The Assessment of Siltation

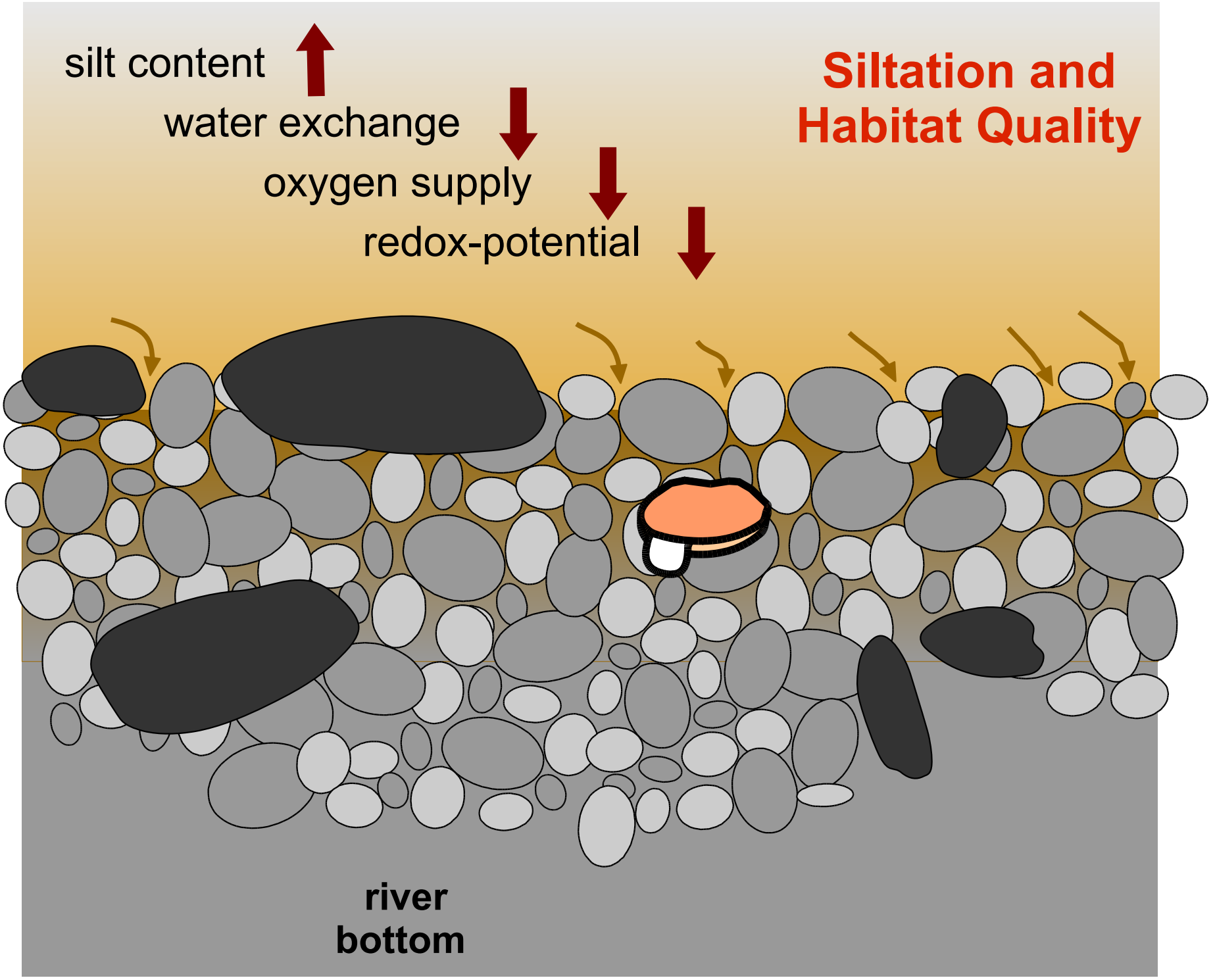
From Single Stream Patches to Whole Catchments



