Změny sladkovodních ekosystémů v prostoru a čase

Z8025 (učebna Z2, pondělí 14.00-15.50)

9. Ekologické aspekty průtokového režimu a hydraulických podmínek

GEOGRAFICKÝ ÚSTAV
PŘÍRODOVĚDECKÁ FAKULTA MU

Mgr. Karel Brabec, Ph.D.

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SYLABUS

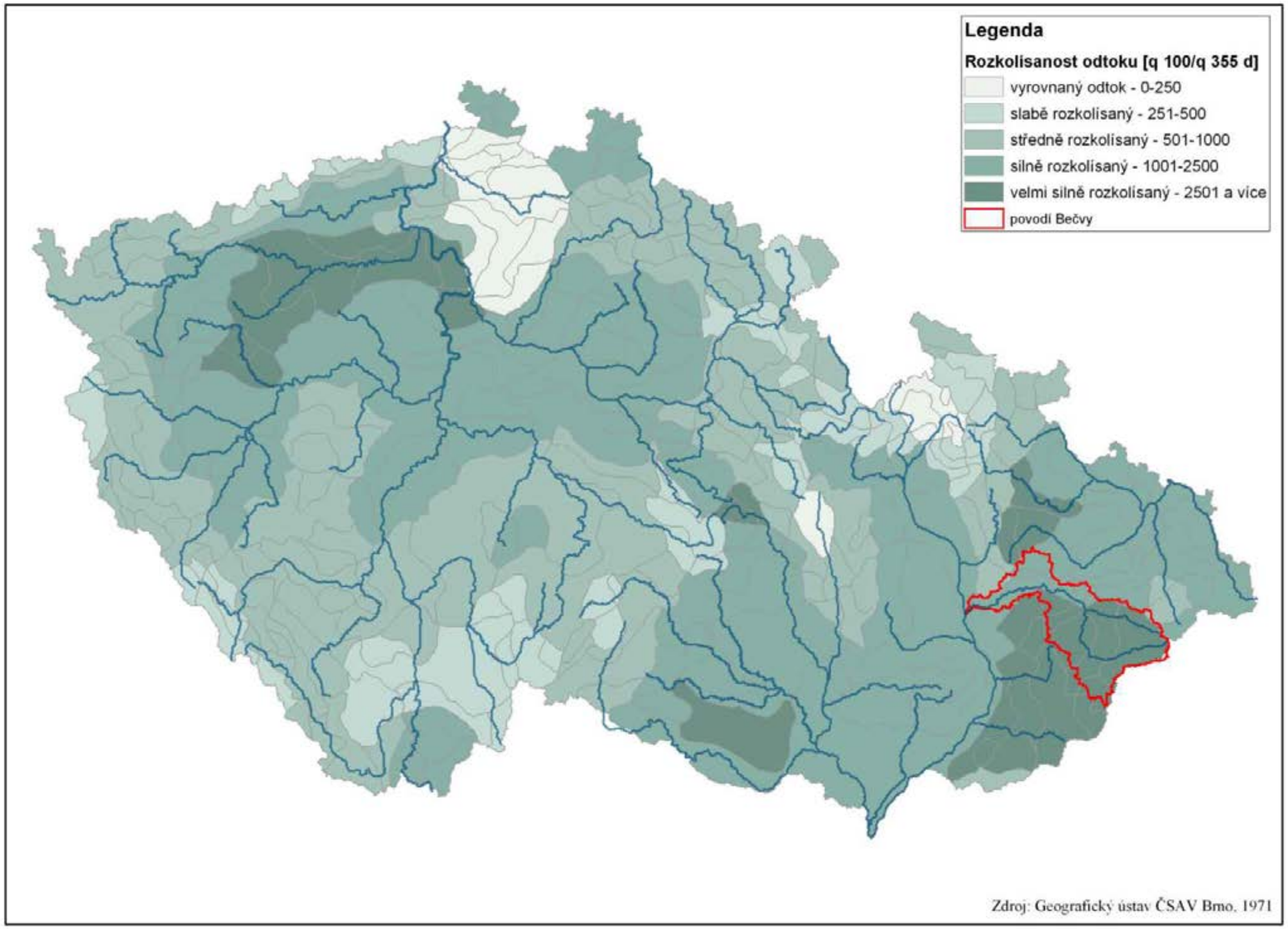
1. Úvod – teoretické koncepty
2. Prostorové škály říční krajiny
3. Změny vodních toků v podélném profilu
4. Laterální a vertikální interakce vodních toků s okolním prostředím
5. Stojaté vody – vztahy k povodí, procesy ve vazbě na prostorové členění
6. Dlouhodobé trendy ve vývoji vodních ekosystémů
7. Sezonní dynamika faktorů prostředí a biologických společenstev
8. Teplotní režim povrchových vod
9. **Ekologické aspekty průtokového režimu a hydraulických podmínek**
10. Antropogenní modifikace vodních ekosystémů (se zřetelem na časoprostorové aspekty)
11. Potenciální dopady změn klimatu ve sladkovodních ekosystémech
12. Časo-prostorové aspekty adaptačních opatření a revitalizací degradovaných ekosystémů
13. Případové studie

EKOLOGICKÉ ASPEKTY PRŮTOKOVÉHO REŽIMU A HYDRAULICKÝCH PODMÍNEK

1. průtokový režim (klasifikace, charakteristiky, časo-prostorové charakteristiky, modelování)
2. hydromorfologické charakteristiky vodních ekosystémů
3. hydraulické parametry
4. substrát
5. transport sedimentů
6. ekologické procesy (vazba na hydromorfologii)
7. vazba bioty na průtokový režim
8. distribuce vodních organismů (role faktorů prostředí)
9. adaptace organismů vůči faktorům souvisejícím s průtokovým režimem (typ proudění, hloubka-jezera, substrát)

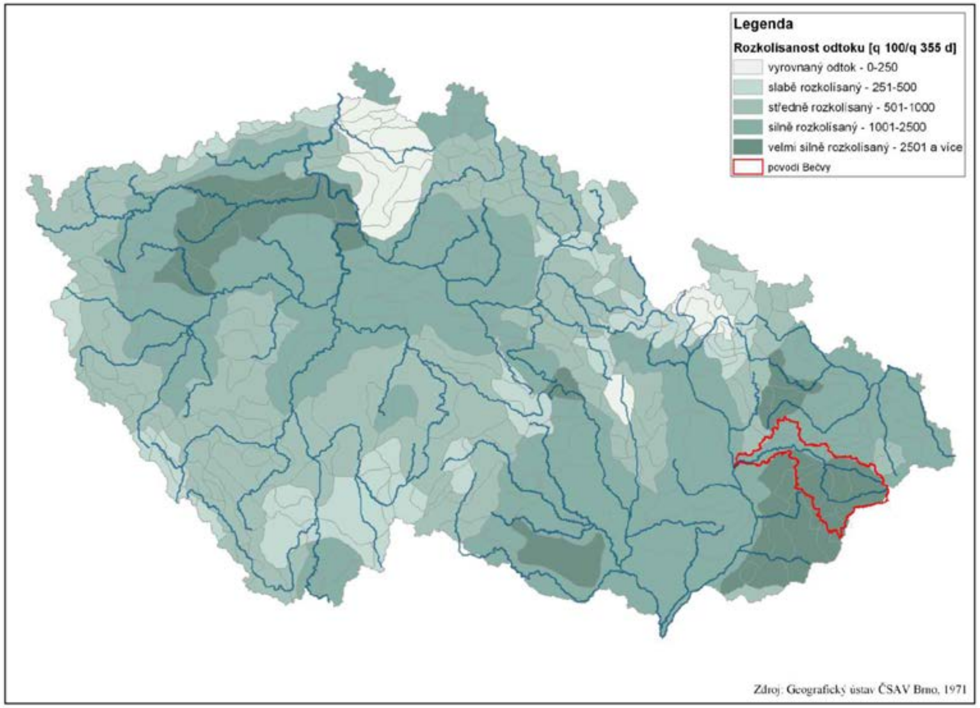
1. PRŮTOKOVÝ REŽIM

- klasifikace
- charakteristiky
- časo-prostorové charakteristiky
- modelování



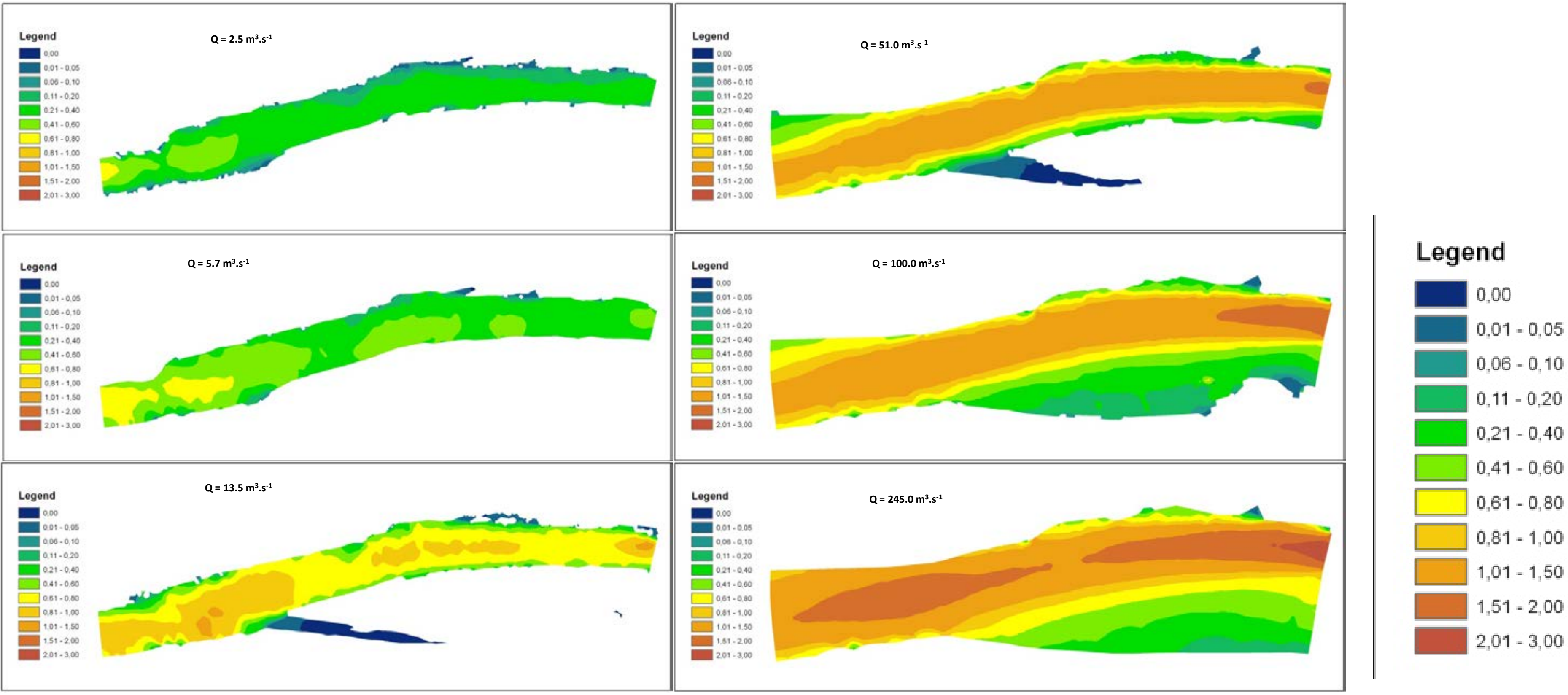
1. PRŮTOKOVÝ REŽIM

- rozkolísanost odtoku



1. PRŮTOKOVÝ REŽIM

modelování



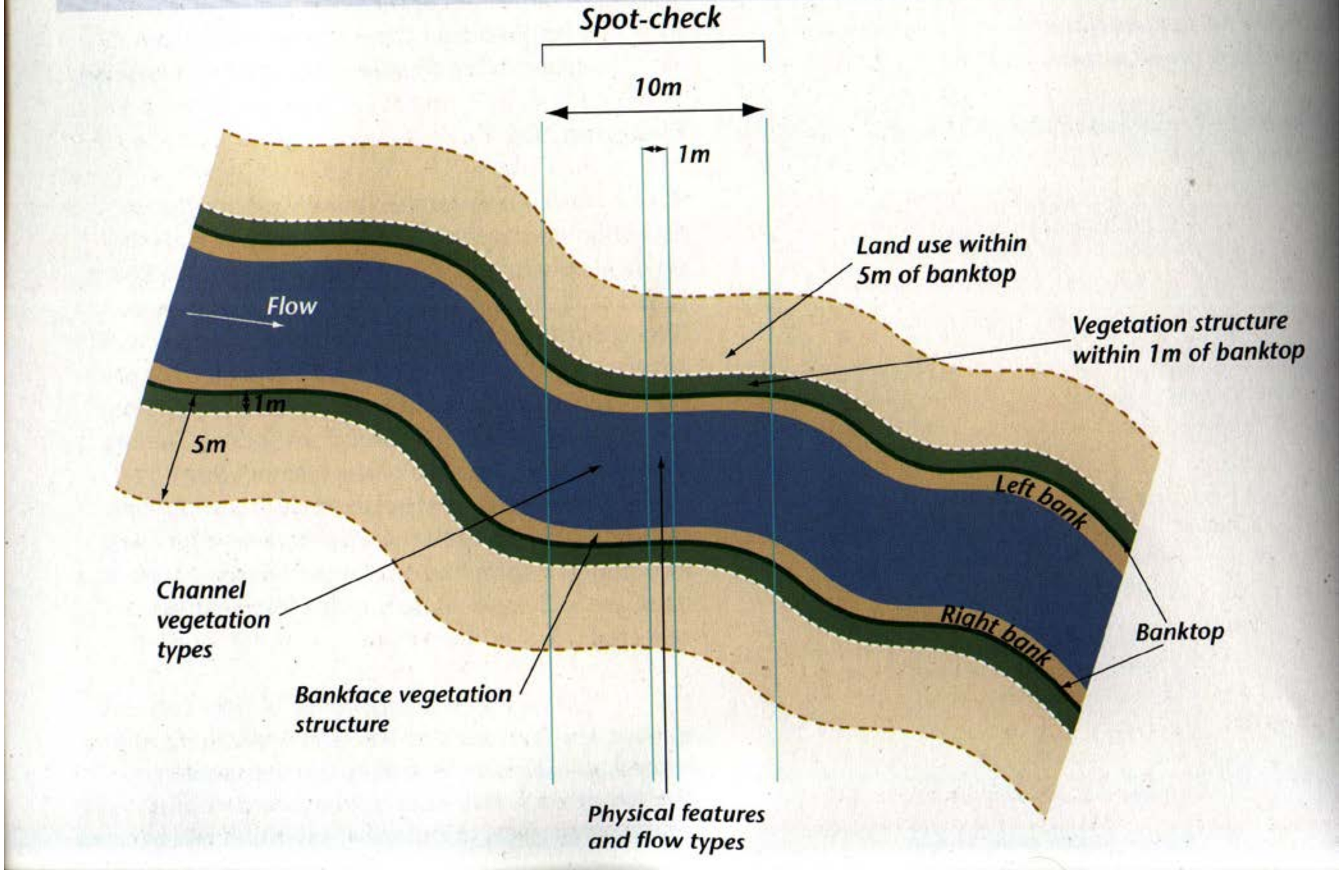
2. HYDROMORFOLOGICKÉ CHARAKTERISTIKY

přehled

RIVER HABITAT SURVEY

(Environment Agency, 1997)

Figure 2 Features recorded at RHS spot-checks.



HYDROMORFOLOGIE střední a nízké průtoky

změny habitatů

RIFFLES (R)

Torrential habitats characterized by Froude number higher than 0.18. Quantity of benthic particulate organic matter and periphyton growths depends on magnitude and duration of high flows preceding sampling.

EROSIONAL AND DEPOSITIONAL ZONES OF MAIN CHANNEL

CHANNEL POOLS – GLIDES (P)

Habitats of main channel defined by Froude number lower than 0.18 and laminar form of flow.

CHANNEL MARGINS (M)

Low current velocity reflects in cummulation of fine sediments. Food sources and refugia for benthic macroinvertebrates are influenced by presence of riparian vegetation (shading, particulate organic matter, woody debris, roots).

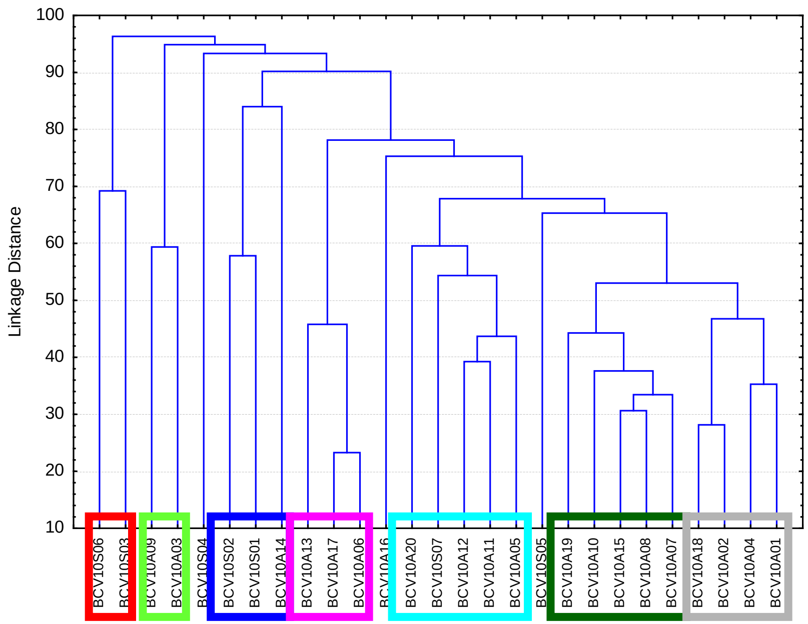
In shallow habitats with slow current the periphyton is developed.

