)**

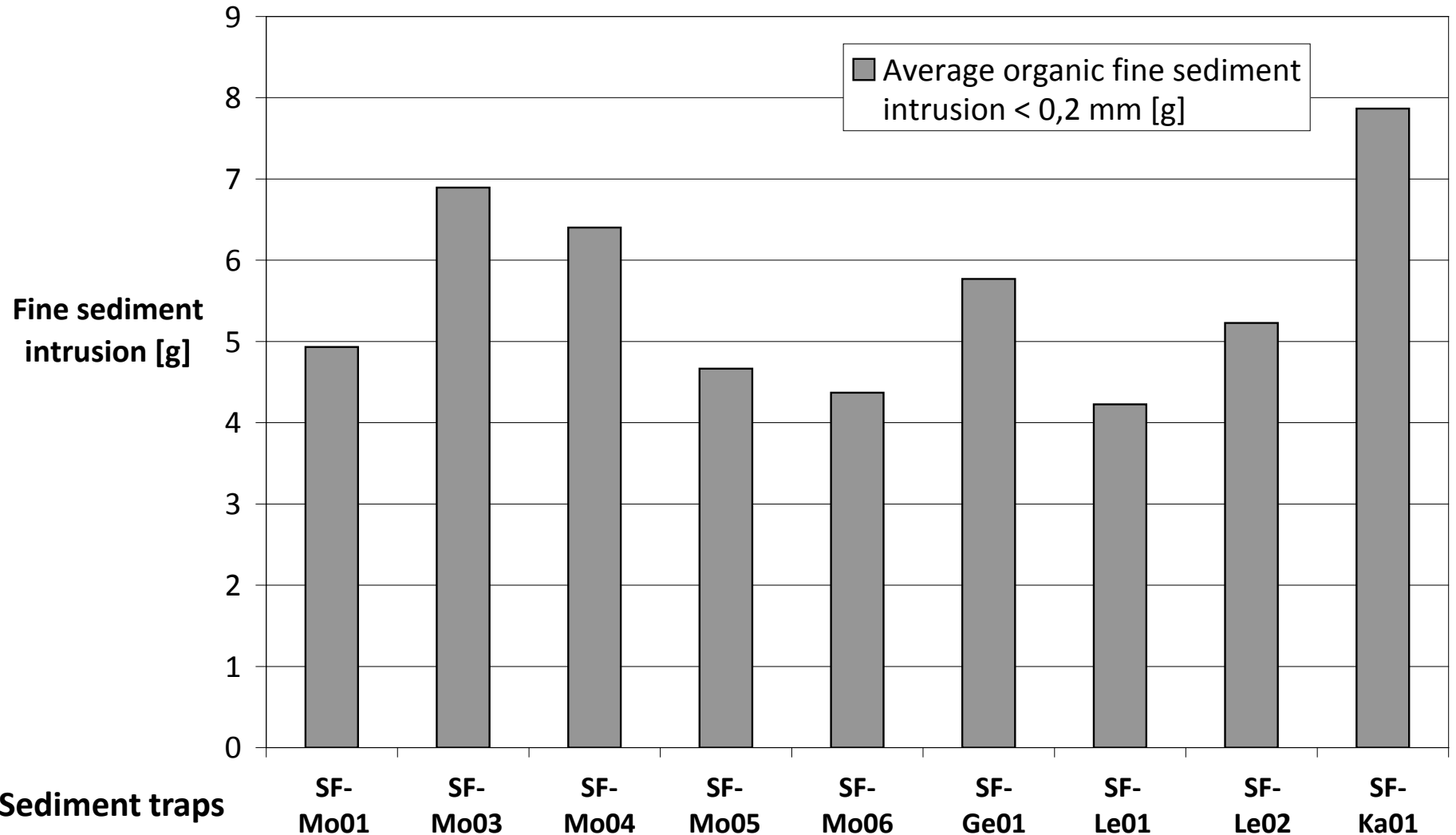
Temporal variation of fine sediment intrusion