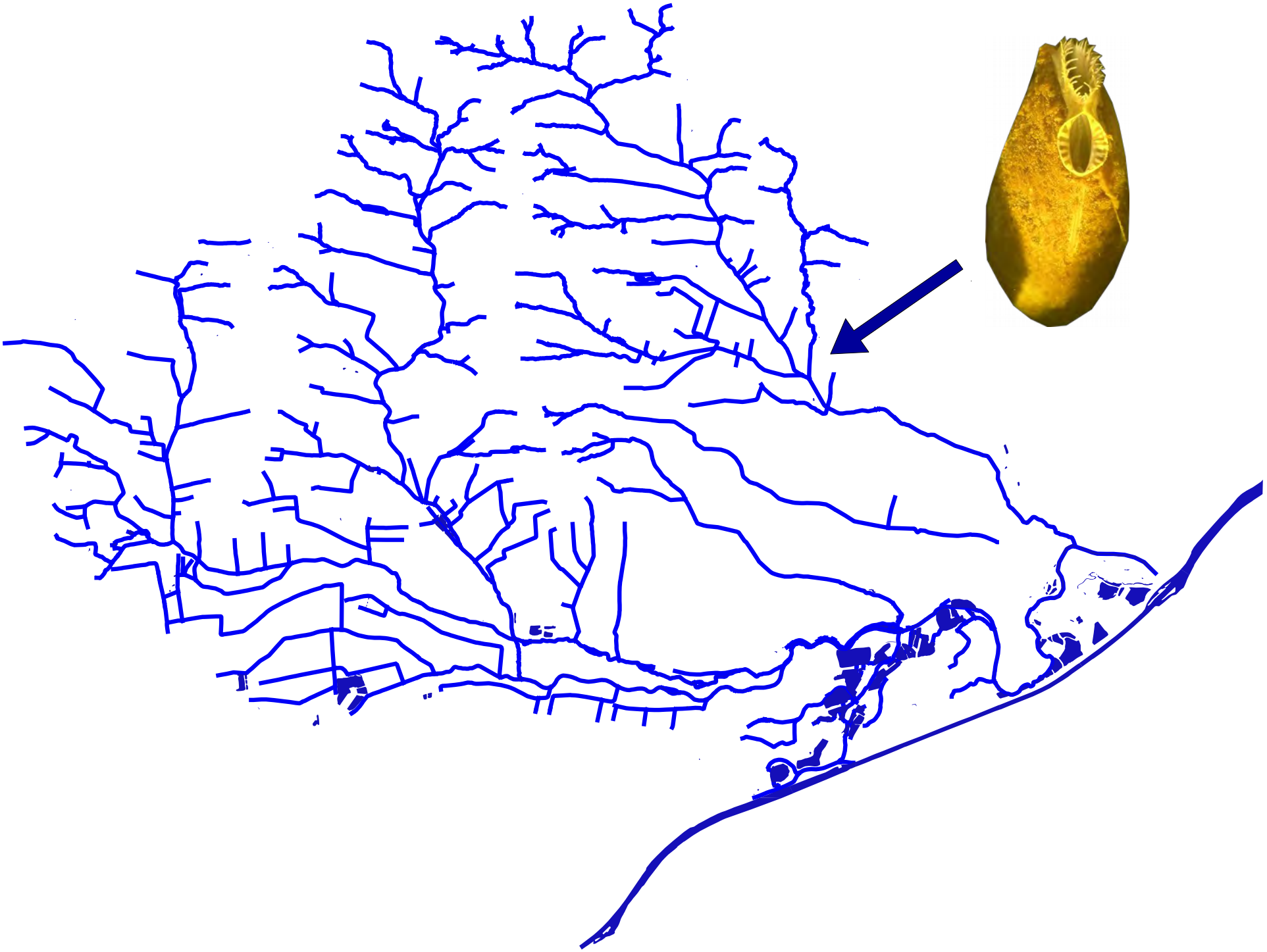
Robert Vandré & Christine Schmidt

Schmidt & Partner

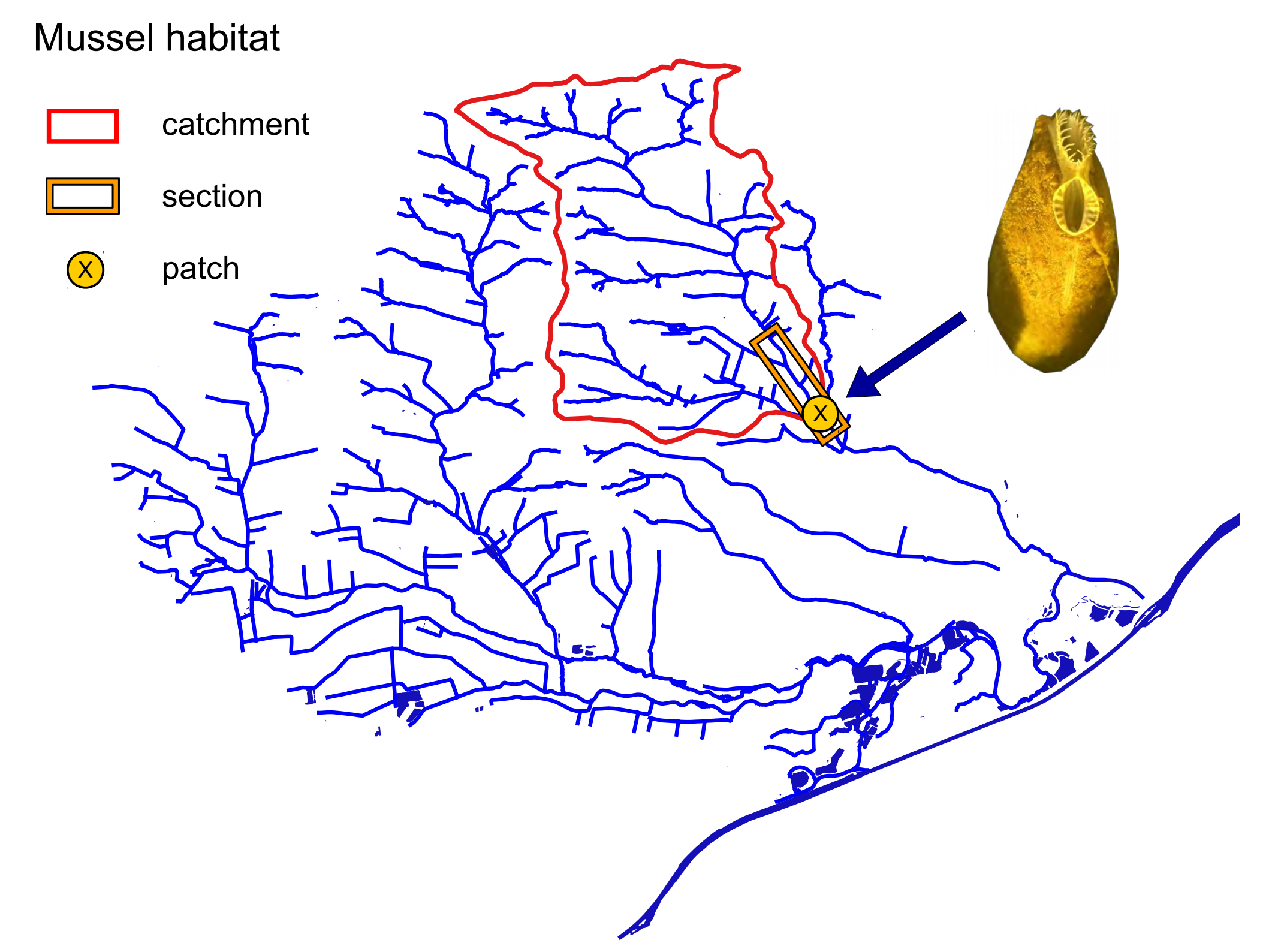
All graphics and pictures by Schmidt & Partner GbR.


silt content
water exchange
oxygen supply
redox-potential
Siltation and
Habitat Quality
river
bottom

Mussel habitat



Mussel habitat



Siltation: hierarchy of scales

stream/river catchment

source of corse and fine sediments, hydrology, overall flow regime

stream/river section

habitat dynamics; local flow regime, laminar and turbulent flow, transport and relocation of sediments