CONNECTIVITY WITH MAIN CHANNEL / INTERACTION WITH RIPARIAN HABITATS

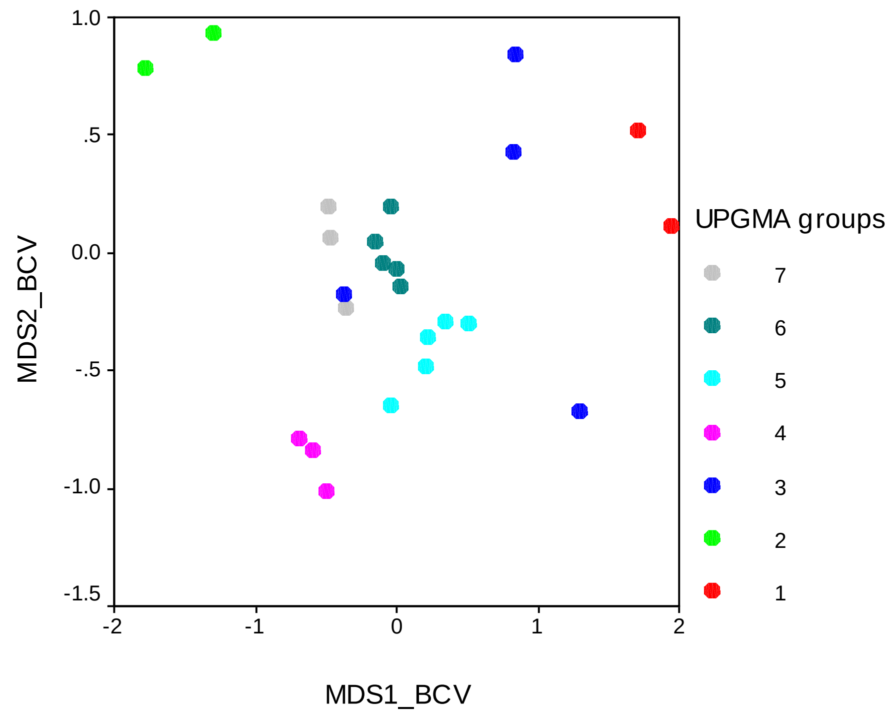
SIDE ARMS (S)

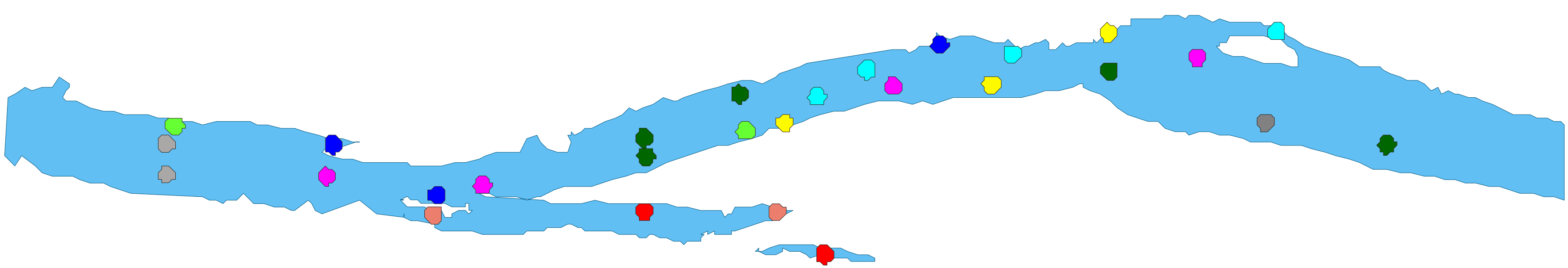
Morphology of habitat is formed by erosive effect of high flows. Side arms are connected with main channel at the downstream part only for the majority of a year. Fine sediments with high proportion of organic matter dominate within substrate types. Groundwater inflow is affecting thermal regime and water chemistry of these habitats.

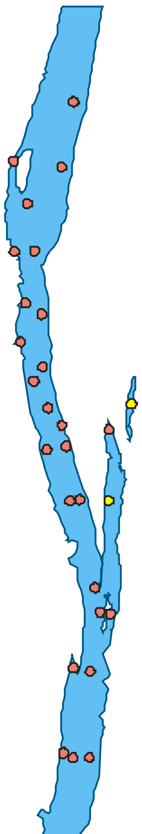
UPGMA (Bray-Curtis dissimilarity)



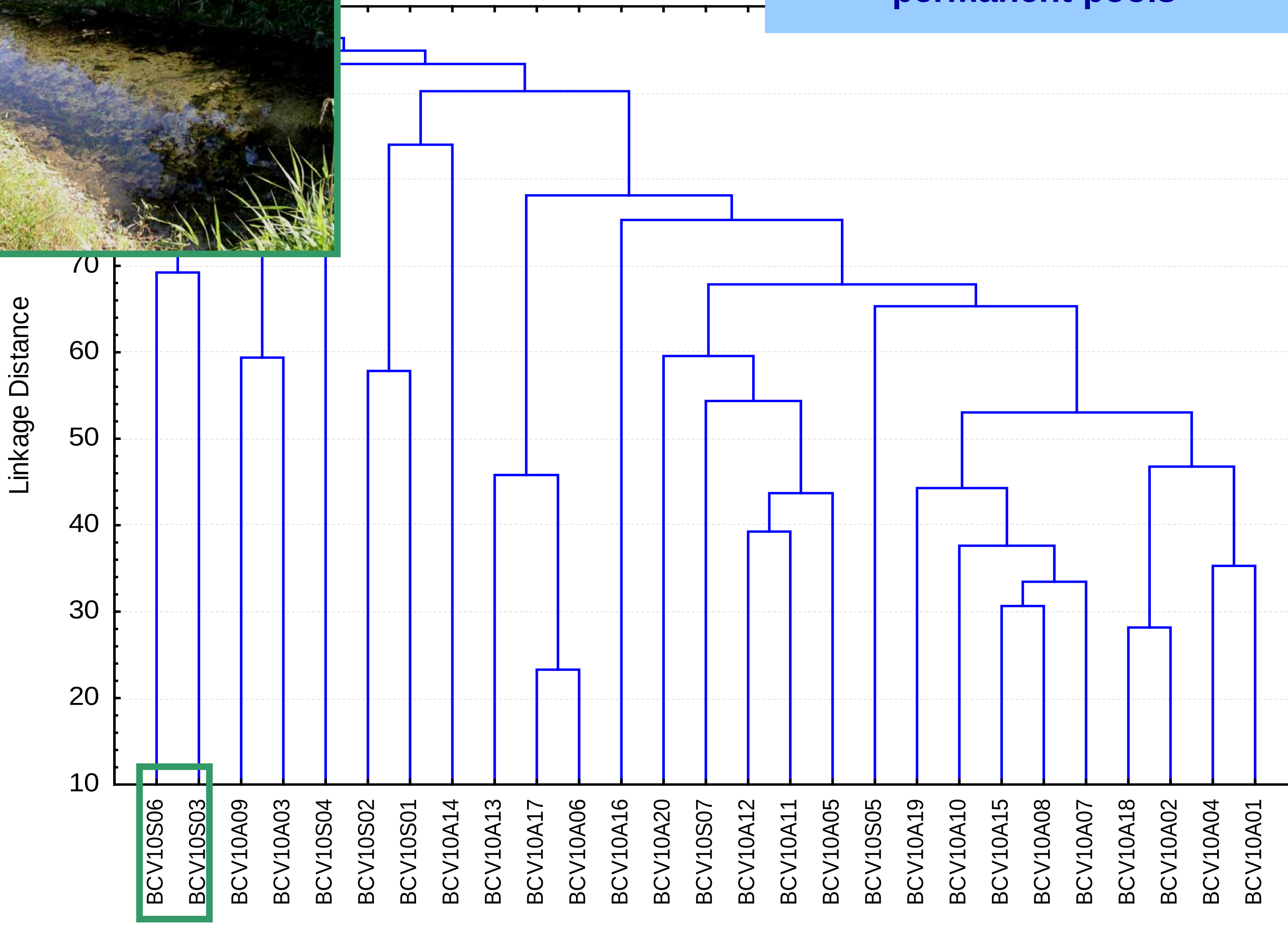
MDS (Bray-Curtis dissimilarity)







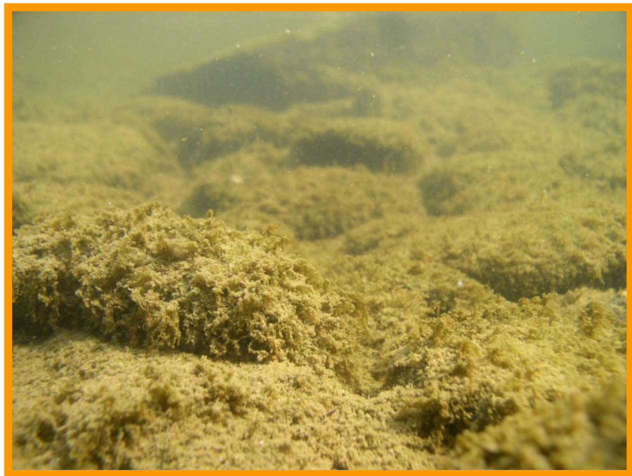
side arms
groundwater inflow
permanent pools

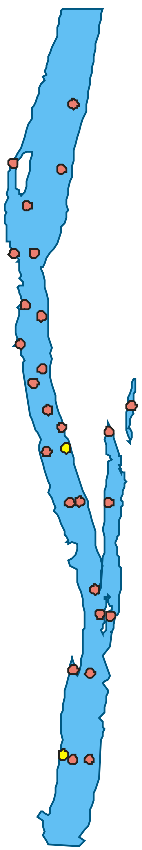


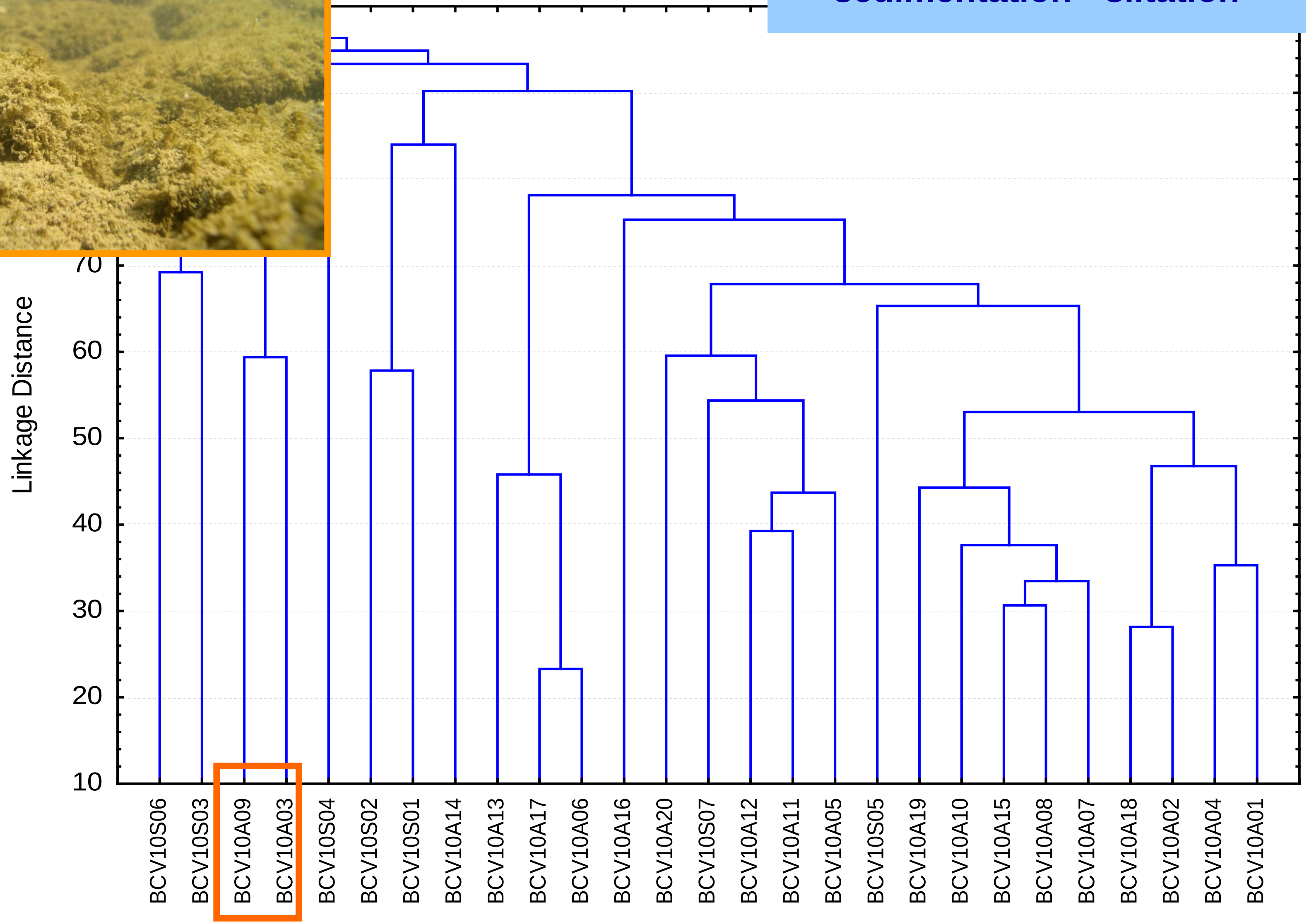
Caenis spp. (25 000 ind/m^2)