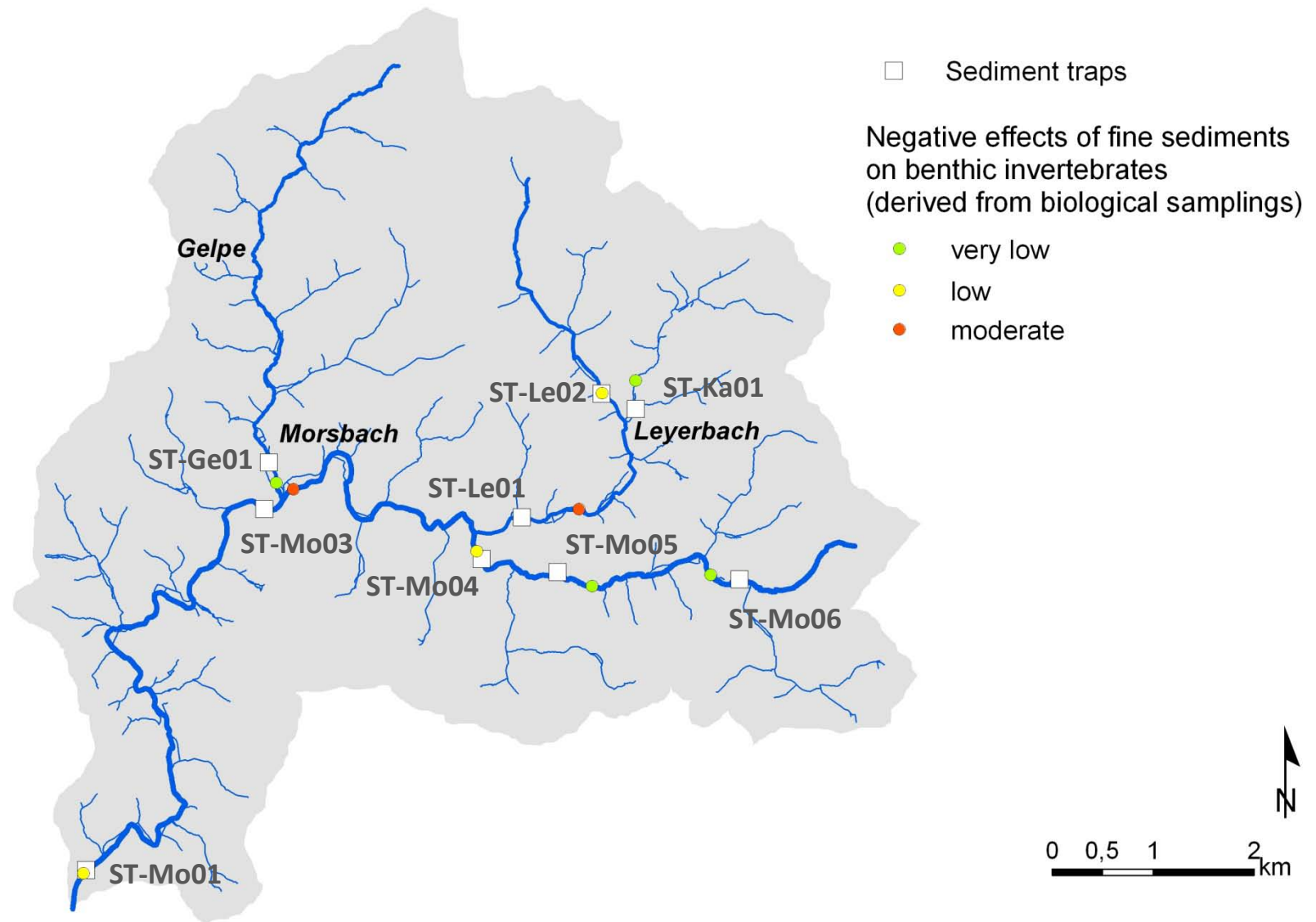
Spatial variation of fine sediment intrusion



Fine sediment intrusion: organic share (spatial variation)