X

stream/river patch

habitat quality; sediment deposition and re-suspension, clogging/colmation



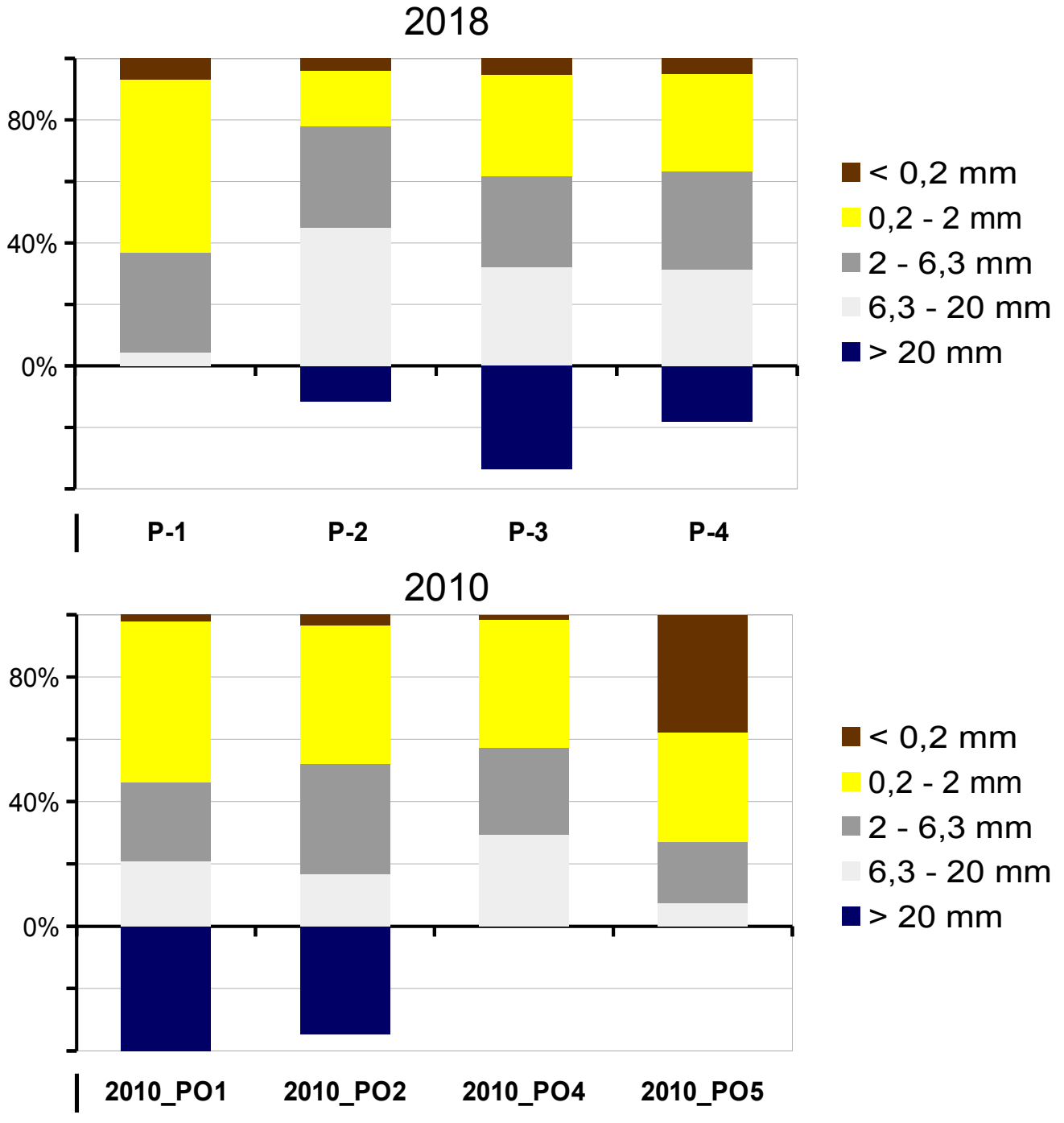





X
stream/river patch: substrate samples

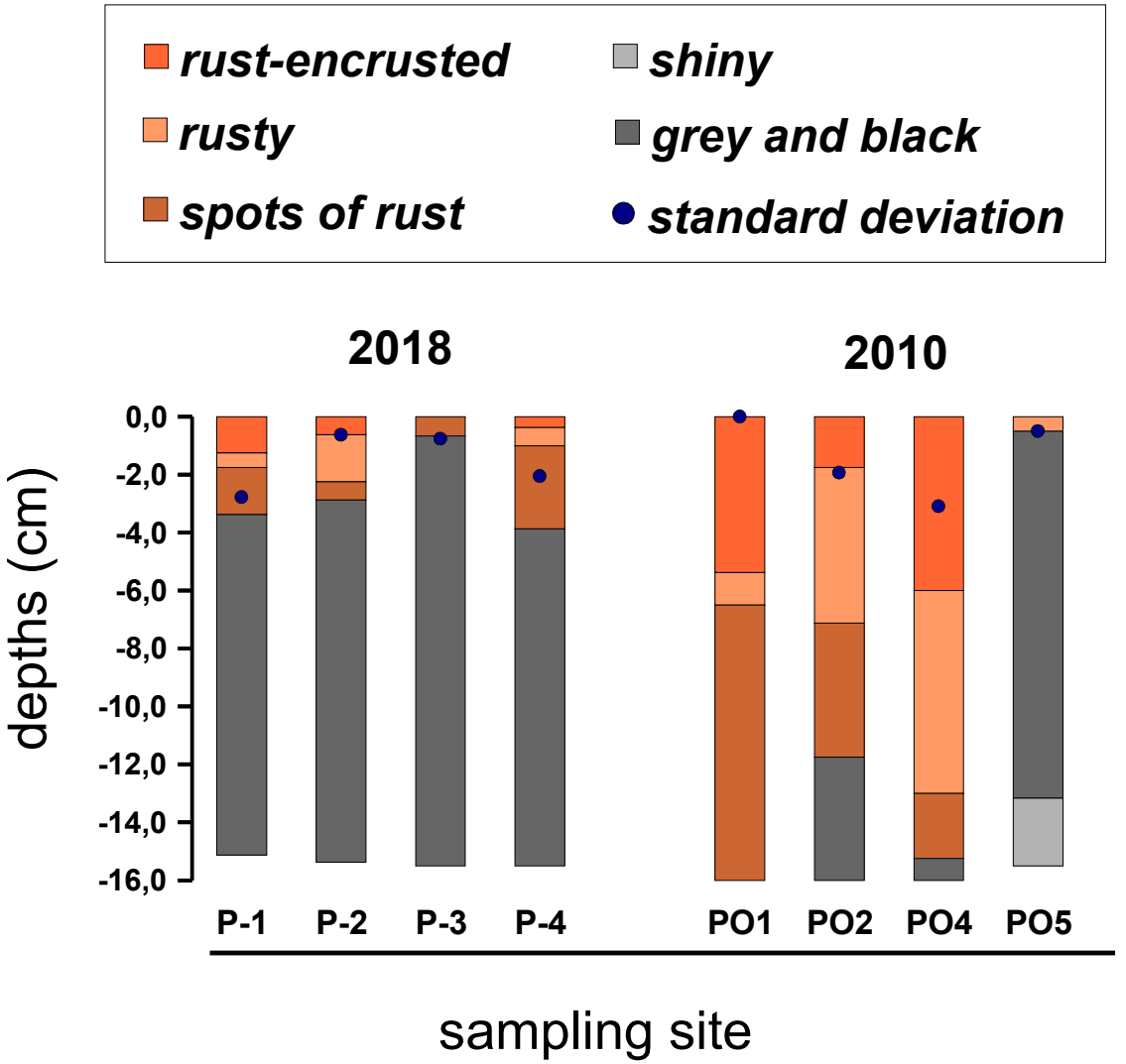
X stream/river patch: fine sediment content