high density

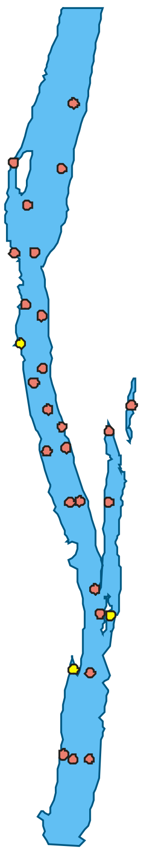
sedimentation - siltation

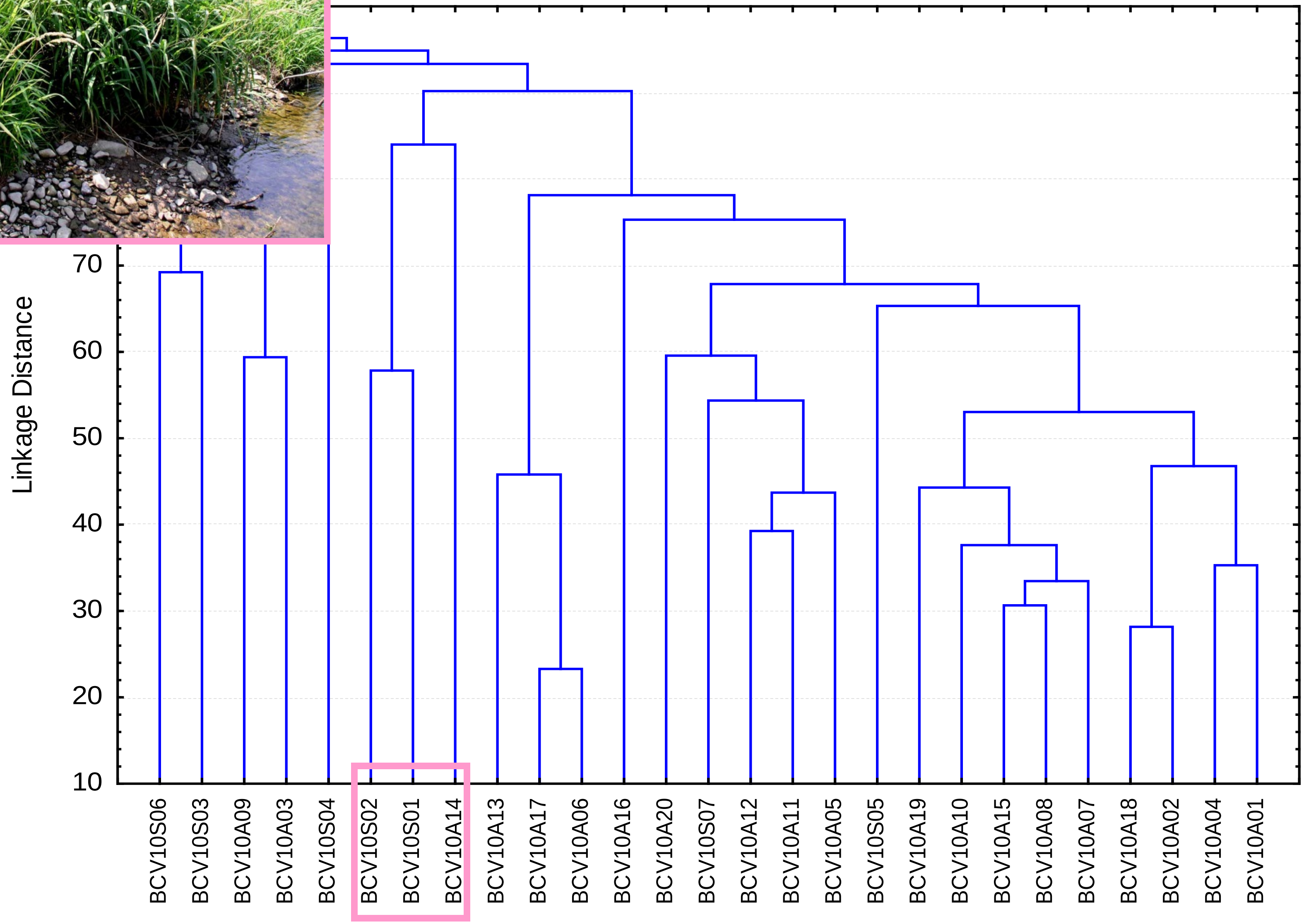






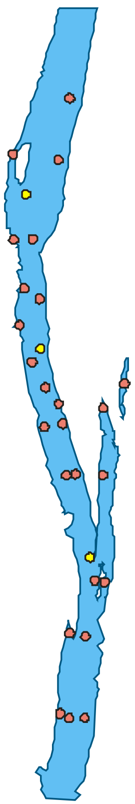
marginal habitats with LPTP

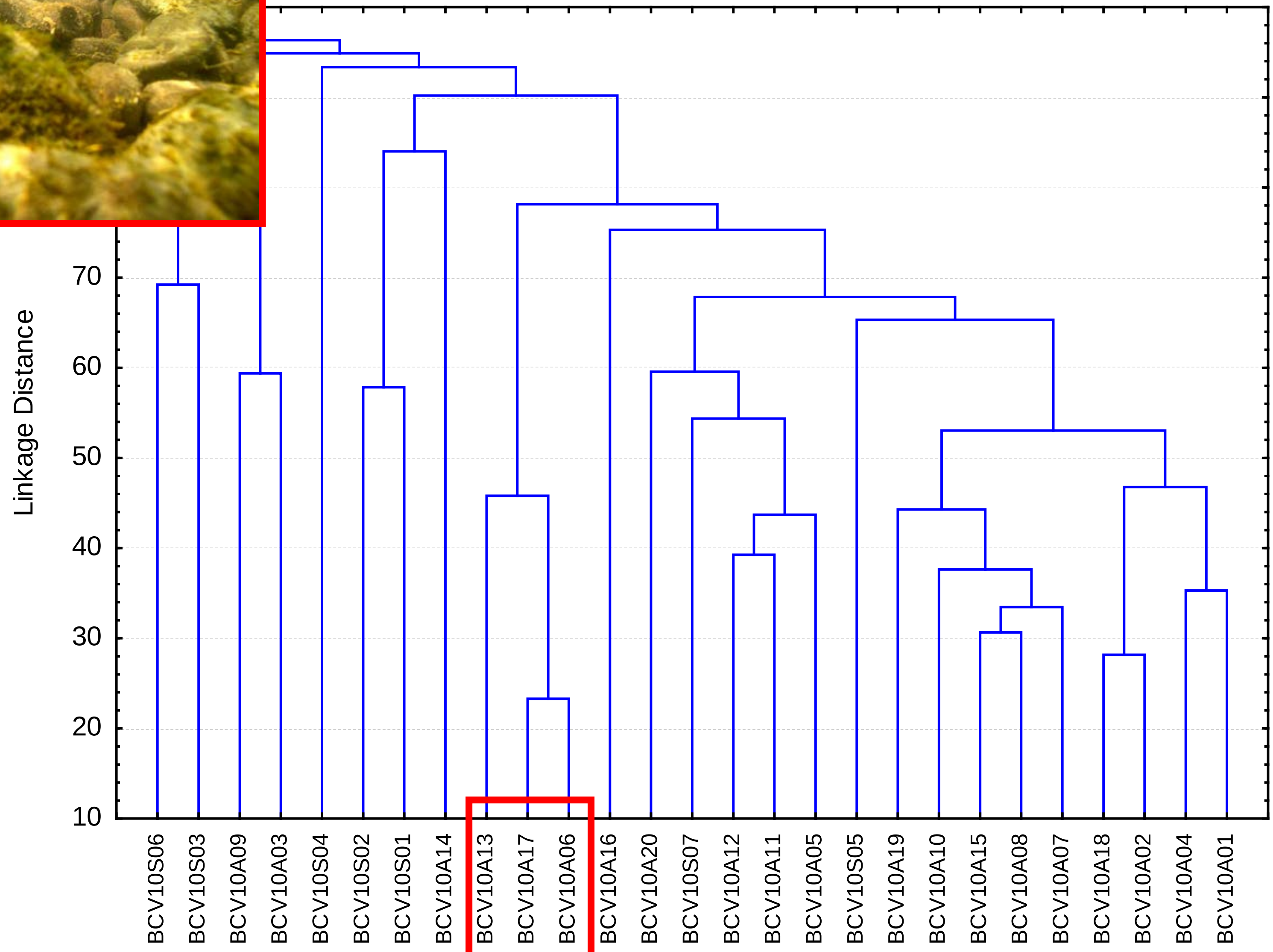




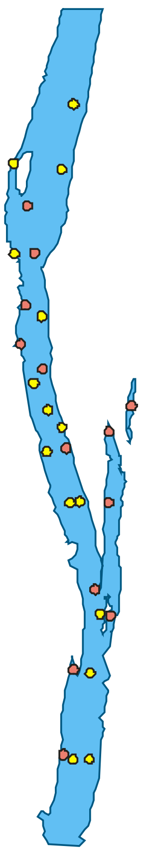
Froude number > 0.4

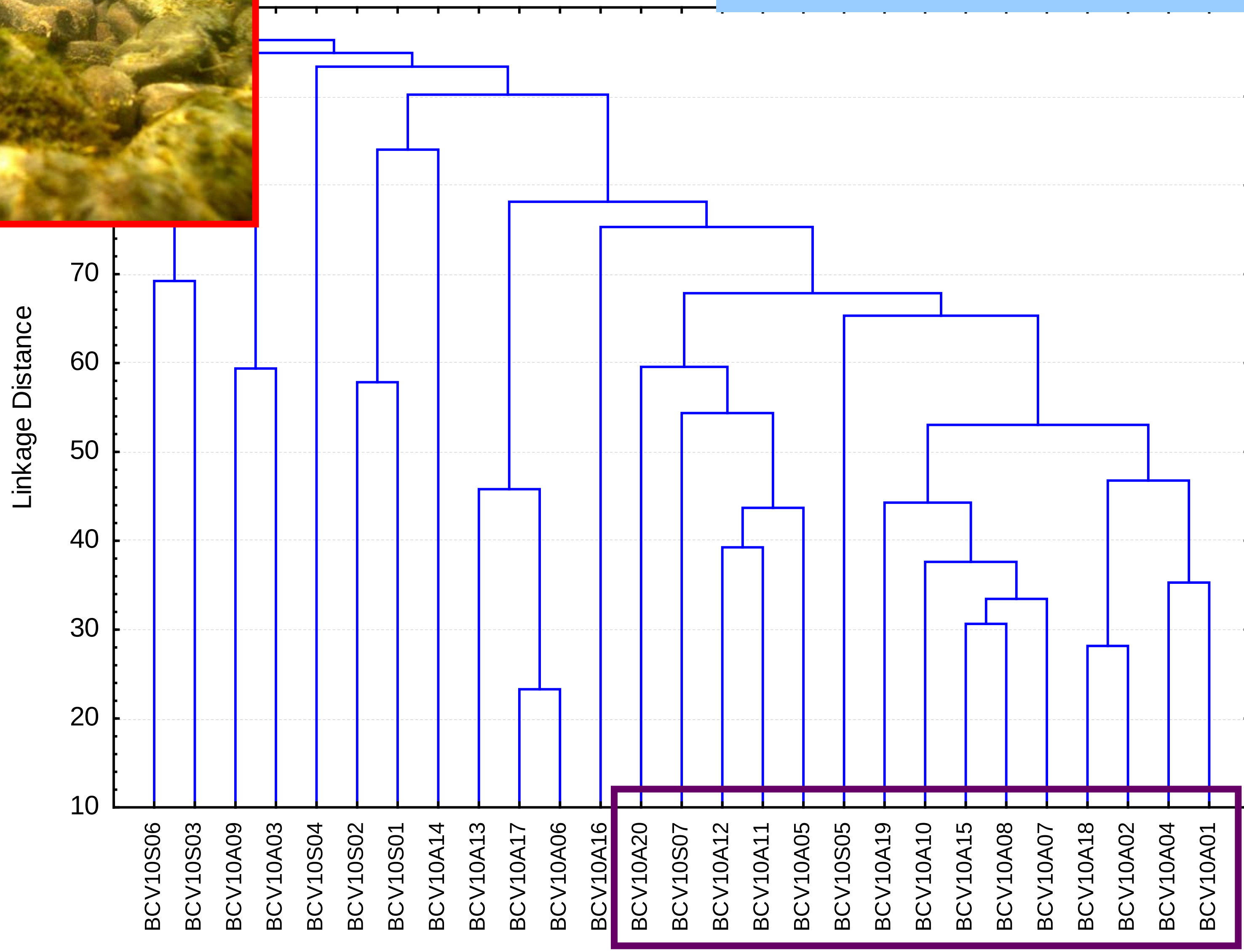
Current velocity 0.4-0.8

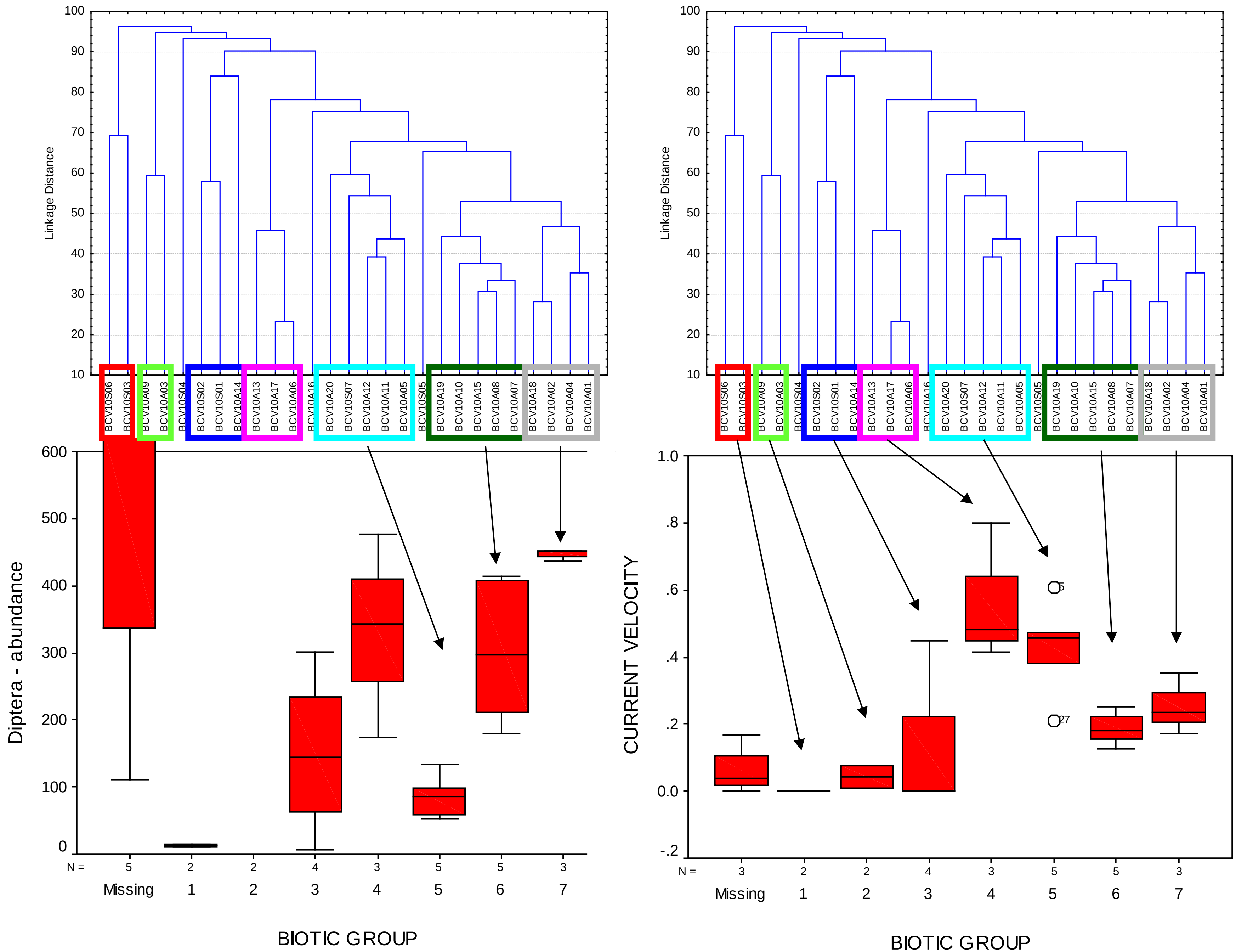




mesolithal covered by algae
run/pool
predominantly mid-channel







Linkage Distance
BCV10S06
BCV10S03
BCV10A09
BCV10A03
BCV10S04
BCV10S02
BCV10S01
BCV10A14
BCV10A13
BCV10A17
BCV10A06
BCV10A16
BCV10A20
BCV10S07
BCV10A12
BCV10A11
BCV10A05
BCV10S05
BCV10A19
BCV10A10
BCV10A15
BCV10A08
BCV10A07
BCV10A18
BCV10A02
BCV10A04
BCV10A01
Diptera - abundance
CURRENT VELOCITY
N =
Missing
BIOTIC GROUP

3. HYDRAULICKÉ PARAMETRY

- prostorové aspekty (podélný profil, v korytě, mikrohabitaty)
- časová dynamika (nízký/vysoký průtok)
- procesy (výměny plynů, látek, hmoty)
- biota (distribuce, adaptace)

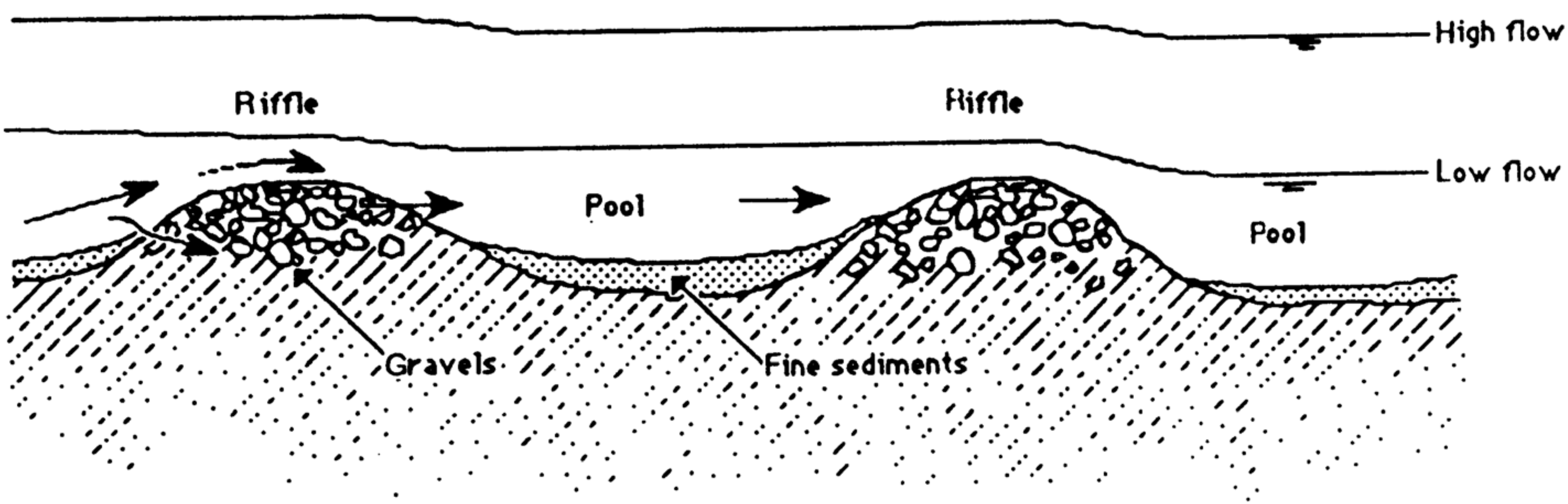
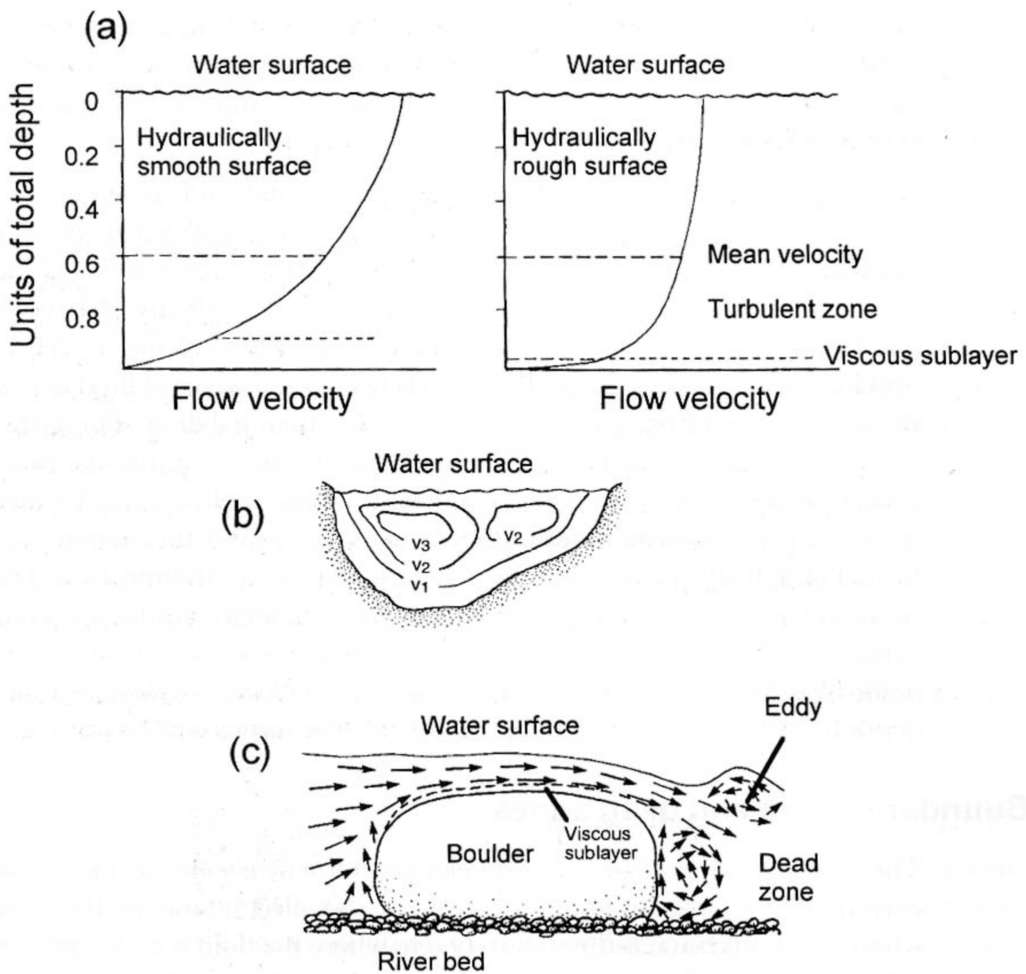


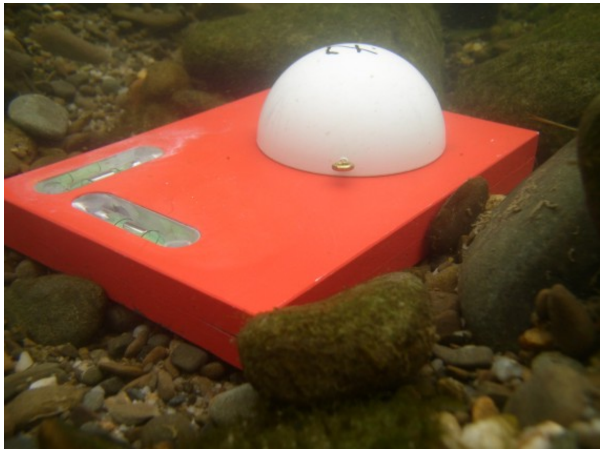
Figure 7.12. Pool–riffle sequences at low and high flow

Fig. 3.7 Velocity gradients in a stream. (a) Vertical gradients over hydraulically smooth and rough substrates (modified from Hynes, 1970, and Gordon *et al.*, 1992). (b) A transverse section through a smooth channel showing velocity contours (v_3 high, v_1 low velocity) (modified from Newson, 1994). (c) Distribution of currents around a boulder (modified from Maitland, 1990).