Biological samplings vs. fine sediment measurements



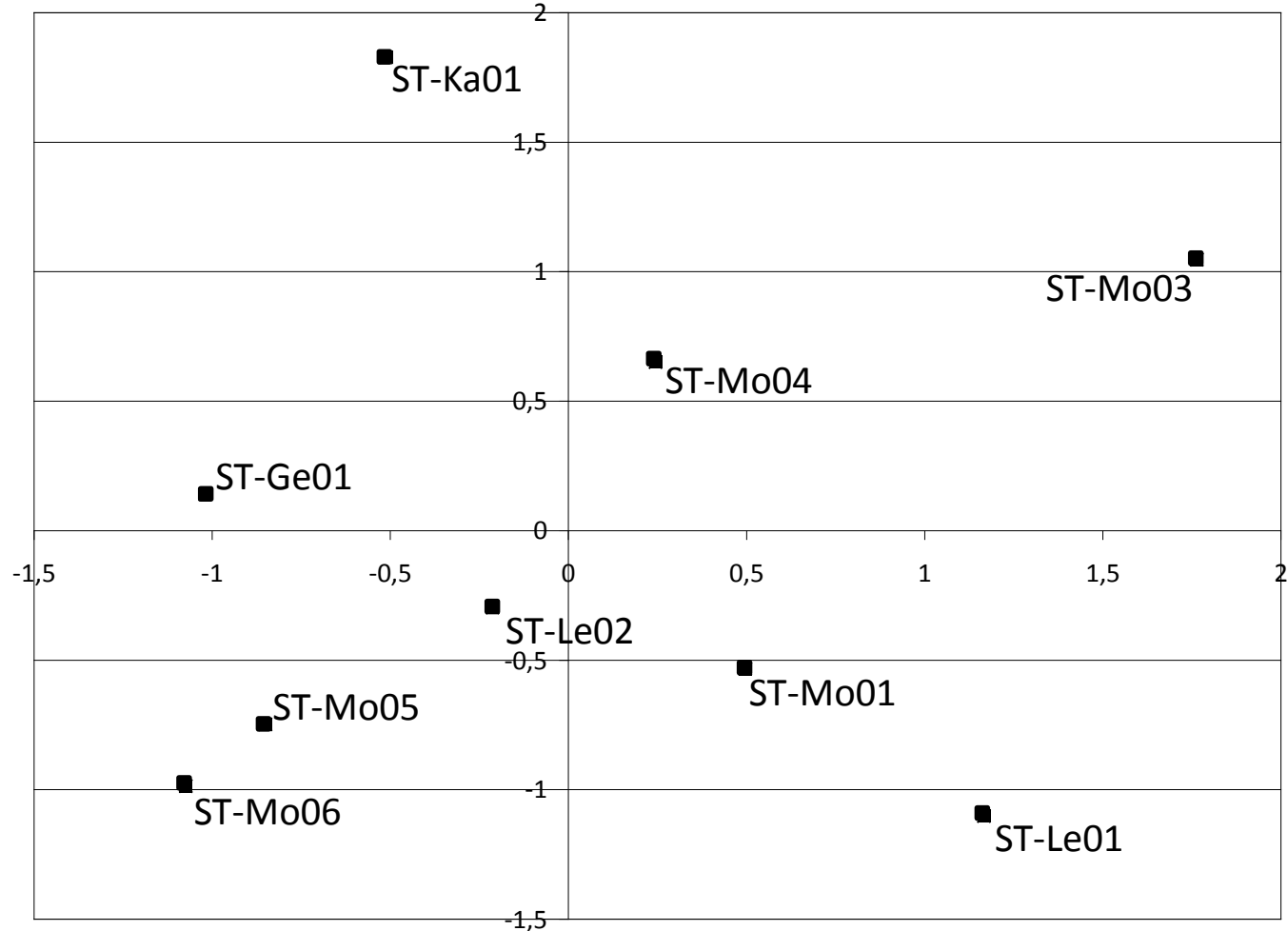
*increasing
intrusion*

Intrusion of organic
fine sediments < 0,2 mm
into sediment traps
(normalized)

$R^2 = 0,0$

$p = 0,7$

$n = 9$



Negative effects of organic fine sediments
on benthic invertebrates,
derived from biological samplings (normalized)

*increasing
negative
effect*

Conclusion

- high content and intrusion rates of fine sediment
- great temporal variation of intrusion in dependency on discharge rates
- great spatial variation of fine sediment intrusion
- no obvious correlation between biological samplings and fine sediment measurements
 - possible reason: different „quality“ of organic fine sediment
 - further investigation: increasing number of sediment traps and calorimetry of organic fine sediment

Thank you for your attention.

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<http://www.tt.fh-koeln.de/start/index.htm>

<http://www.zumbroich.com/>

<http://www.wupperverband.de/>

References

Milan, D. J. (2000): Regional variations in the sediment structure of trout streams in southern England – benchmark data for siltation assessment and restoration. In: Aquatic Conservation: Marine and Freshwater Ecosystems, Volume 10 Issue 6, pp 407-420, Willey, Chichester.

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Wupperverband (2008): Vergleich detaillierter Nachweisverfahren nach BWK-Merkblatt 3 (hydrologisch-hydraulisch-biologisch) für das Morsbacheinzugsgebiet, Wuppertal (unpublished).