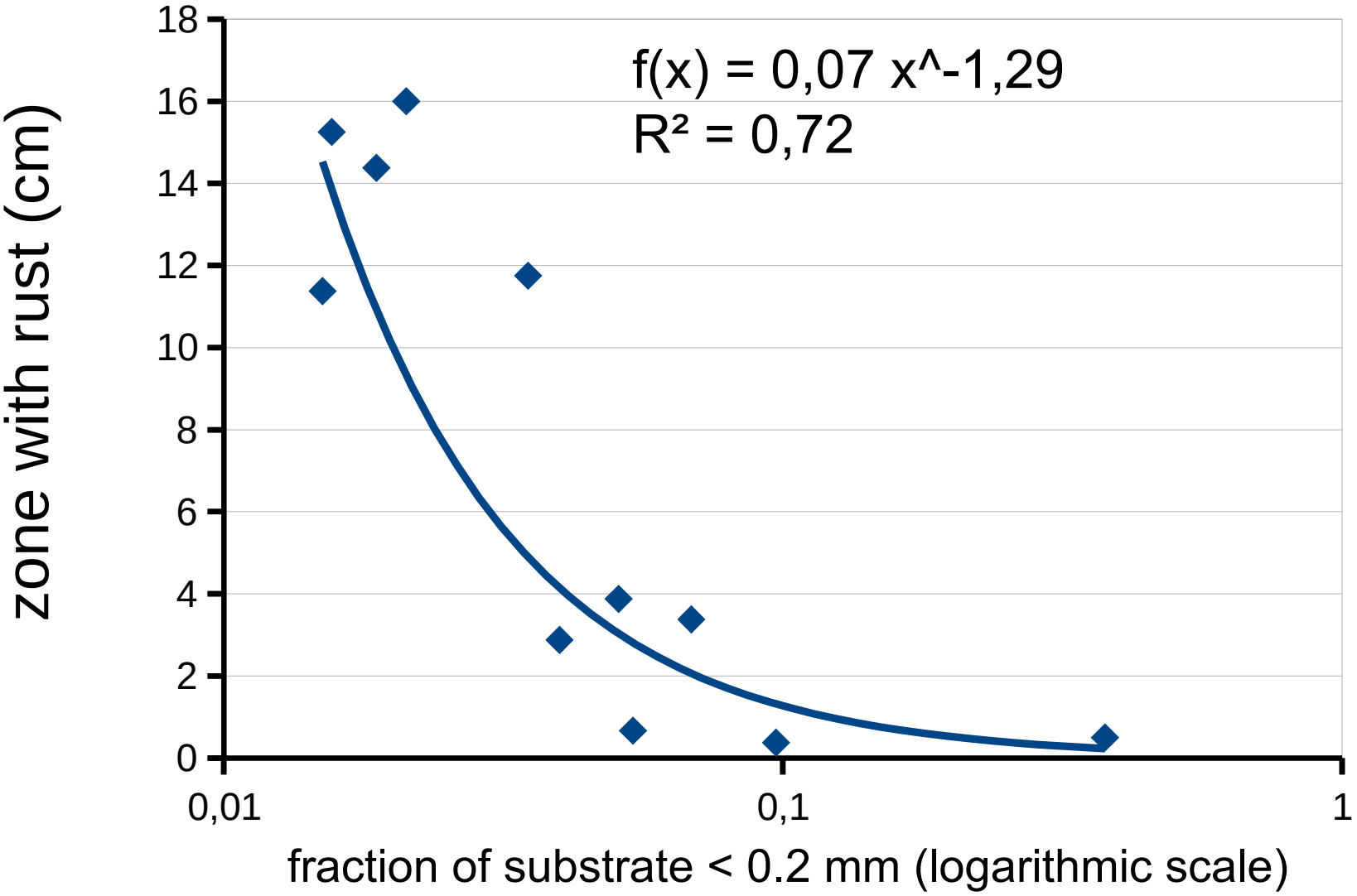




stream/river patch: oxygen supply and depletion in the substrate

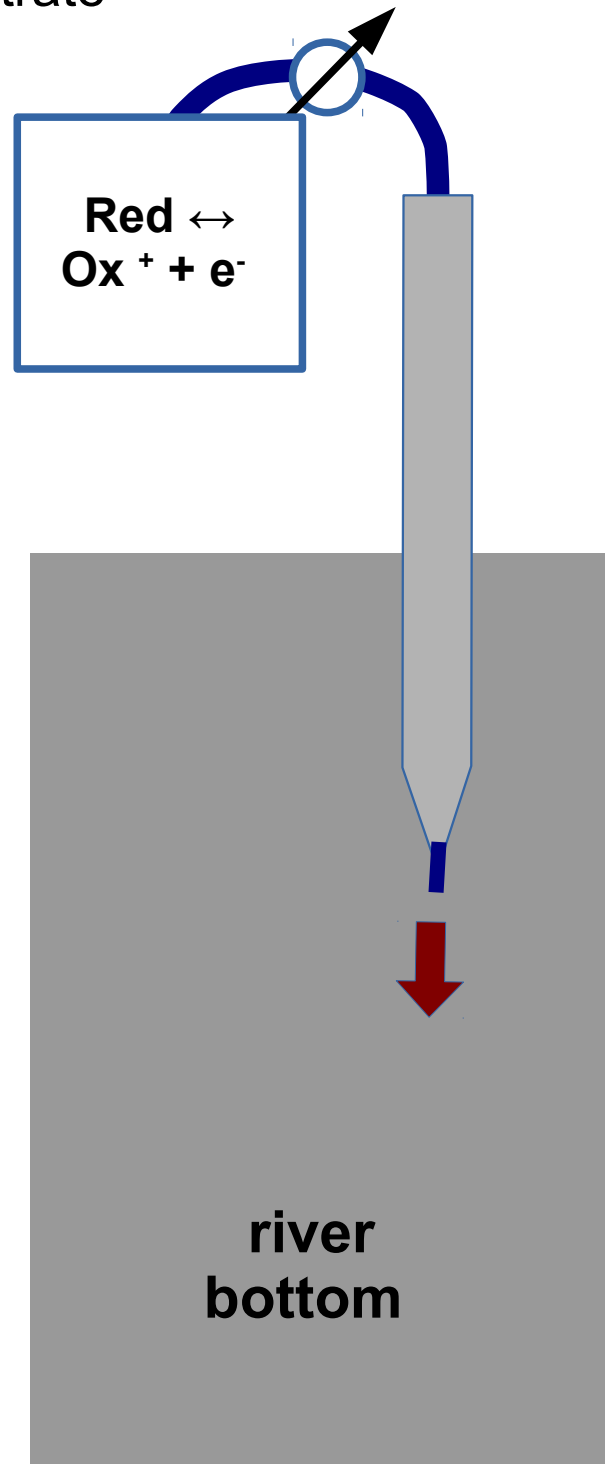


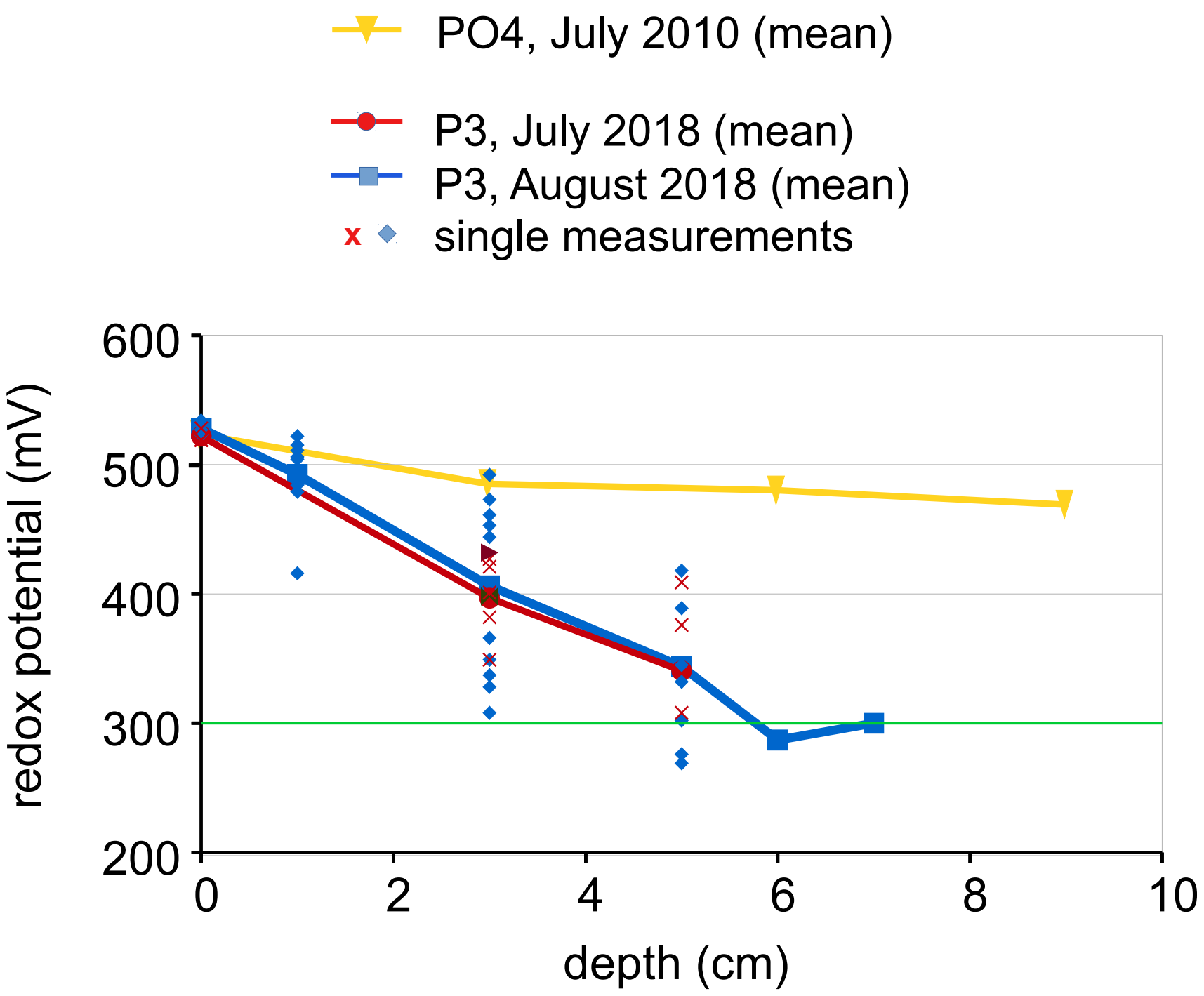



f(x) = 0,07 x^-1,29
R² = 0,72
zone with rust (cm)
18
16
14
12
10
8
6
4
2
0
0,01
0,1
1
fraction of substrate < 0.2 mm (logarithmic scale)

stream/river patch: redox potential in the substrate






PO4, July 2010 (mean)
P3, July 2018 (mean)
P3, August 2018 (mean)
single measurements
redox potential (mV)
600
500
400
300
200
0
2
4
6
8
10
depth (cm)