3. HYDRAULICKÉ PARAMETRY

rychlost proudění



typologie proudění

Froudeho číslo

- výpočet založený na měření hloubky a rychlosti proudění
- určení typu proudění na základě měření fyzikálních veličin (riffle, run, pool) /Jowet 1993/

$$Fr = \frac{v}{\sqrt{gD}}$$

v ... water velocity ($m.s^{-1}$)
g ... acceleration due to gravity ($m.s^{-2}$)
D ... hydraulic depth (m)

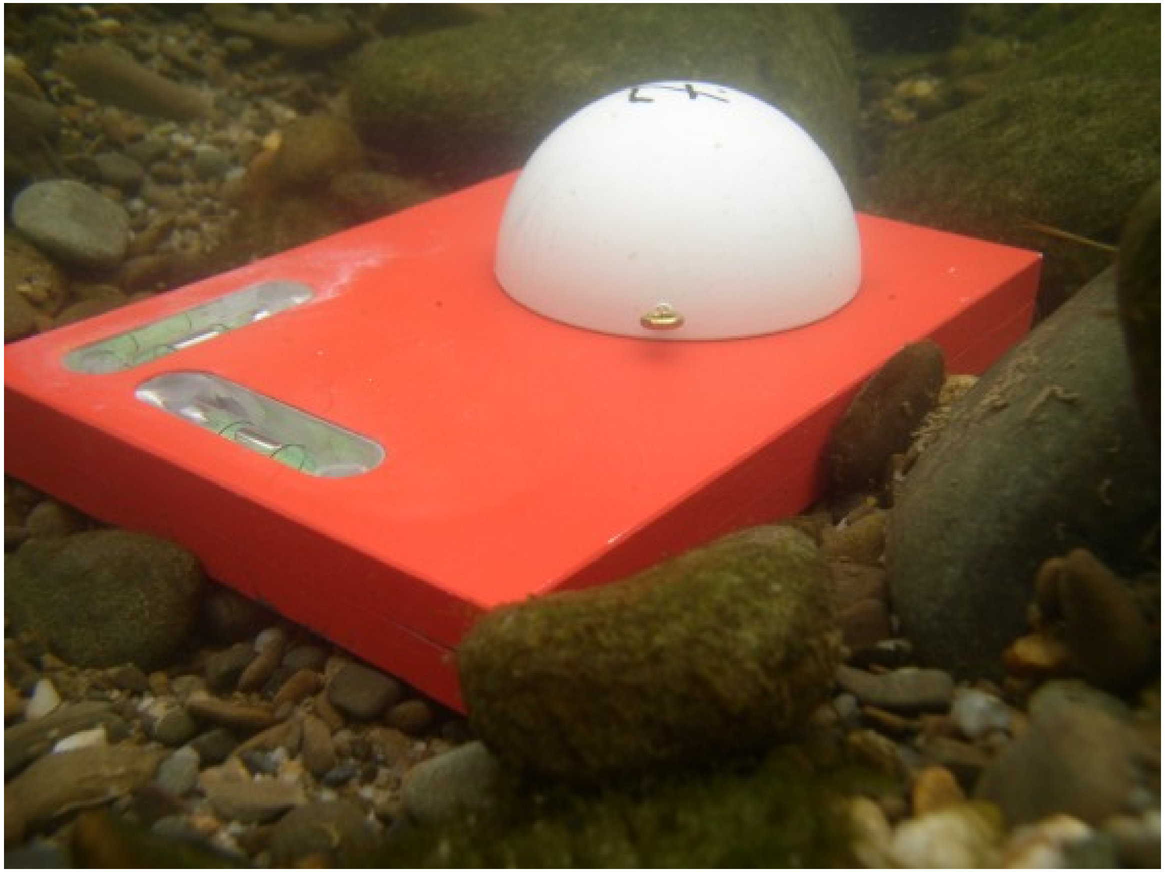
SHARE STRESS

FST polokoule (Statzner & Müller, 1989; Statzner 1991)

$$\mathrm{Re} = \frac{VL\rho}{\mu}$$

$$\mathrm{Re} = \frac{VL}{v}$$

V ... water velocity (m.s^{-1})
L ... some characteristic length (m)
ρ ... fluid density (kg.m^{-3})
μ ... dynamic viscosity (N.s.m^{-2})
v ... kinematic viscosity (m^2.s^{-1})



drsnost dna

- **zařízení pro stanovení drsnosti dna (Ks = průměr(SD v řadách*2)**
- **Winget (1985) kv = (5C1+3C2+C3)/9**

C=1 for <0.3 cm; C=2 for 0.3-3 cm; C=3 for 3-30 cm; C=4 for >30 cm

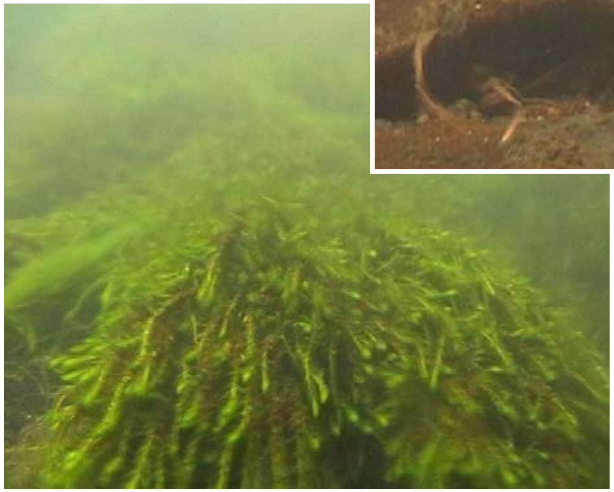
C1 ... nejvíce zastoupený typ substrátu

C2 ... druhý nejvíce zastoupený typ substrátu

C3 ... třetí nejvíce zastoupený typ substrátu

4. SUBSTRÁT

- faktory ovlivňující vlastnosti substrátu
- minerální substrát
- biotické substráty
- vztah bioty k substrátu



SUBSTRÁT

- **armouring** – hrubější substrát na povrchu chrání před erozí níže uložené jemnější vrstvy
- **imbrication** – částice (diskovitý tvar) jsou naskládány na sebe

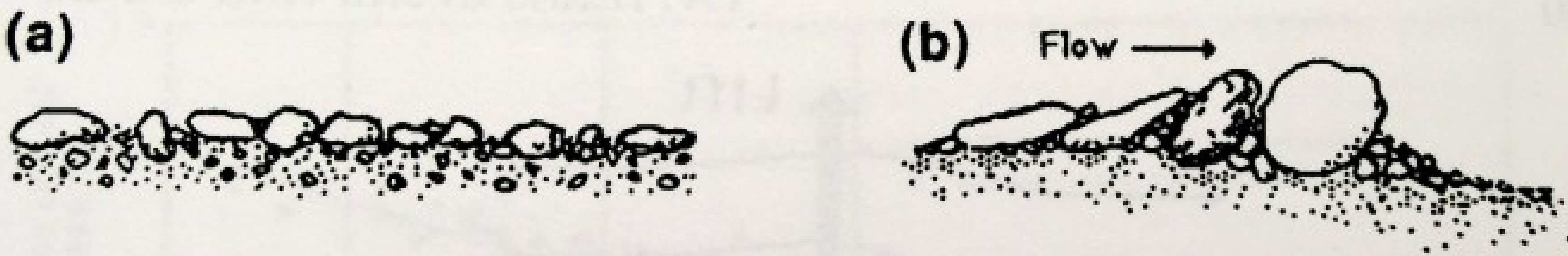


Figure 7.16. Arrangement of surface bed materials: (a) armour layer over finer subsurface materials and (b) imbrication of disc-shaped particles

Gordon, 1992: Stream hydrology, An introduction for ecologists

4. SUBSTRÁT

minerální

Plošné zastoupení typů substrátu (krok 5%; <5% „+“)

Minerální substráty:	%
HP - hygropetrické habitaty	
MG - megalithal (>40 cm)	
MK - makrolithal (20-40 cm)	
MS - mesolithal (6-20 cm)	
MI - mikrolithal (2-6 cm)	
AK - akal (2 mm - 2 cm)	
PS - psamal/psamopelal (6 µm - 2 mm)	
AG - argyllal (<6 µm)	

substrát dna	mm	%
skalnaté podloží		
balvany	nad 256	
kameny	64 - 256	
hrubý štěrk	16 - 64	
štěrk	2 -16	
písek	0,1 - 2	
bahno	pod 0,1	
jíl		
antropogenní úprava dna		
	Σ	100%
úpr. dna překryta nánosy		
ø mocnost nánosu (cm)		

4. SUBSTRÁT

biotické

Biotické substráty:	%
AL - makroskopické řasy	
AS - mikroskopické řasy	
MF- makrofyta	
LPTP - živé části terestrických rostlin	
XY- xylal	
CPOM - hrubá partikulovaná organická hmota	
FPOM - jemná partikulovaná organická hmota	
BC - bakteriální nárosty (sapropel)	

biotické mikrohabitaty	%
vláknité řasy zelené	
hnědé povlaky rozsivek	
ruduchy	
sinice	
mechorosty	
vyšší rostliny	
xylal	
CPOM	
FPOM	
bakterialni nárosty	

SUBSTRÁTOVÉ PREFERENCE

- fytofilní
- xylofilní
- litofilní
- psamofilní
- pelofilní

Table 7.4 Some general categories of benthic insects based on substrate preference

Substrate Type	Faunal Category
Hydrophytes	Phytophilous
Wood	Xylophilous
Stones	Lithophilous
Gravel	Psephophilous
Sand	Psammophilous
Mud	Pelophilous

Eukiefferiella claripennis

Zkratka	Typ	Hodnota	Poznámka
hpe	mikrohabitat: pelál	0	Jemné bahnité sedimenty, velikost zrn menší než 0,063 mm.
har	mikrohabitat: argylál	0	Jíl, hlína, velikost zrn menší než 0,063 mm.
hps	mikrohabitat: psamál	0	Písek, velikost zrn 0,063-2 mm.
hak	mikrohabitat: akál	0	Jemný až středně zrnitý štěrk, velikost zrn 2-20 mm.
hli	mikrohabitat: litál	6	Hrubý štěrk, kameny, balvany, velikost zrn větší než 2 cm.
hph	mikrohabitat: fytál	4	Řasy, mechy a makrofyta včetně živých částí suchozemských rostlin.
hpo	mikrohabitat: POM	0	Partikulovaná organická hmota, hrubá (CPOM) a jemná (FPOM), dřevní zbytky.
hot	mikrohabitat: jiný	0	

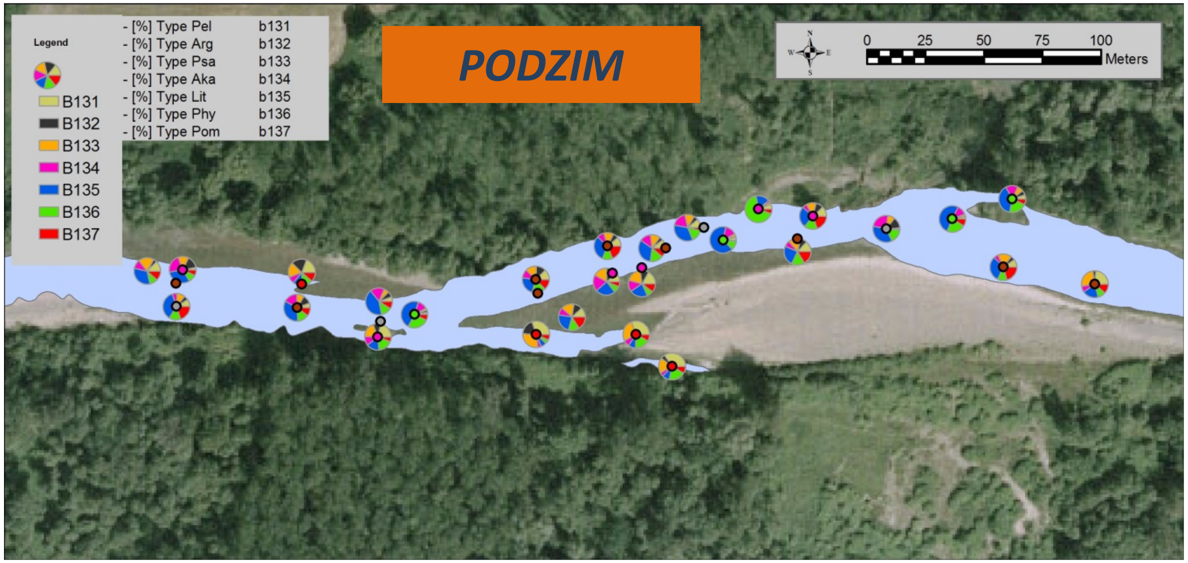
SEZÓNNÍ ZMĚNY HABITATŮ

SEZÓNNÍ PROJEVY BIOTY

substrátové preference

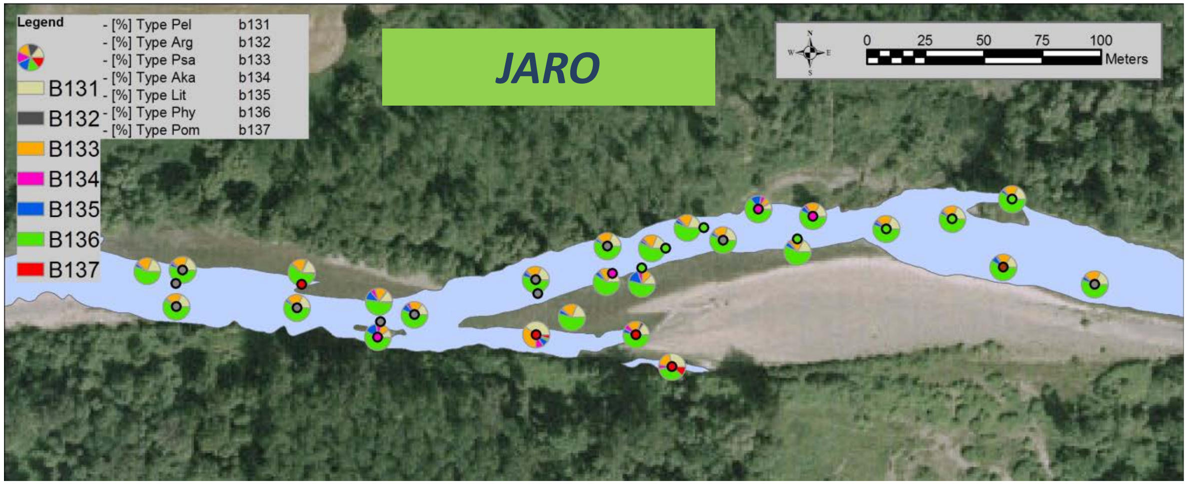
podzim

- větší diverzita SP
- převaha lithal (kamenitý substrát)



jaro

- převaha phytal (řasy a makrofyta)
- homogenita napříč habitaty



4. SUBSTRÁT

- stanovení hloubkové distribuce frakcí a množství organické hmoty (bioty)
- freeze-core

5. TRANSPORT SEDIMENTŮ

- faktory ovlivňující transport sedimentů
- vliv stability substrátu na biotu

Tabulka 12

Kritická hodnota unášecí rychlosti částic ($cm . s^{-1}$) v čisté a kalné vodě (podle Schmitze, 1961)

Částice dna	Čistá voda	Zakalená voda
jemnozrnná zemina	30	50
písčitá zemina	30	50
jíl	60	100
jemný písek	20	30
hrubý písek	30–50	45–70
hrubý štěrk	100–140	140–190
kamení	170	180

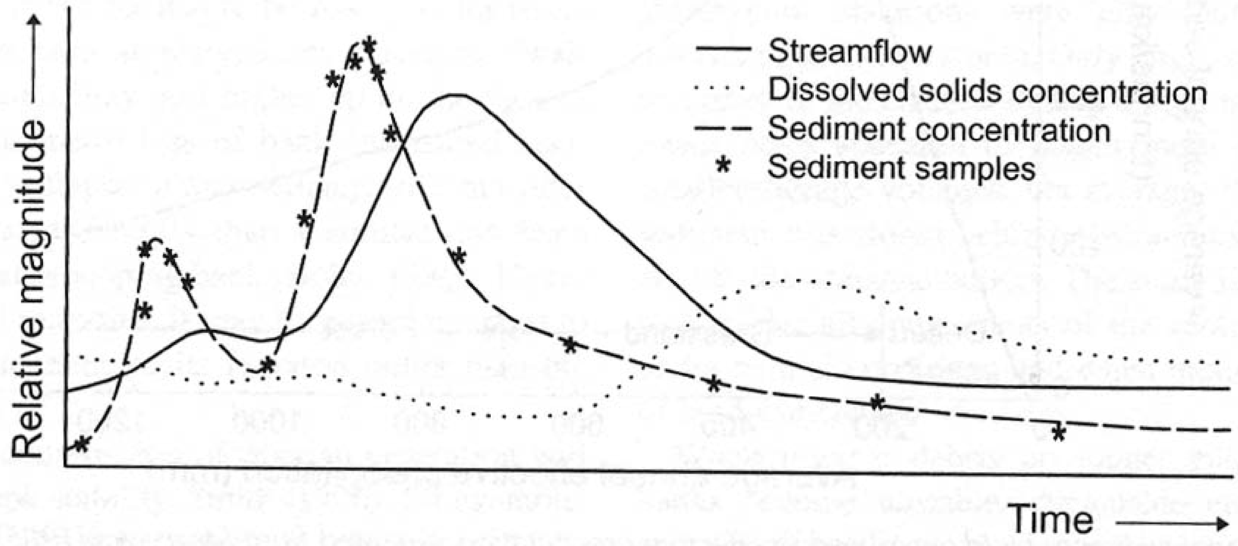
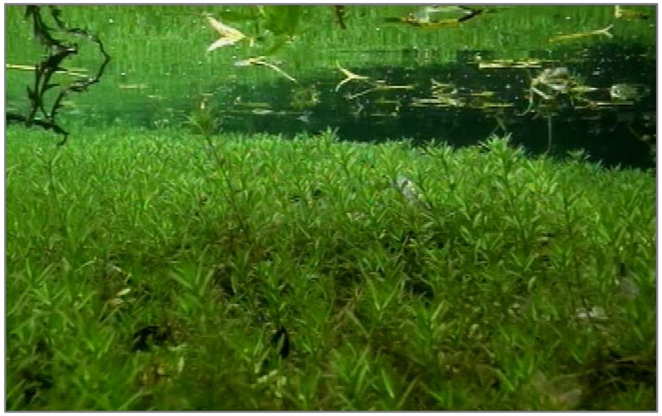


Figure 7.21. Generalized graphs showing the change in streamflow, sediment load and dissolved load, and spacing of sediment samples during a runoff event