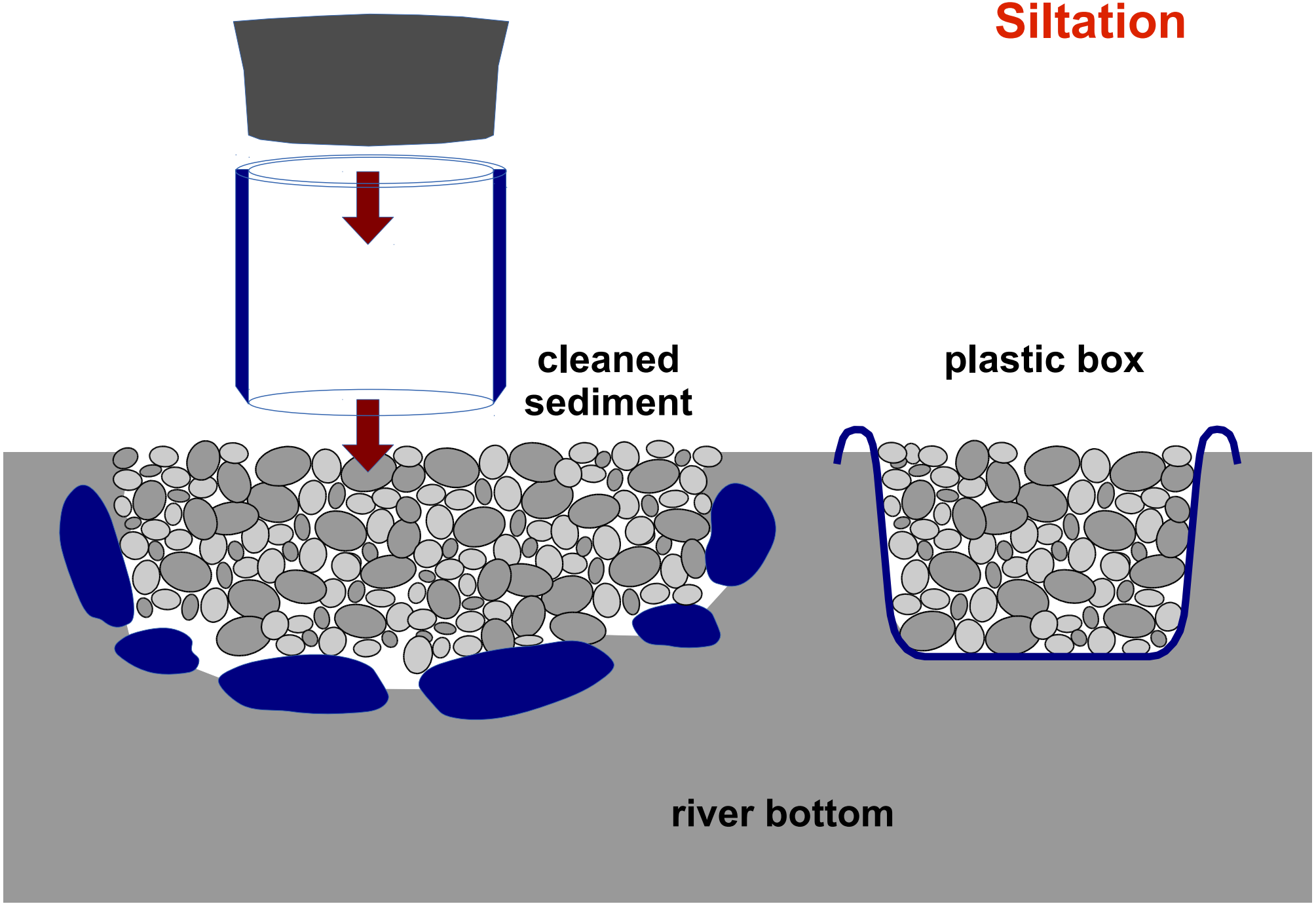
Macrozoobenthos



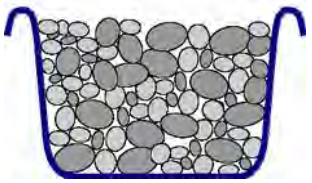


X stream/river patch: fine sediment deposition and infiltration

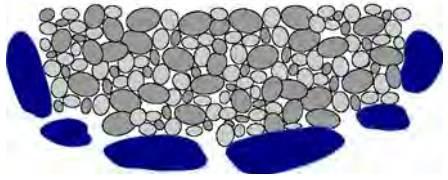
Siltation

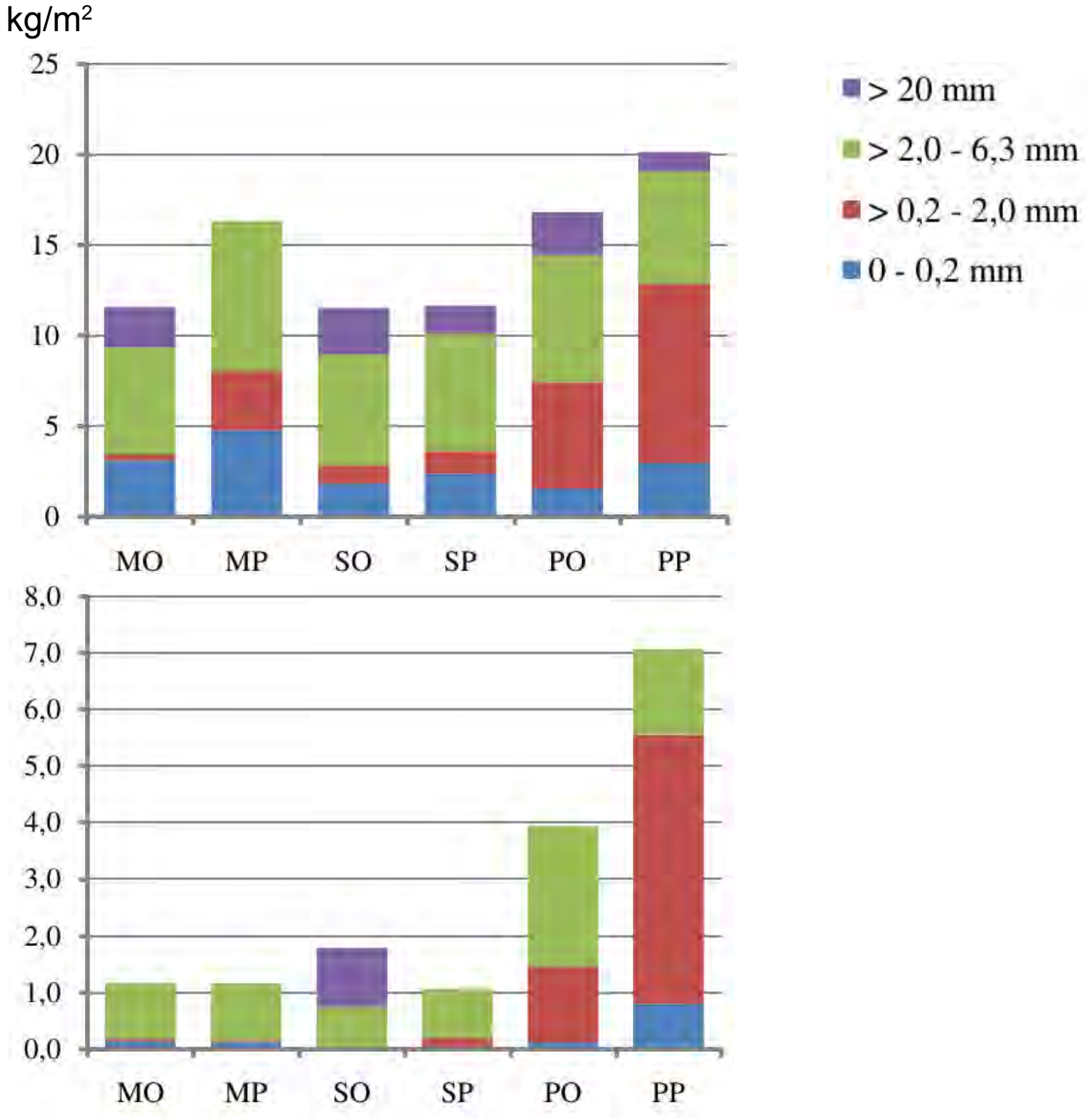