6. EKOLOGICKÉ PROCESY
(VAZBA NA HYDROMORFOLOGII)

přehled

- 4 typy říčních habitatů
- specifické taxony a vlastnosti společenstev

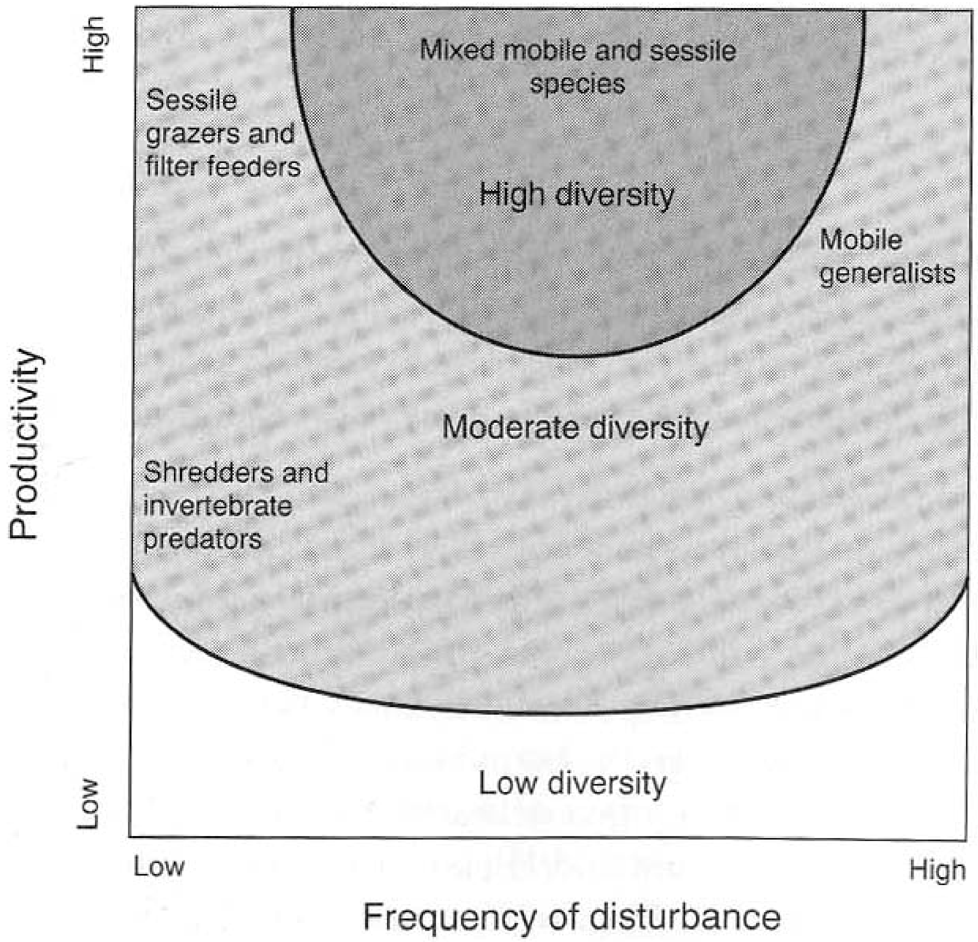


Fig. 3.13 A postulated relationship between frequency of disturbance and productivity and some structural features of the benthic invertebrate communities of riffles. (After Hildrew and Townsend, 1987.)

6. VAZBA BIOTY NA PRŮTOKOVÝ REŽIM

rychlost proudění

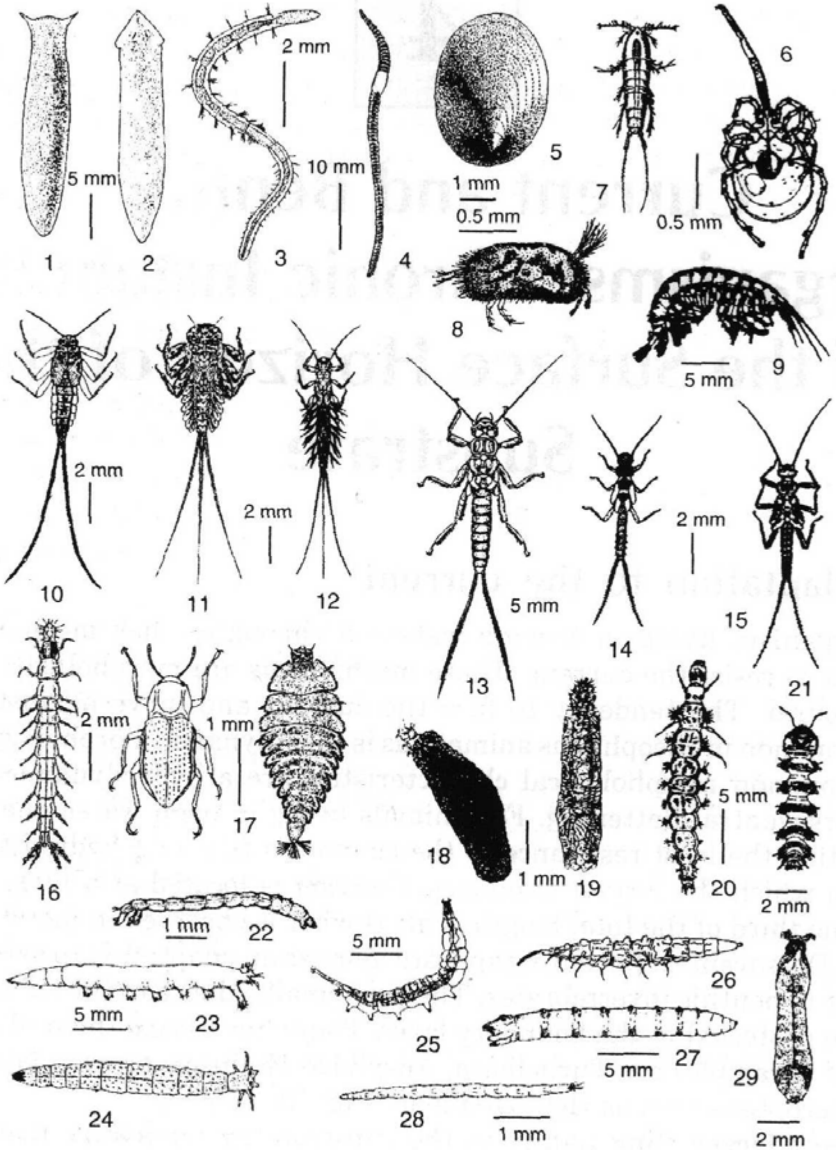
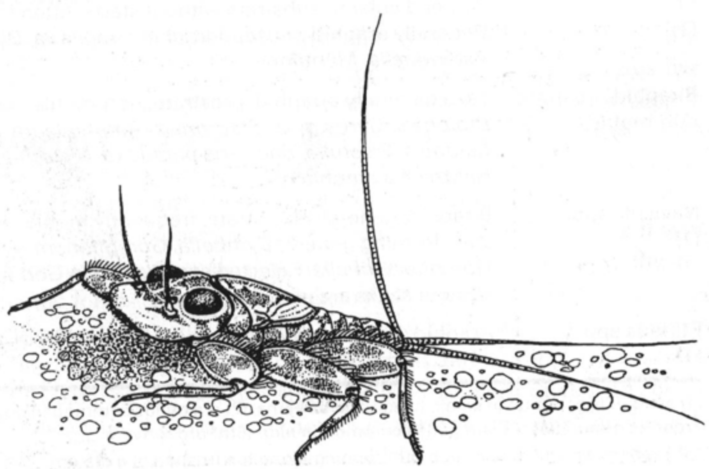


Fig. 13. Types of invertebrates characteristic of running waters. 1. *Polycelis felina*, Turbellaria. 2. *Dugesia gonocephala*, Turbellaria. 3. *Nais variabilis*, Oligochaeta. 4. *Eiseniella*, Oligochaeta. 5. *Ancylus fluviatilis*, Mollusca. 6. *Pseudotorrenticola rhynchota*, Hydrachnellae. 7. *Canthocamptus*, Copepod Harpacticide. 8. *Herpetocypris*, Ostracoda. 9. *Gammarus pulex*, Amphipoda. 10. *Baetis fluminum*, Ephemeroptera. 11. *Ecdyonurus*, Ephemeroptera. 12. *Habroleptophlebia*, Ephemeroptera. 13. *Perlodes*, Plecoptera. 14. *Leuctra*, Plecoptera. 15. *Nemoura*, Plecoptera. 16. *Orectochilus*, Coleoptera. 17. *Elmis* larva and adult, Coleoptera. 18. *Hydroptila*, Trichoptera. 19. *Pticolepus*, Trichoptera. 20. *Rhyacophila*, Trichoptera. 21. *Liponeura*, Diptera Blephariceridae. 22. Chironominae, Diptera. 23. Hemerodrominae, Diptera. 24. Tipulidae, Diptera. 25. Limnobiidae, Diptera. 26. Athericidae, Diptera. 27. Rhagionidae, Diptera. 28. Ceratopogonidae, Diptera. 29. *Simulium*, Diptera Simuliidae (Angelier, 1950; Brocher, 1913; Pattee, 1981; Richoux, 1982; Tachet et al., 1987).

6. VAZBA BIOTY NA PRŮTOKOVÝ REŽIM

- tvar těla (hydrodynamický – kapkovitý profil Beatis, „Přísavka“ Heptageniidae, přísalky, muchničky)
- velikost těla – malé organismy mají nízké Reynoldsovo číslo (pakomáři)
- háčky, výběžky (Rhyacophila)
- produkce vláken (chrostíci, muchničky, pakomáři)
- sítě chrostíků

Fig. 5.3 A nymph of the *Ecdyonurus venosus* group. The lowered positioning of its head shield and use of the femura as spoilers decreases lift.



6. VAZBA BIOTY NA PRŮTOKOVÝ REŽIM

rychlost proudění

- limnofilní
- rheofilní

Table 2. Maximum velocity of current at which some invertebrate species remain fixed (Dittmar, 1955)

	Max. velocity (m/s)
Liponeura cinarescens, Diptera	< 3
Simulium sp., Diptera	2.8
Rhyacophila sp., Trichoptera	1.22
Ancylus fluviatilis, Mollusca	1.18
Rhitrogena semicolorata, Ephemeroptera	0.96
Dugesia gonocephala, Turbellaria	0.93
Baetis sp., Ephemeroptera	0.84
Isoperla oxylepis, Plecoptera	0.60
Ecdyonurus venosus, Ephemeroptera	0.57
Radix ovata, Mollusca	0.48

6. VAZBA BIOTY NA PRŮTOKOVÝ REŽIM

rychlost proudění

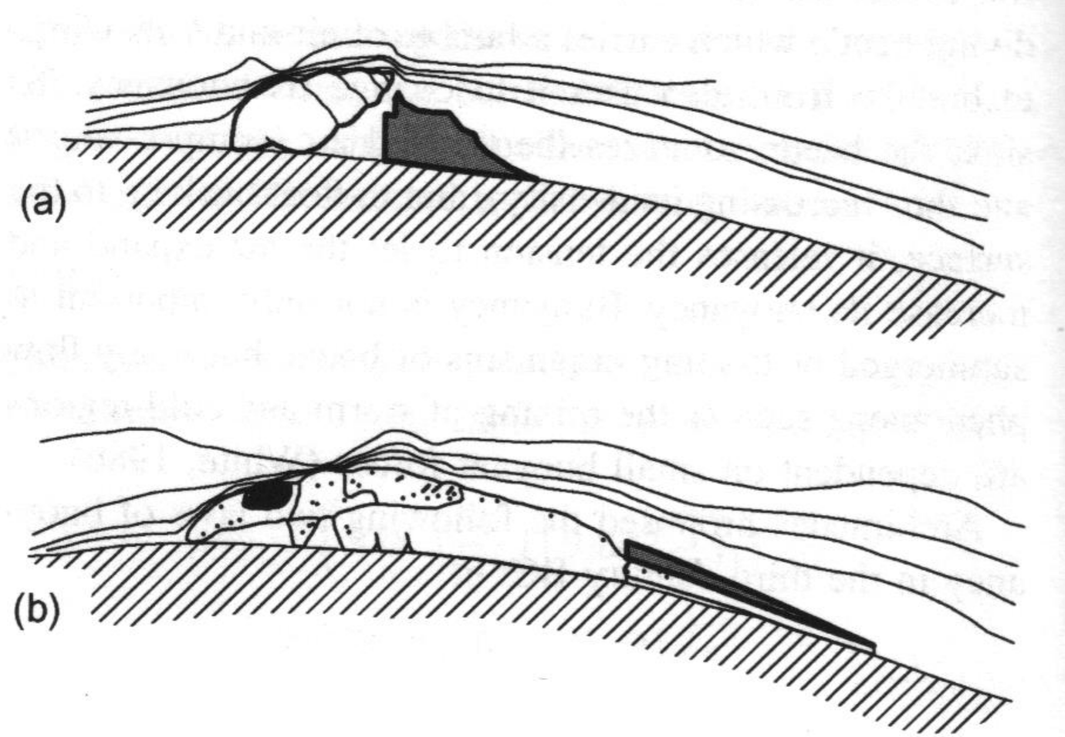


Figure 6.4. *Isovels (lines of equal velocity) around (a) water snail (Potamopyrgus jenkinsi) and (b) mayfly nymph (Ecdyonurus cf. venosus), shown as a schematic without legs. Flow is from left to right. Free stream velocity is about 0.18 m/s in both figures, and shaded areas represent regions of zero velocity. Re-drawn from Statzner and Holm (1989, 1982), by permission of Springer-Verlag and B. Statzner*

Oecologia (1989) 78:145–157

Oecologia
© Springer-Verlag 1989

Original papers

Morphological adaptation of shape to flow: Microcurrents around lotic macroinvertebrates with known Reynolds numbers at quasi-natural flow conditions

B. Statzner[1] and T.F. Holm[2]

Makrozoobentos - preference pohybu (IS ARROW)

Zkratka	Typ	Hodnota	Poznámka
lss	plovoucí/klouzající	0	Druhy pohybující se po povrchu vody.
lsd	plovoucí/potápějící se	0	Druhy plovoucí ve volné vodě.
lbb	hrabající/vrtající	0	Druhy osídlující jemné sedimenty, v nichž si mohou hloubit chodbičky.
lsw	lezoucí/kráčející	10	Druhy osídlující povrch substrátů.
lse	přirostlí či částečně přirostlí	0	Druhy nepohyblivé či schopné pohybu pouze v omezené míře.
lot	pohybující se jiným způsobem	0	

6. VAZBA BIOTY NA PRŮTOKOVÝ REŽIM

pohyb

Table 5.2 Modes of existence of lotic animals. (Adapted from Cummins and Merritt, 1996. From *An Introduction to the aquatic insects of North America*, (eds. R. W. Merritt and K. W. Cummins) © 1996, Kendall/Hunt Publishing Company. Used with permission.)

Category	Description	Examples
Skaters	Adapted for life on the water surface where they feed on organisms trapped in the surface film, low-order streams or margins of high-order rivers	Water striders/pond skaters (gerrid bugs) adults and juveniles
Planktonic	Inhabiting open water, slow-flow or still, in high-order rivers	Planktonic crustaceans (Cladocera, Copepoda)
Divers	Insects adapted for swimming in slow-flowing pools, by 'rowing' with hind legs coming to surface to obtain oxygen, and often clinging to macrophytes or submerged objects	Water boatmen (Corixidae and Notonectidae) and diving beetles (Dytiscidae) (adults and juveniles)
	Semi-aquatic vertebrates; including those that forage underwater but spend most time on the water surface (birds) or land (mammals)	Diving ducks, dippers, other waterfowl, otters, mink, platypus
Swimmers	Insects adapted for 'fish-like' swimming, clinging to substrate between short bursts of swimming (height to width ratio near 1). Fully aquatic vertebrates that maintain position by swimming or using flow refuges	Streamlined mayfly nymphs (Baetidae, Leptophlebiidae), fish, lotic amphibians, reptiles
Clingers	Possess behavioural (e.g. silk nets, pads, fixed retreats) or morphological (claws, dorsoventral flattening, suckers) adaptations for attachment to substrate surfaces, or that are sessile and colonial	Net-spinning caddis larvae (*Hydropsyche*), simuliid larvae, heptageniid mayflies (*Ecdyonurus*), gastropod snails (*Ancylus*), leeches, Bryozoa, sponges
Sprawlers	Inhabit the surface of floating leaves of vascular plants or fine sediments in depositional habitats with modifications for staying on the substrate (e.g. wide bodies) and maintaining respiratory surfaces free of silt	Mayfly (Caenidae), dragonfly (Libellulidae) larvae
Climbers	Living and moving on vascular plants or detrital debris (e.g. overhanging branches, roots, and vegetation)	Damselfly (Coenagrionidae), mayfly (Ephemerellidae), midge (Chironomidae) larvae
Burrowers	Inhabiting fine sediment (and hyporheos), some constructing discrete burrows, or ingesting their way through the sediments, either very small-bodied or filiform (long and thin, e.g. cylindrical shape)	Microcrustacea (copepods, ostracods), rotifers, stonefly larvae (Leuctridae), burrowing mayfly larvae (Ephemeridae), Chironominae midge larvae, worms (Oligochaeta), bivalve molluscs (Sphaeridae, Unionidae), lampreys

tůně sekundárního koryta

šidélko ruměnné
Pyrrhosoma nymphula (V4)

uchatka toulavá
Radix labiata (V4)

VAZBA TAXONŮ NA TYPY HABITATŮ

peřeje

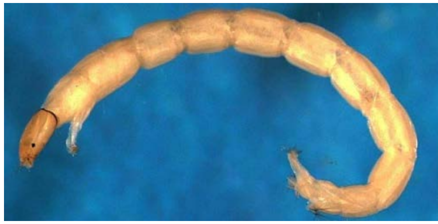
restored

Heptageniidae Gen. sp.