plastic box



cleaned sediment



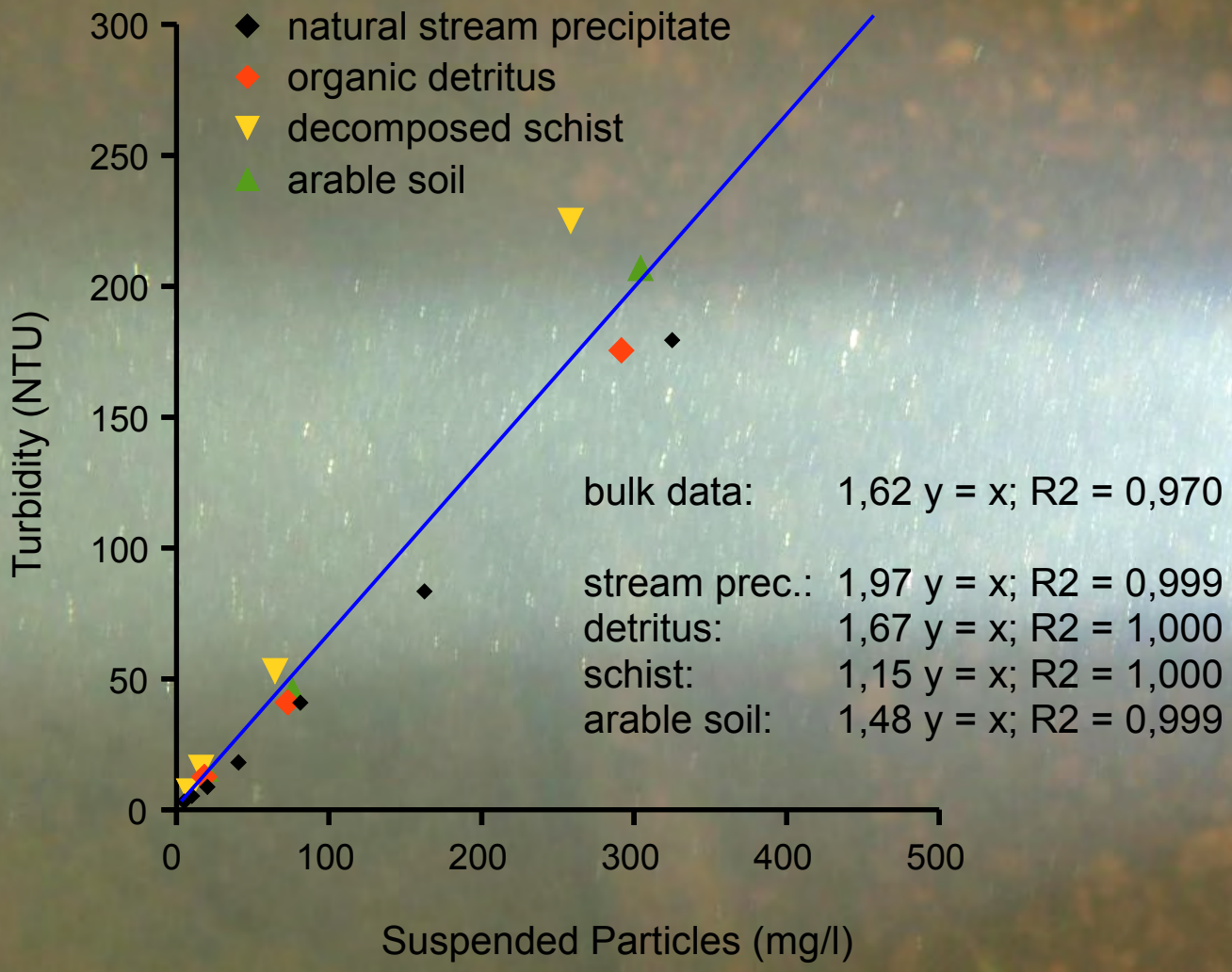




Transport of Silt and Clay: Suspension

Turbidity

1 NTU ≈ 1,2 - 2.0 mg / l of suspended particles



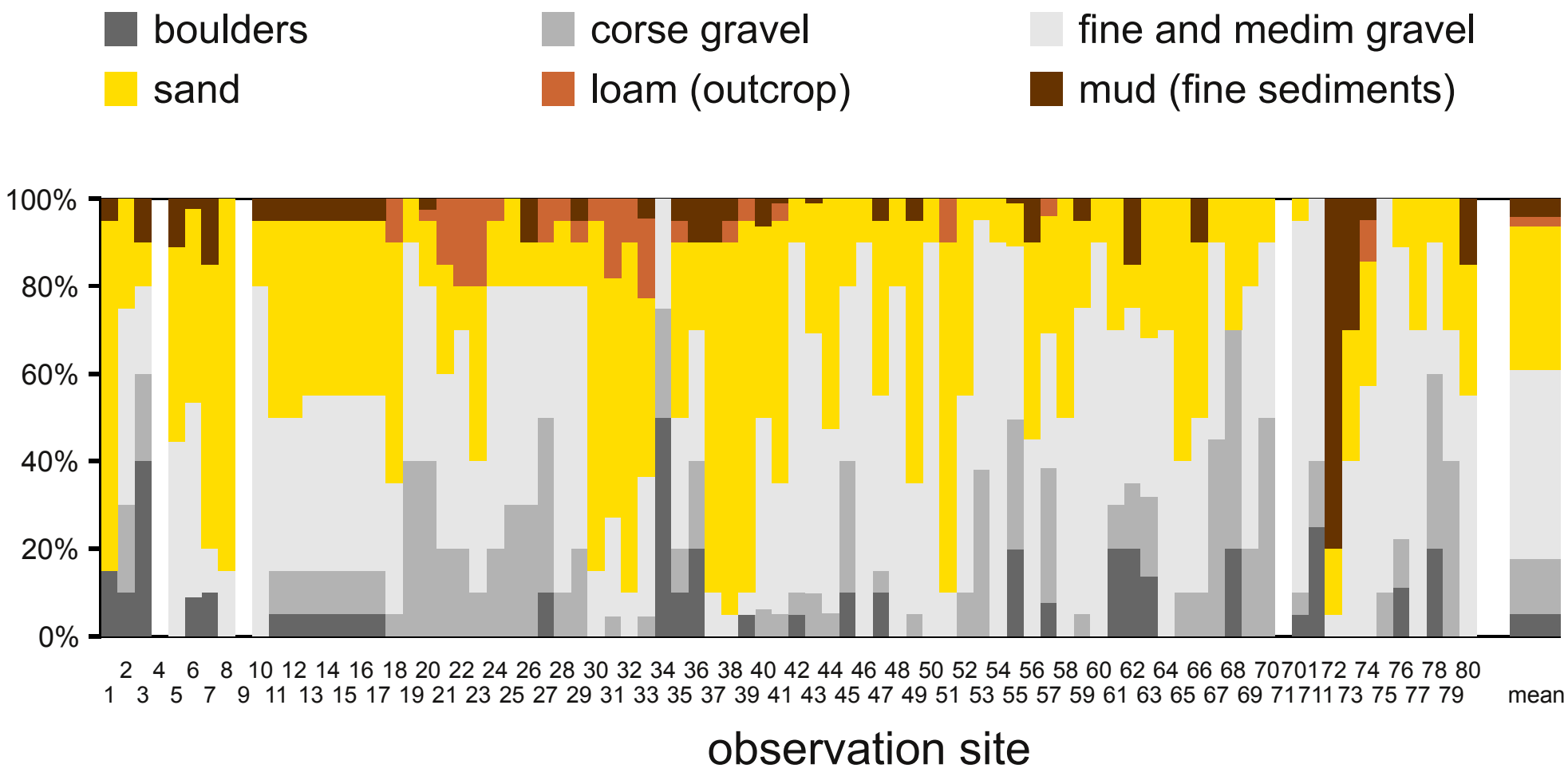
Österling et al. 2010:

0.96 ± 0.14 NTU in streams with juvenile pearl mussels

> 1.9 NTU in streams without recent pearl mussel recruitment

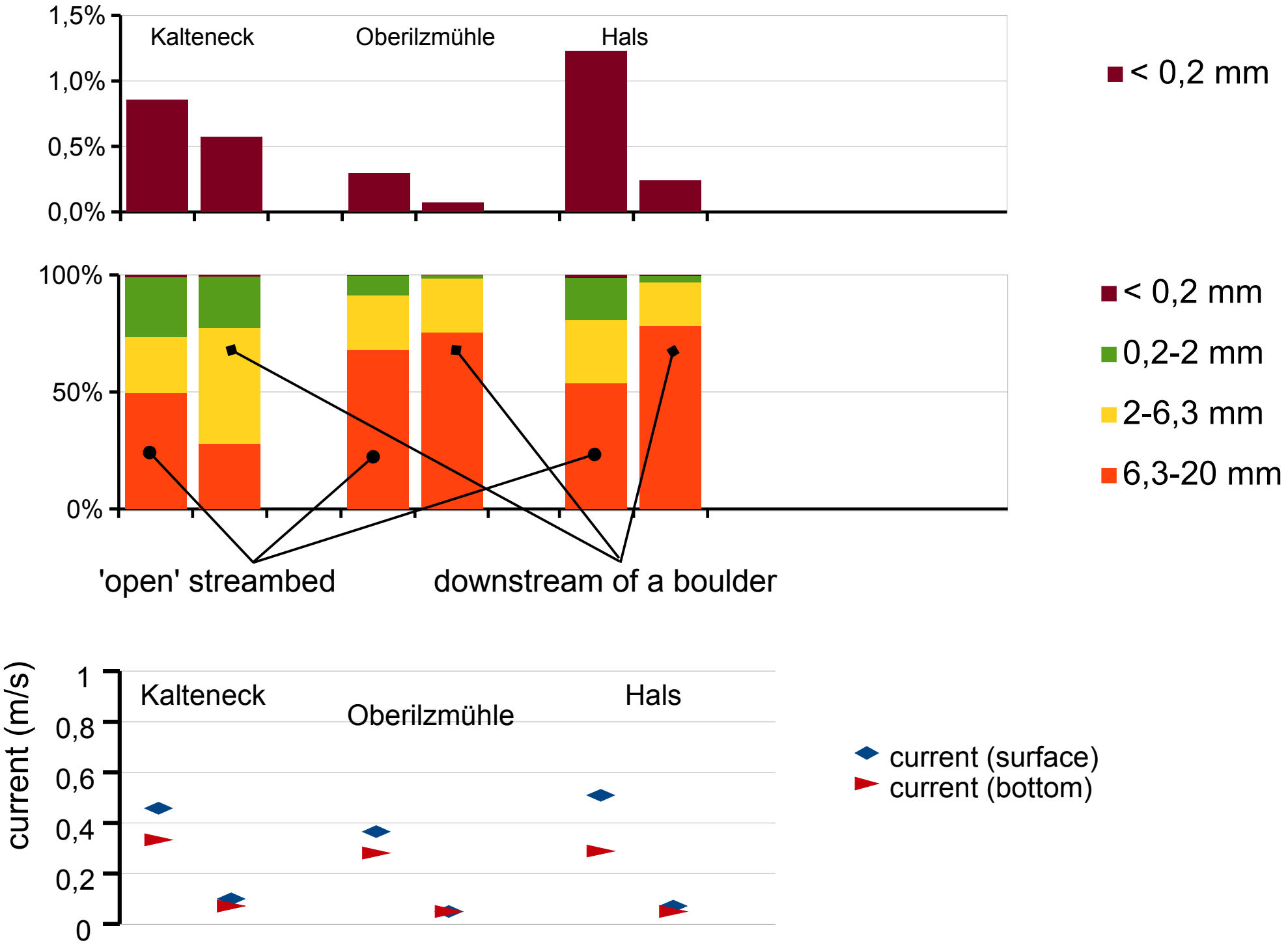

stream/river section

stream/river section: visual estimate of the share of sediment types



stream/river section: special channel features and flow regimes

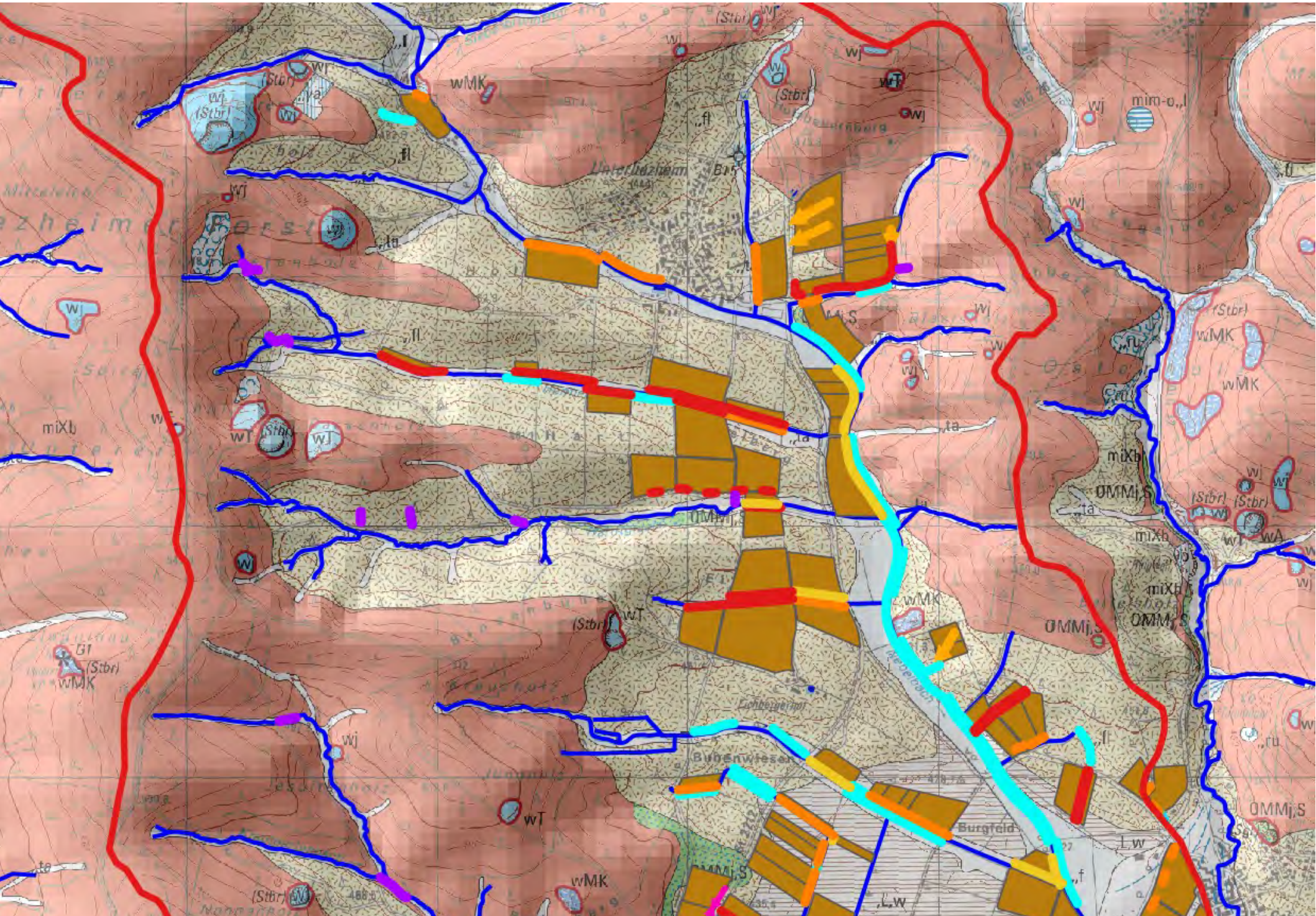



1,5%
1,0%
0,5%
0,0%
Kalteneck
Oberilzmühle
Hals
< 0,2 mm
100%
50%
0%
< 0,2 mm
0,2-2 mm
2-6,3 mm
6,3-20 mm
'open' streambed
downstream of a boulder
current (m/s)
1
0,8
0,6
0,4
0,2
0
Kalteneck
Oberilzmühle
Hals
current (surface)
current (bottom)