Baetis sp.

regulated

Limnius perrisi



Chironomidae

tišiny (hlavní koryto)

revitalizovaný

Habroleptoides confusa

Leuctra sp.

regulovaný

Simulium ornatum

VAZBA TAXONŮ NA TYPY HABITATŮ

okraj toku s vegetací (MV)

revitalizovaný

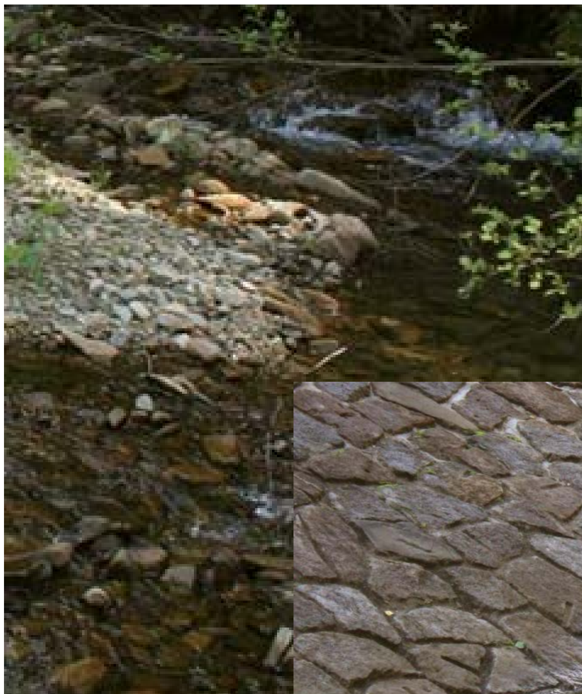
Centroptilum luteolum, Baetis sp.

Gammarus fossarum

regulovaný

Aulodrilus japonicus

okraj toku bez vegetace (MU)



revitalizovaný

Habroleptoides confusa

Gammarus fossarum

Hydropsyche sp.

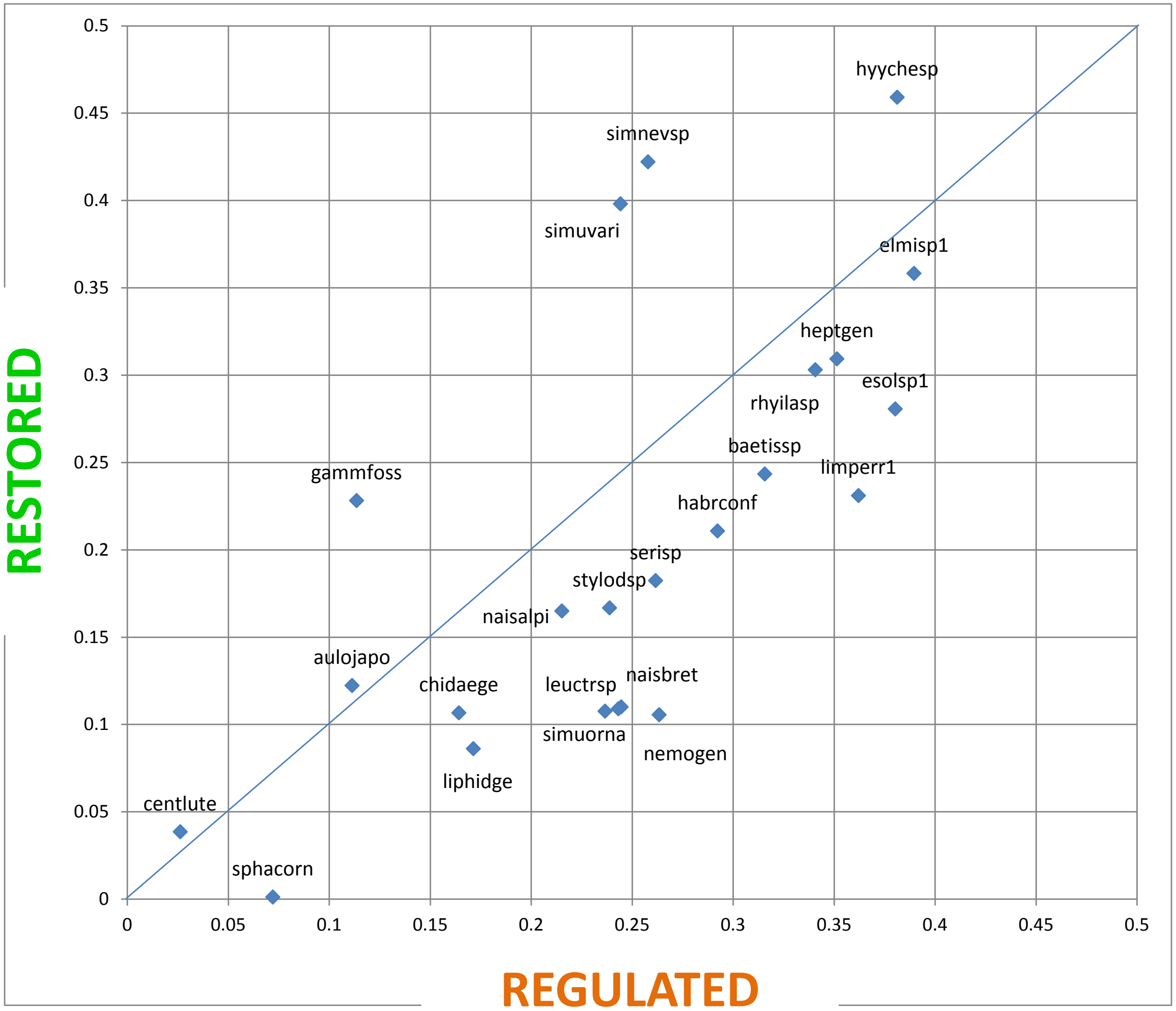
regulovaný

Simulium ornatum

ENVIRONMENTAL PREFERENCES (weighted average)

Froude number

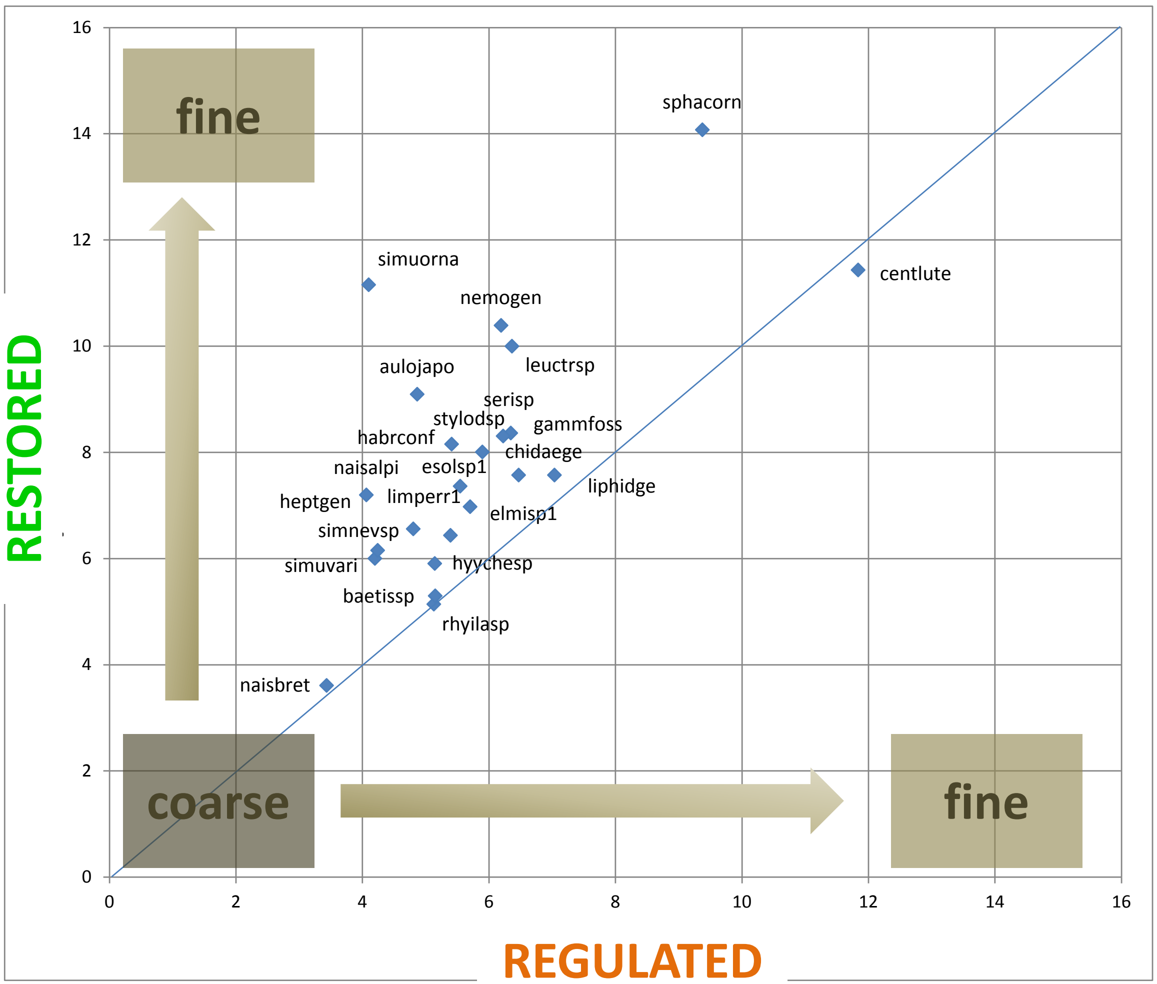
$$Fr = \frac{V}{\sqrt{gD}}$$



- hydraulic preferences of frequently occured taxa were identified
- majority of taxa preferred lower Froude number in restored stretch than in regulated

ENVIRONMENTAL PREFERENCES (weighted average)

substrate (phi+12)



- identified linkages between taxa and substrate particle size
- taxa occurred at finer substrate in restored stretch

EKOTON VODA-SOUŠ

přehled

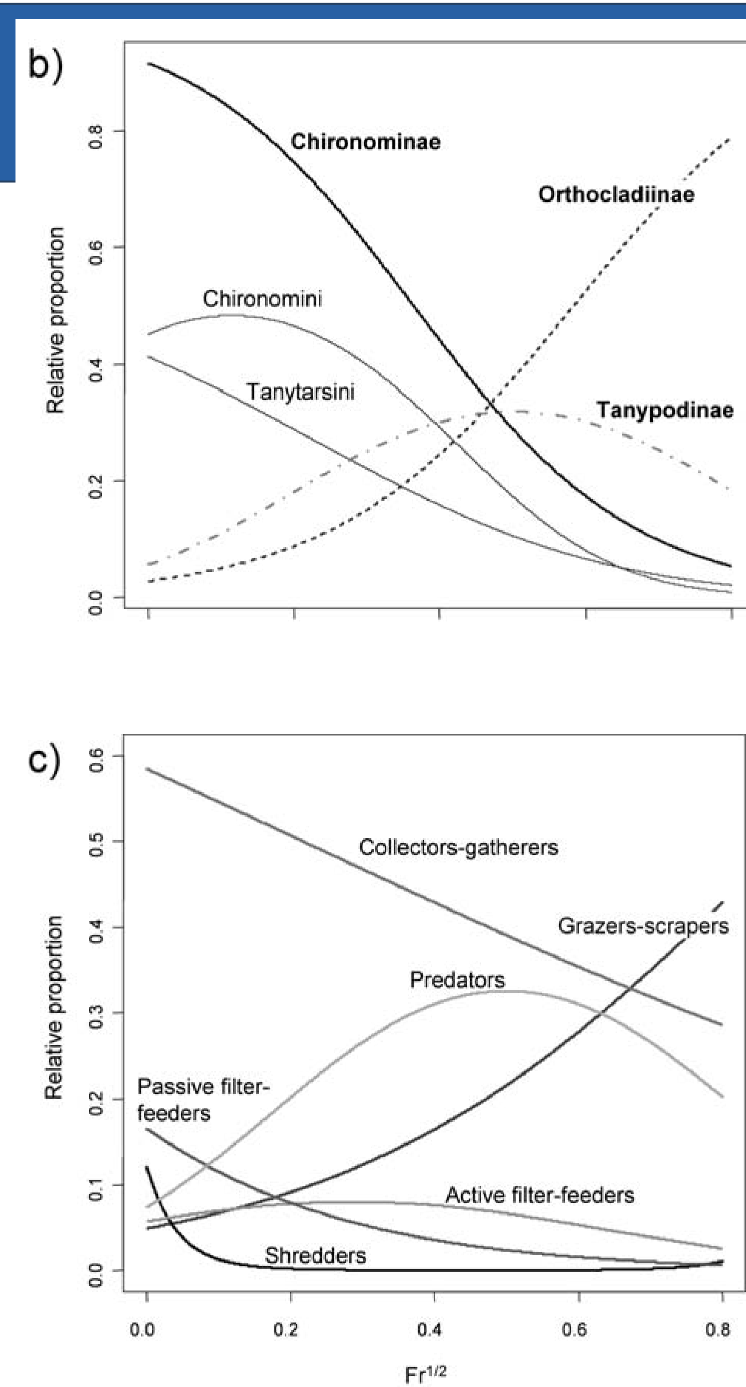
- časová dynamika
- procesy
- biota (semiterestrické)

6. VAZBA BIOTY NA PRŮTOKOVÝ REŽIM

Fundam. Appl. Limnol. Vol. 178/1, 43–57
Stuttgart, September 2010
Article

The response of chironomid assemblages (Diptera: Chironomidae) to hydraulic conditions: a case study in a gravel-bed river

Vít Syrovátka[1,2,*] and Karel Brabec[1,3]



6. VAZBA BIOTY NA PRŮTOKOVÝ REŽIM

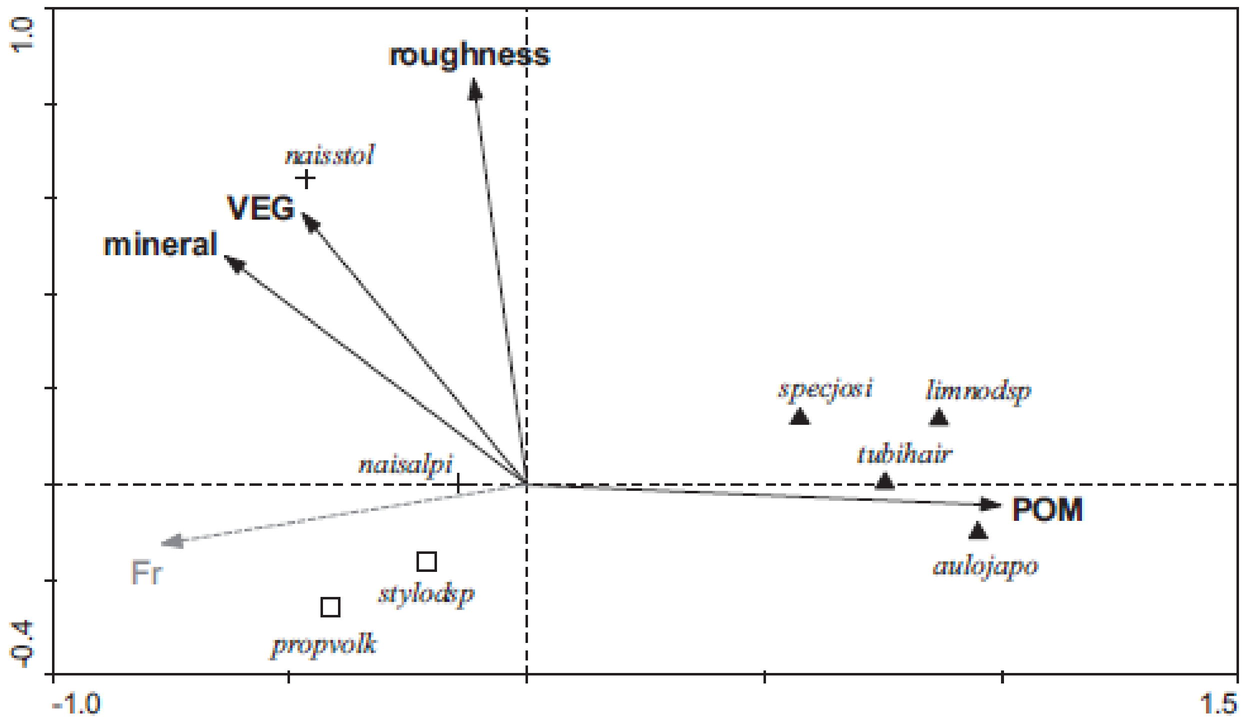
Oligochaeta

Fundamental and Applied Limnology
Archiv für Hydrobiologie
Vol. 174/1: 43–62, February 2009

The distribution of chironomid larvae and oligochaetes within a stony-bottomed river stretch: the role of substrate and hydraulic characteristics

Vít Syrovátka*, **Jana Schenková** and **Karel Brabec**[1]

Fig. 4. CCA ordination diagram (the first and second axes) showing the positions of oligochaete taxa in relation to environmental variables significantly influencing the oligochaete community structure. Only the taxa with species fit and species weight > 10 % are displayed. Froude number is displayed as a passive variable. (mineral – the category of mineral substrate grain size, POM – the category of the amount of particulate organic matter, roughness – substrate roughness, VEG – the occurrence of aquatic vegetation, Fr – Froude number, □ indicator taxa of the second community type, ▲ indicator taxa of the third community type, + other taxa).



6. VAZBA BIOTY NA PRŮTOKOVÝ REŽIM

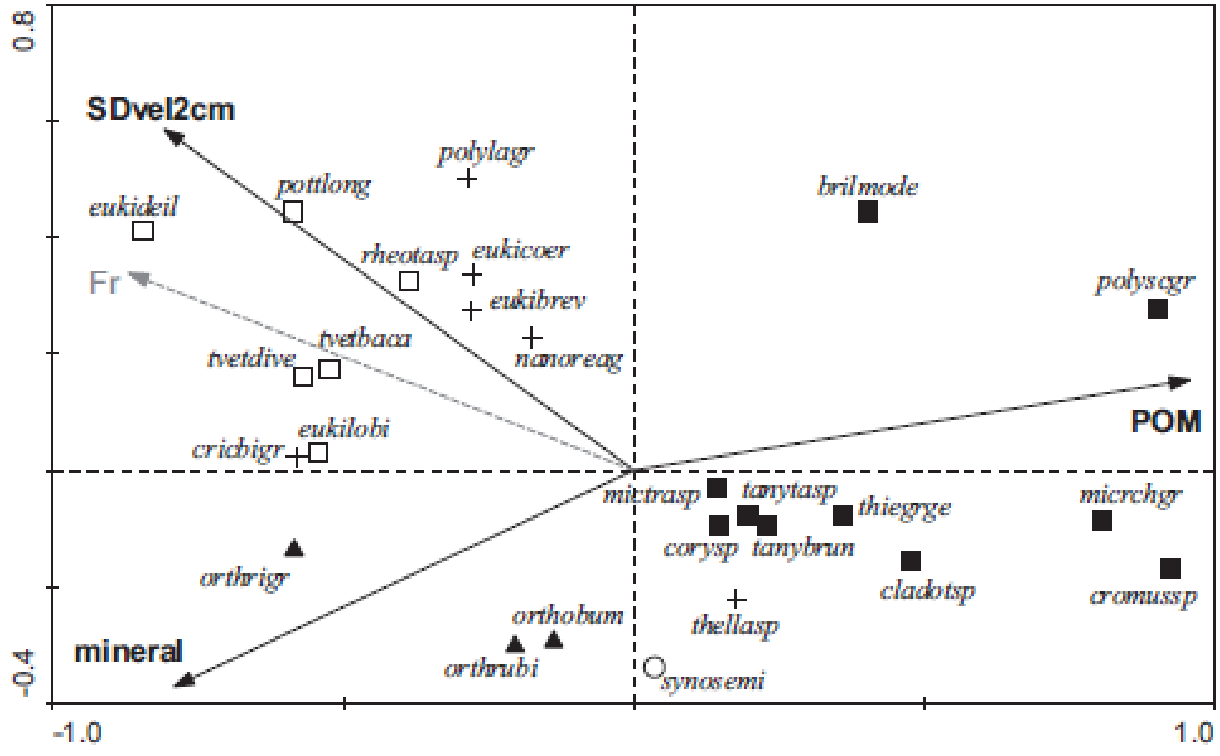
Chironomidae

Fundamental and Applied Limnology
Archiv für Hydrobiologie
Vol. 174/1: 43–62, February 2009

The distribution of chironomid larvae and oligochaetes within a stony-bottomed river stretch: the role of substrate and hydraulic characteristics

Vít Syrovátka*, Jana Schenková and Karel Brabec[1]

Fig. 7. CCA ordination diagram (the first and the second axes) showing the positions of chironomid taxa in relation to environmental variables significantly influencing the chironomid community structure. Only the taxa with species fit and species weight > 10 % are displayed. Froude number is displayed as a passive variable. (mineral – the category of mineral substrate grain size, POM – the category of the amount of particulate organic matter, SDvel2 cm – the current velocity variability 2 cm above the bottom. Fr – Froude number, ■ indicator taxa of the first community type, ○ indicator taxa of the second community type, ▲ indicator taxa of the third community type, □ indicator taxa of the fourth community type, + other taxa)



6. VAZBA BIOTY NA PRŮTOKOVÝ REŽIM

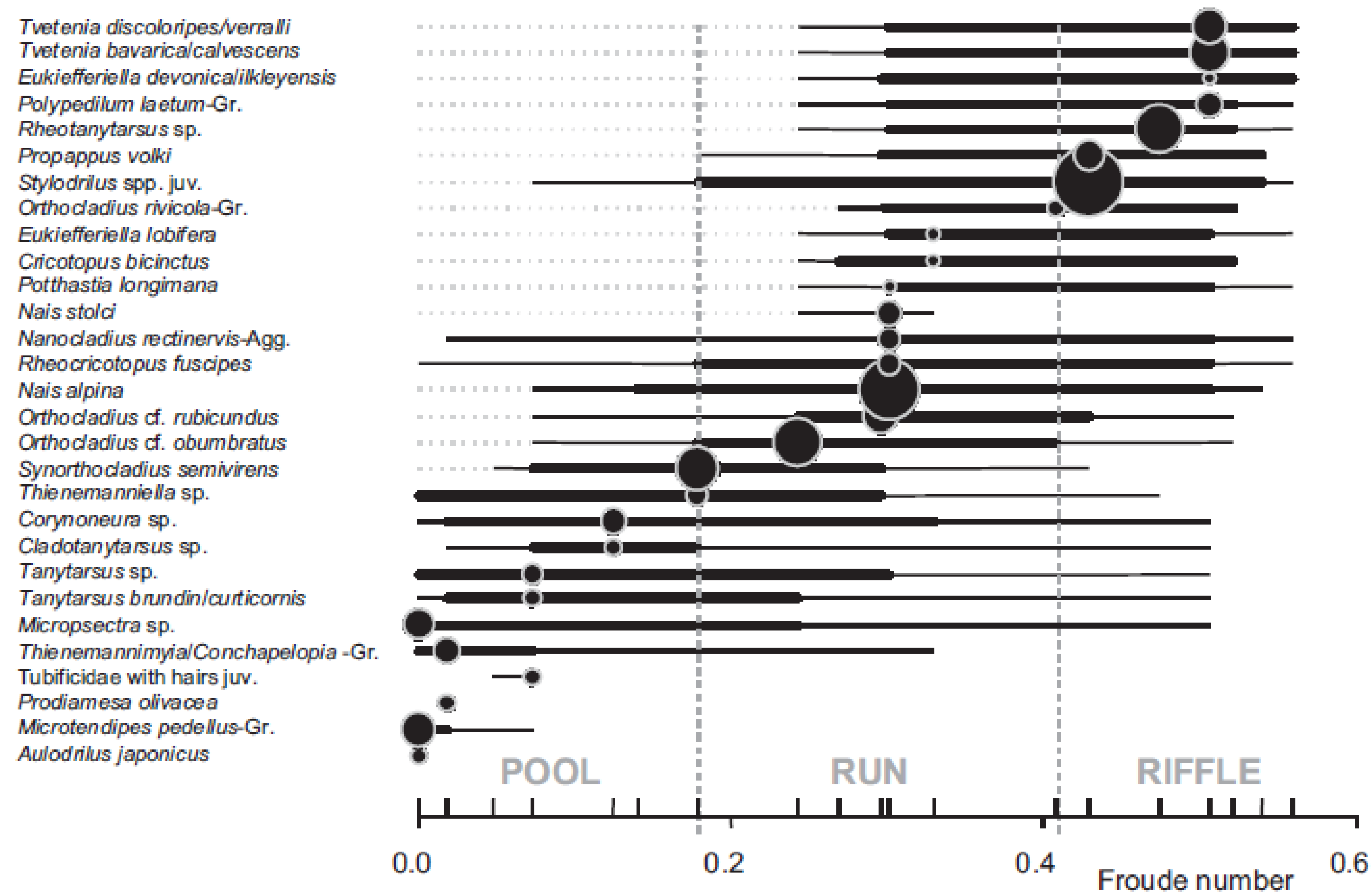


Fig. 9. Hydraulic preferences of frequent taxa. Medians (circles), lower and upper quartiles (thick lines) and 10 % and 90 % quantiles (thin lines) of Froude number are weighted by the abundances of taxa. The area of the circles reflects the total abundance of particular taxa. Tick marks pointing upwards indicate the position of the samples on the gradient of the Froude number. Pool, run and riffle habitats are identified according to Froude number (Jowett 1993).

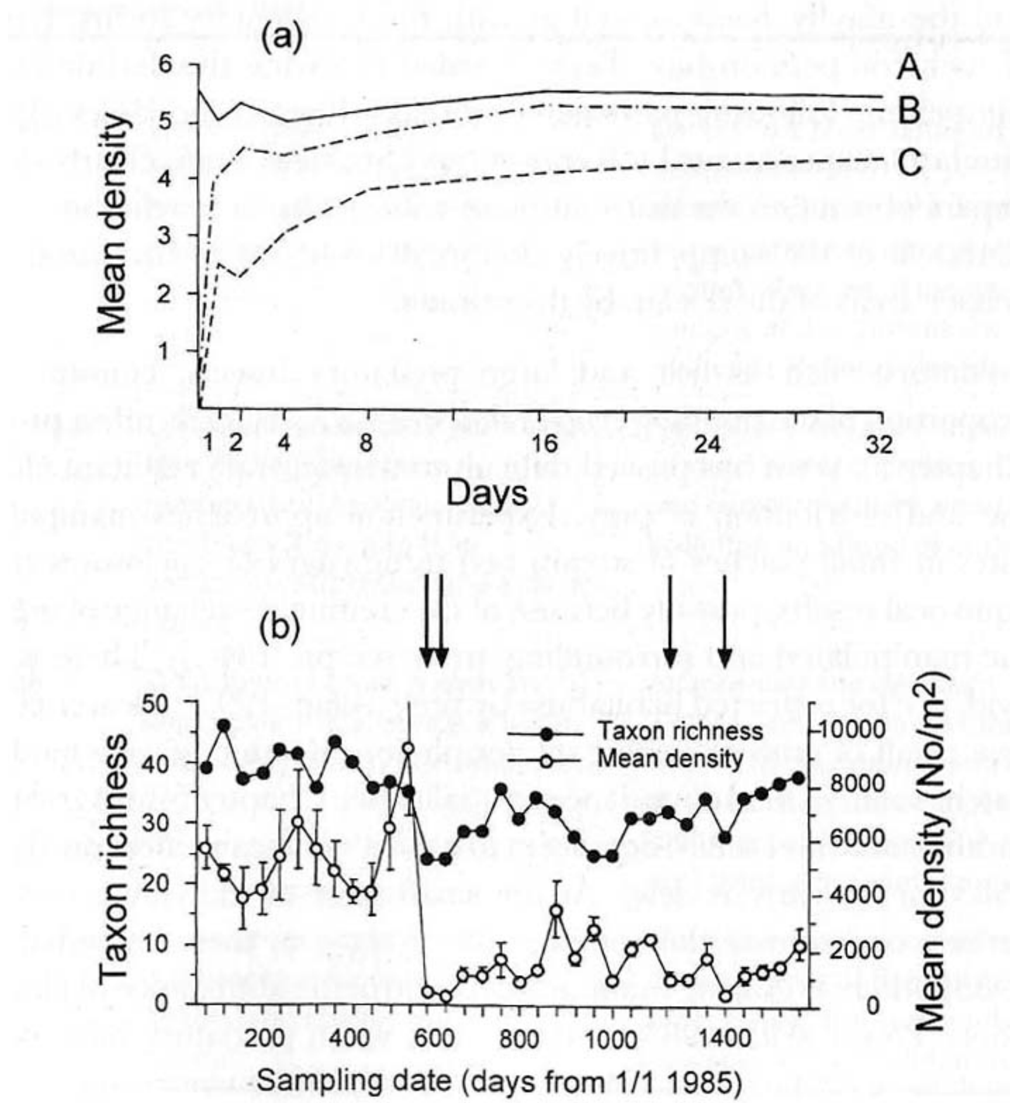
Fundamental and Applied Limnology
Archiv für Hydrobiologie
Vol. 174/1: 43–62, February 2009

The distribution of chironomid larvae and oligochaetes within a stony-bottomed river stretch: the role of substrate and hydraulic characteristics

Vít Syrovátka*, Jana Schenková and Karel Brabec[1]

REKOLONIZACE

- povodeň
- sucho
- sukcesní trajektorie (procesy, taxony, společenstva)



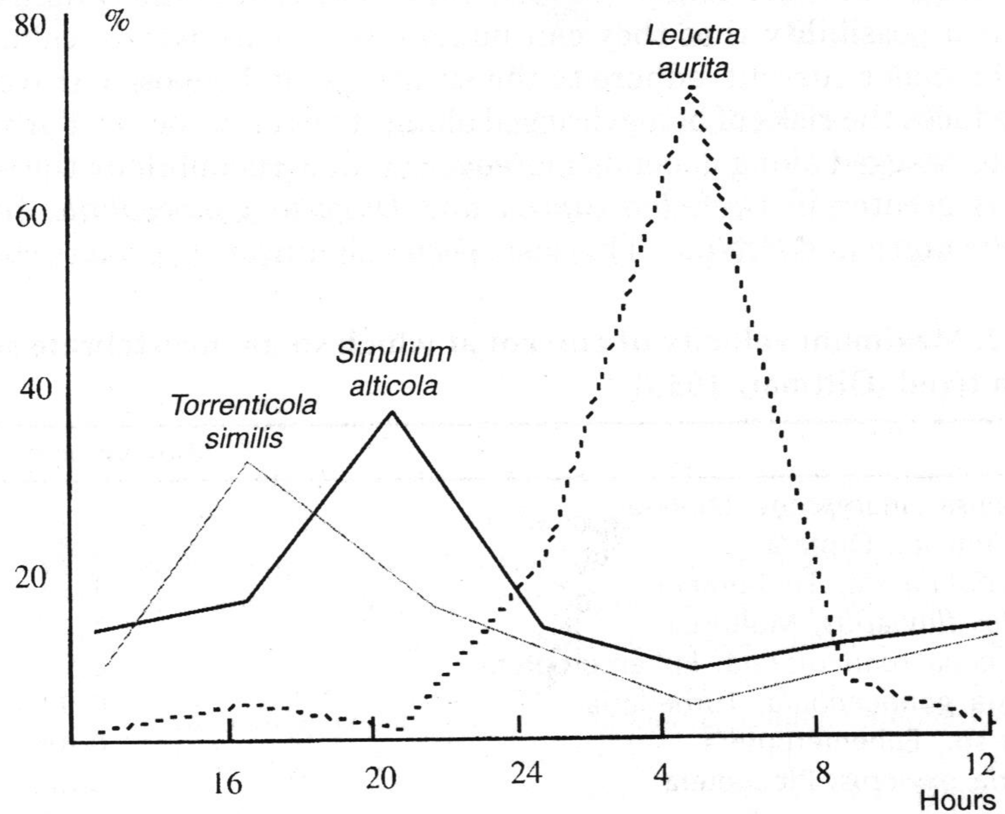


Fig. 14. Rate of drift of benthic invertebrates during the course of a day (Gazagnes, 1983)

MINIMÁLNÍ PRŮTOKY

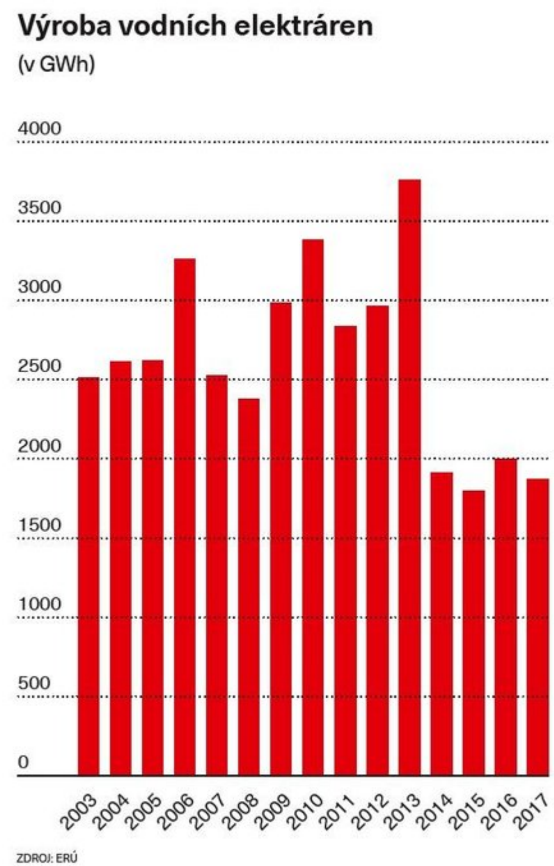
přehled

VTEI/ 2018 / 2

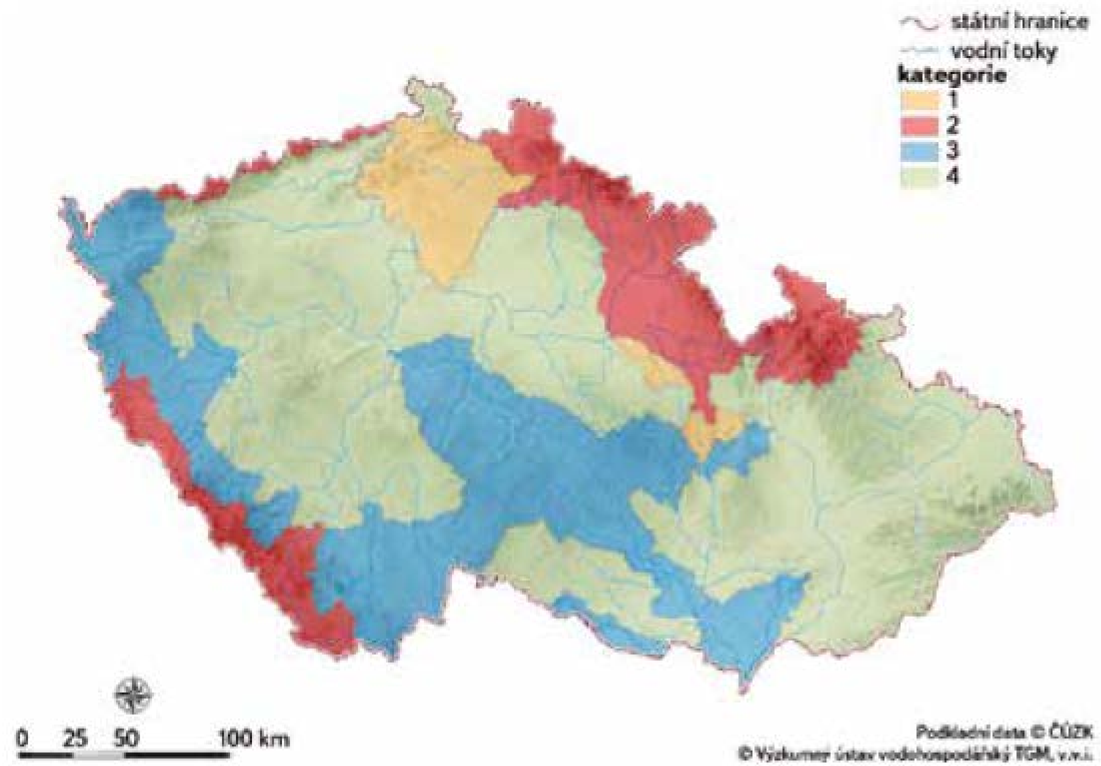
https://www.euro.cz/udalosti/boj-o-prutok-nove-vladni-narizeni-urci-kolik-vody-ma-zustat-v-rece-1419513

Stanovení hodnot minimálních zůstatkových průtoků v podmínkách ČR

PAVEL BALVÍN, ADAM VIZINA



MINIMÁLNÍ PRŮTOKY



Obr. 1. Rozdělení ČR do čtyř kategorií podle K99
Fig. 1. Division of the Czech Republic into 4 categories according to K99

parametr K99 udává poměr mezi průměrným denním průtokem s pravděpodobností překročení 99 % během referenčního období a hodnotou průměrného dlouhodobého průtoku Q_a za stejné období

MINIMÁLNÍ PRŮTOKY

přehled

Tabulka 1. Podíl hodnoty M-denního průtoku s danou dobou překročení a průměrného dlouhodobého průtoku – průměr pro pilotní vodoměrné stanice zatříděné do jednotlivých kategorií
Table 1. Share of M-day flow rate with given overflow time and average long-term flow – average for pilot water meters sorted into individual categories

	Qmd/Q_a [–]						
Kategorie	Q_{210d}	Q_{240d}	Q_{270d}	Q_{300d}	Q_{330d}	Q_{355d}	Q_{364d}
1	0,72	0,65	0,59	0,53	0,46	0,38	0,29
2	0,57	0,5	0,43	0,37	0,31	0,24	0,17
3	0,54	0,46	0,39	0,33	0,26	0,18	0,11
4	0,44	0,35	0,28	0,22	0,15	0,08	0,04