stream/river catchment

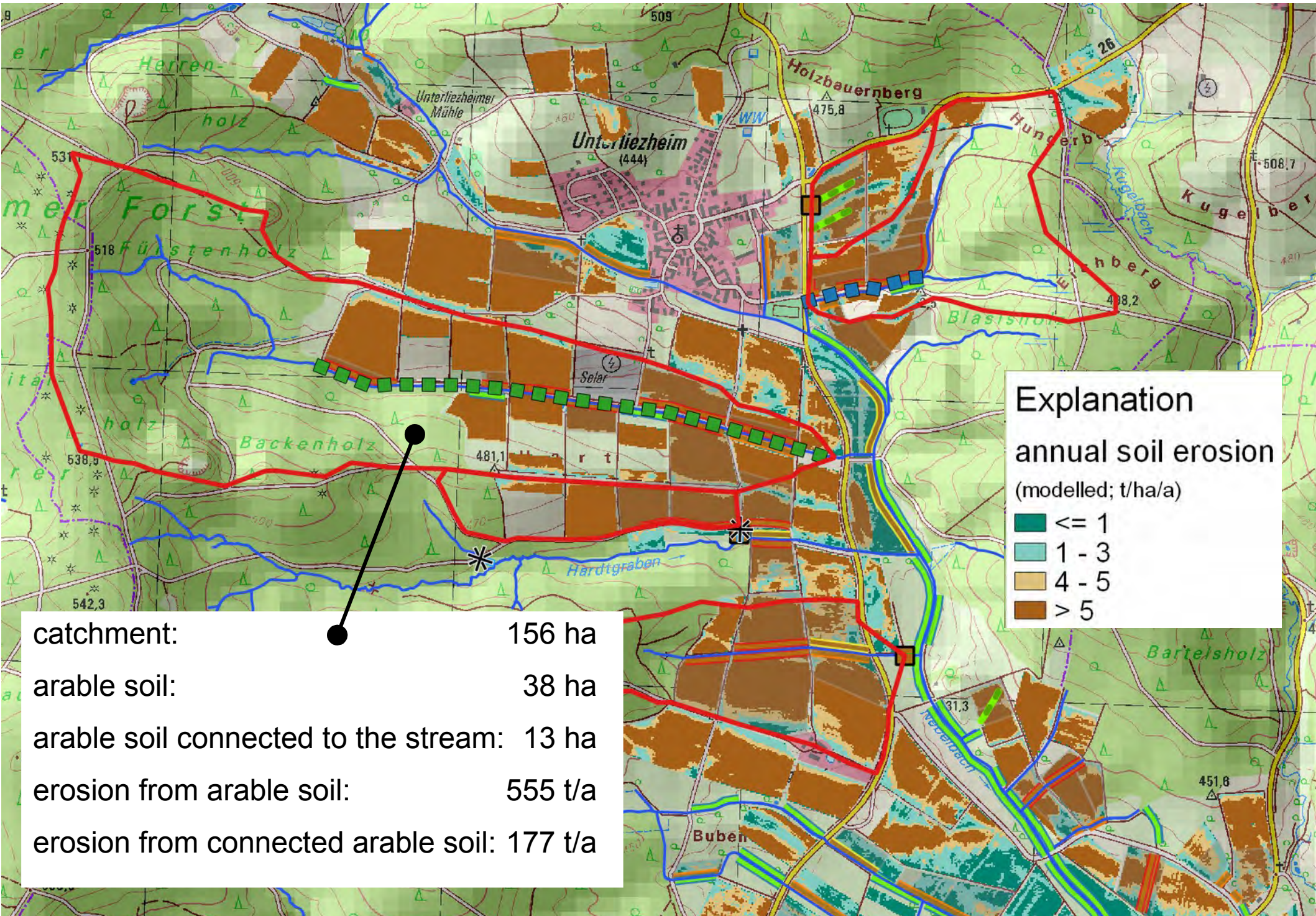


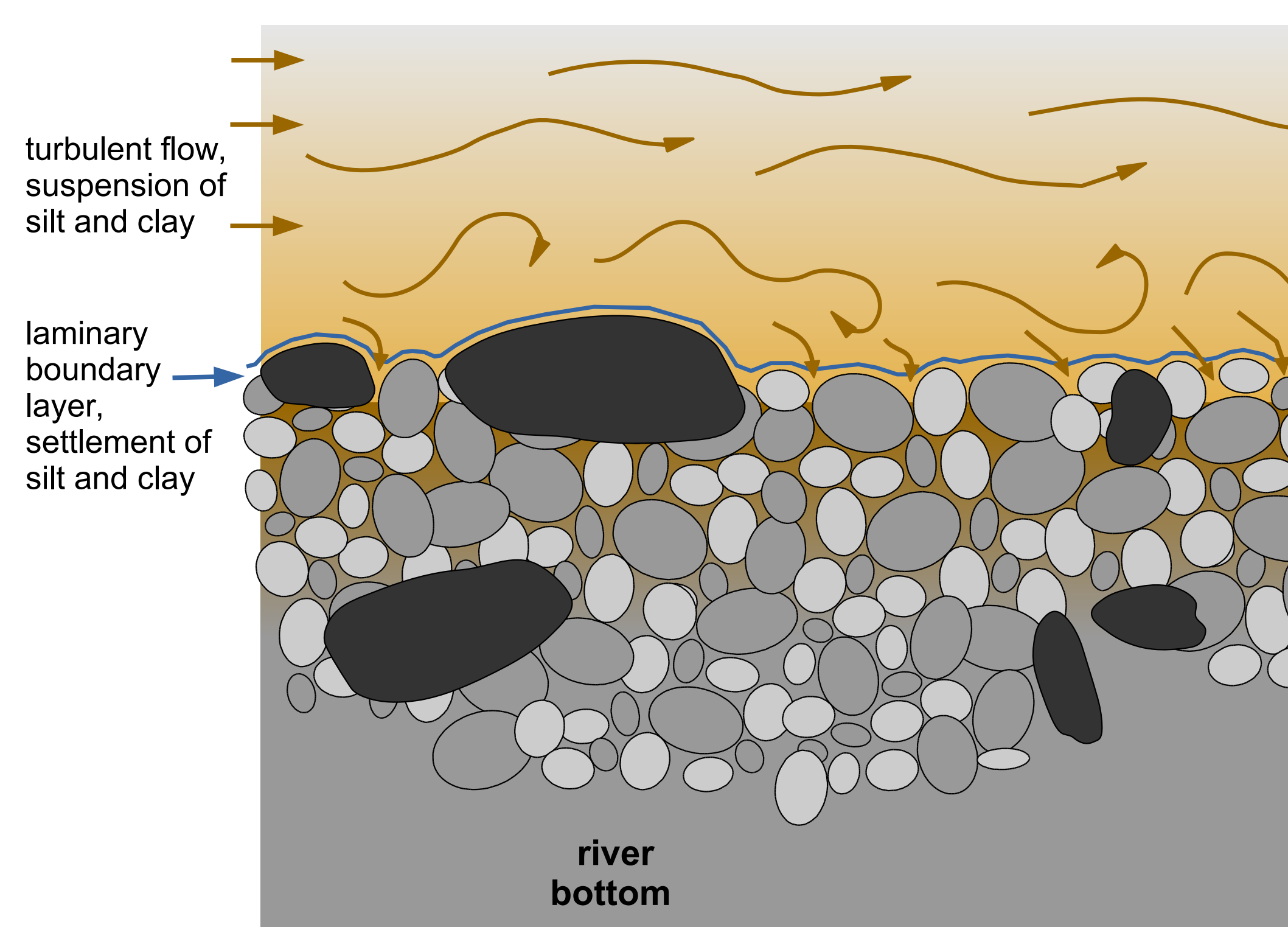
stream/river catchment: sediment sources and their connection to the river





stream/river catchment: annual amount of sediment loaded to the river




turbulent flow, suspension of silt and clay
laminary boundary layer, settlement of silt and clay
river bottom

*Vandré & Schmidt 2015**:

„Besides eutrophication, the clogging of the substrate of pearl mussel rivers with fine textured sediments is another factor of habitat degradation (*Buddensiek 1995; Geist & Auerswald 2007*).“

„The main source of fine textured sediments is soil erosion … . ...sediment loading by bank erosion … is probably minor...“

„...measures for the reduction of fine sediment load should be taken mainly at the headwaters: abatement of soil erosion, disconnection of the flow paths between arable land and the main river...“

* *Vandré R., Schmidt C. 2015*: River dynamics, bank erosion and fine sediment load in freshwater pearl mussel rivers. Proceedings of the International conference: Conservation and Restoration of Freshwater Pearl Mussel Population and Habitat in Europe, Brest, 26-27. November, 2014. Penn Ar Bed 222, 93-99.

Auerswald & Geist 2018*:

„...only 1.3% or less of the erosion material delivered to the stream [Moosach] was deposited on the river bed.“

„...the findings of this study challenge the frequent perception that stream siltation and colmation problems could be solved by addressing land use management, erosion control, and connectivity within the terrestrial catchment…

„Siltation can hardly be controlled by lowering terrestrial erosion rates.“

„...this study suggests that restoration of stream bed quality must also focus on in-stream processes and flow regime management, while erosion control remains essential in its own right.

* *Auerswald, K. & Geist, J. 2018*: Extent and causes of siltation in a headwater stream bed: Catchment soil erosion is less important than internal stream processes. Land Degrad. Develop. 29: 737–748 (2018)

Siltation: hierarchy of scales

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