- nový přístup je založen na regionálním rozdělení respektující hranice povodí a odlišné hydrologicko-geologické charakteristiky.
- do výpočtu MZP zavádí více hydrologických charakteristik a vytváří podmínky pro sezonní rozdělení MZP během roku

ENVIRONMENTAL FLOW METHODOLOGIES

HABITAT SIMULATION

- IFIM/PHABSIM (may include 2-D/3-D hydrodynamic modelling)

  Dunbar et al. 1998; Scott & Shirvell 1987; Shirvell 1986; Tharme 1996

- Integrated GIS-based habitat simulation model

  Semmekrot et al. 1996

- Linked statistical hydraulic & multivariate habitat use models

  Lamoroux et al. 1998; Lamoroux et al. 1999

- Direct use of GIS-based studies of physical habitat for fish/invertebrate species

  Muotka et al. 1996

HISTORIC FLOW REGIME METHOD

- assumes that some percentage of the mean flow is needed to maintain a healthy stream environment
- Tennant (1976), Reiser et al. (1989)

HYDRAULIC METHODS

- relate various parameters of the hydraulic geometry of stream channels to discharge
- width, depth, velocity and wetted perimeter are determined within surveyed cross-section

HABITAT METHODS

- extension of hydraulic methods
- predicted depth and velocity are compared with habitat suitability criteria of target aquatic species
- habitat duration curves
- variation of the habitat utilized by many species and life stages
- PHABSIM

PHABSIM (Physical Habitat Simulation)

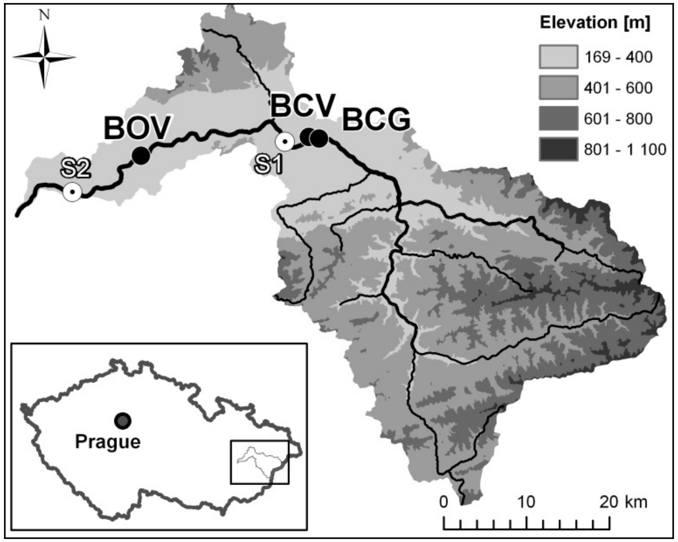
https://www.usgs.gov/software/physical-habitat-simulation-phabsim-software-windows

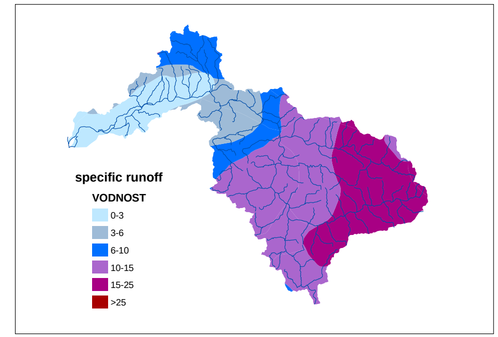
- suitability curves
- weighted usable area (WUA)
- reach habitat value = WUA/wetted area of reach
- reach–scale output consist of changes in habitat value or WUA with discharge rate
- time consuming field works (three dimensional topography of the bed and water surface

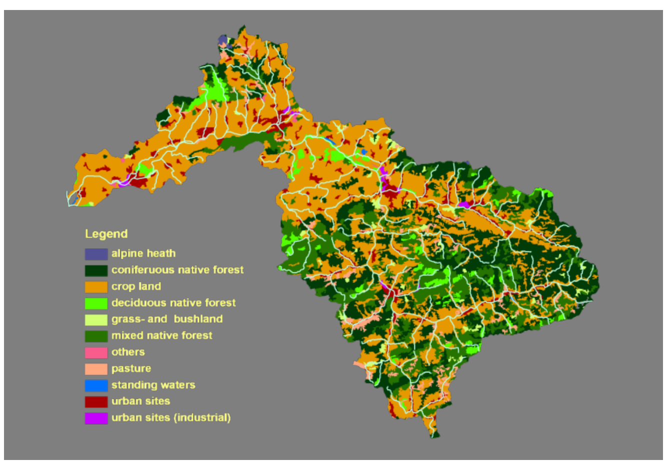
BECVA RIVER

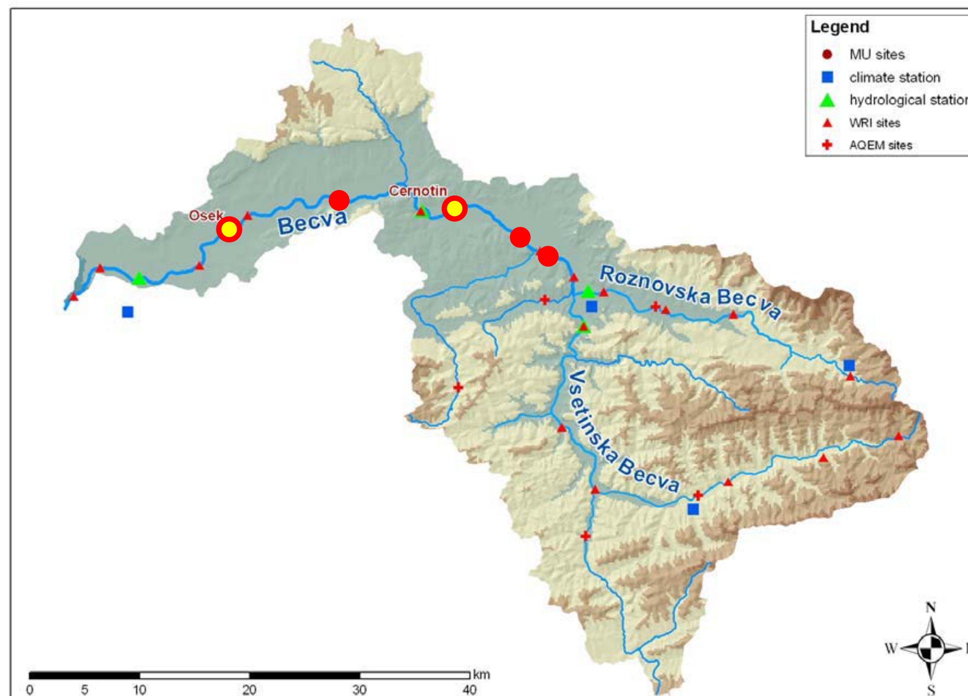
Catchment

	BOV	BCV	BCG
altitude	219	254	255
catchment area (km^2)	1527	1222	1222
slope (m/km)	2.23	2.55	1.69









Research centre
for toxic compounds
in the environment

RIVER CHANGES IN TIME

2nd military mapping, 1819-1858

before floods in 1997

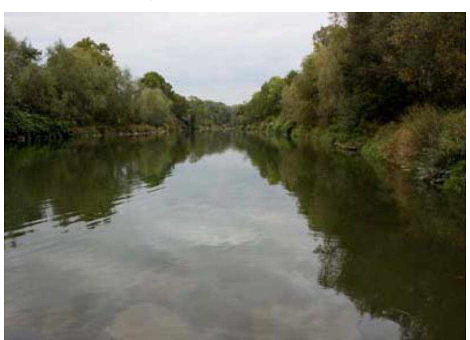
after floods in 1997

STUDY SITES

Becva – Osek

channelization
bank fixation
resectioning (trapezoid)
stagnation


regulated (BOG)



restored (BOV)

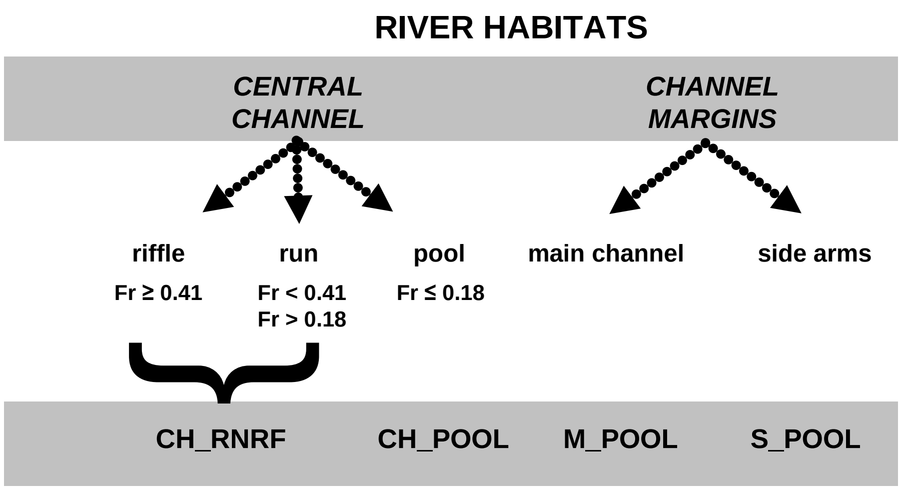
Becva – Cernotin

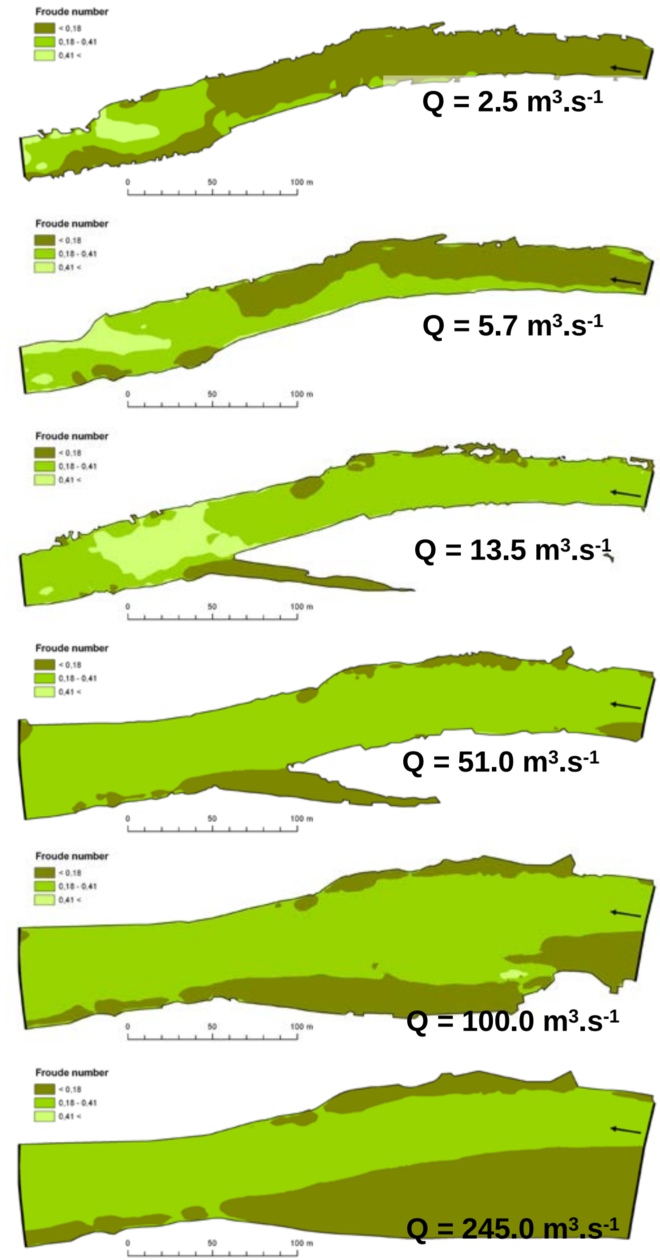
channelization
bank fixation
resectioning (trapezoid)


regulated (BCG)

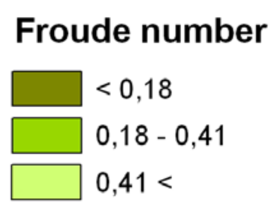
restored (BCV)

RIVER HABITAT TYPOLOGY





Jowett, I.G. 1993. A method of objectively identifying pool, run, and riffle habitats from physical measurements. *New Zealand Journal of Marine and Freshwater Research 27*:241-248.



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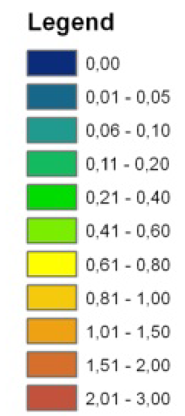
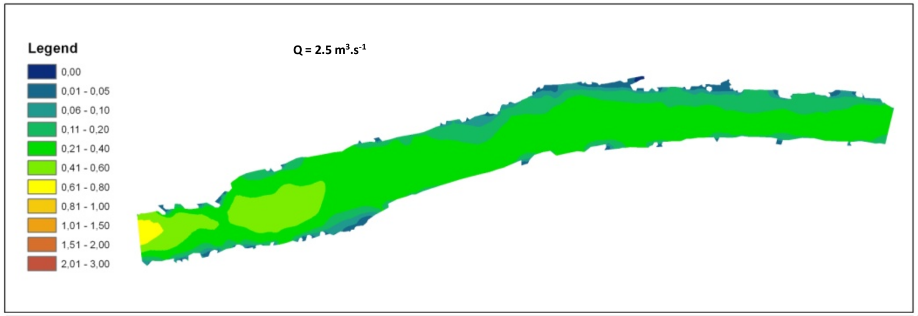
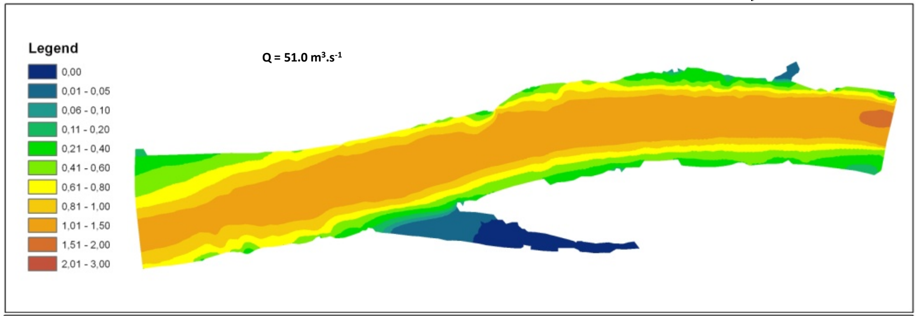
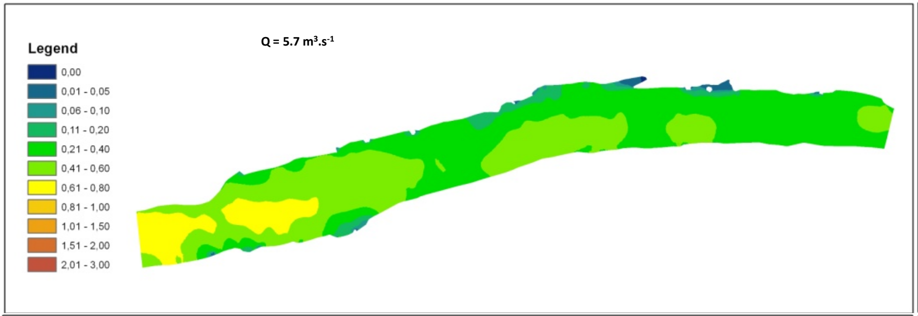
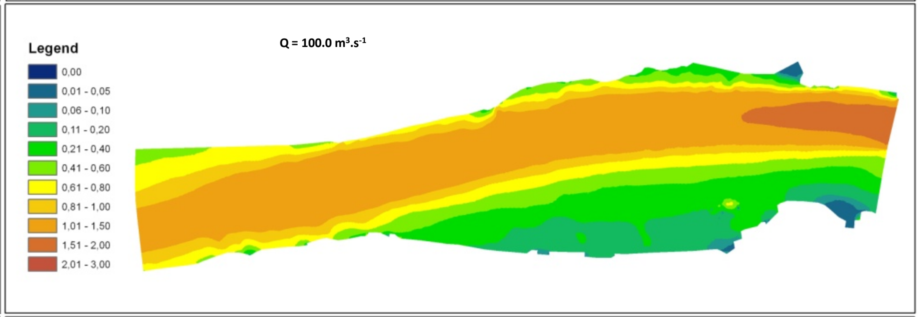
HYDRAULIC MODEL

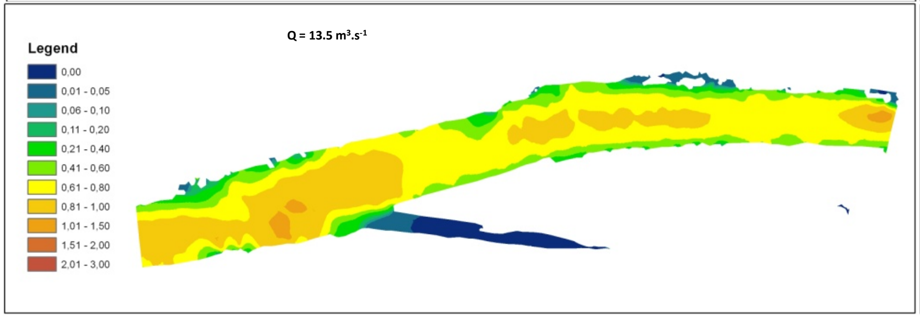


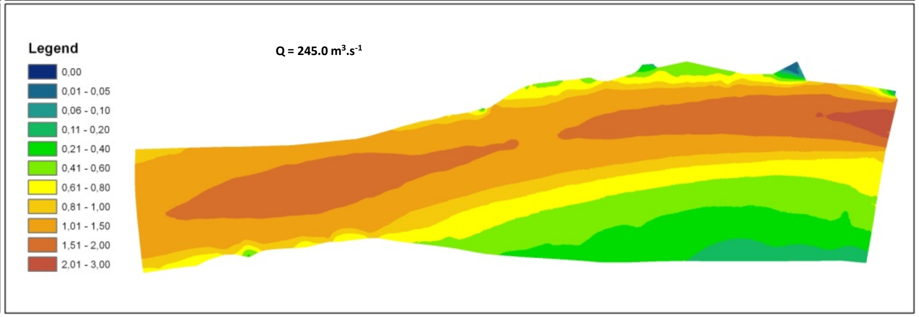




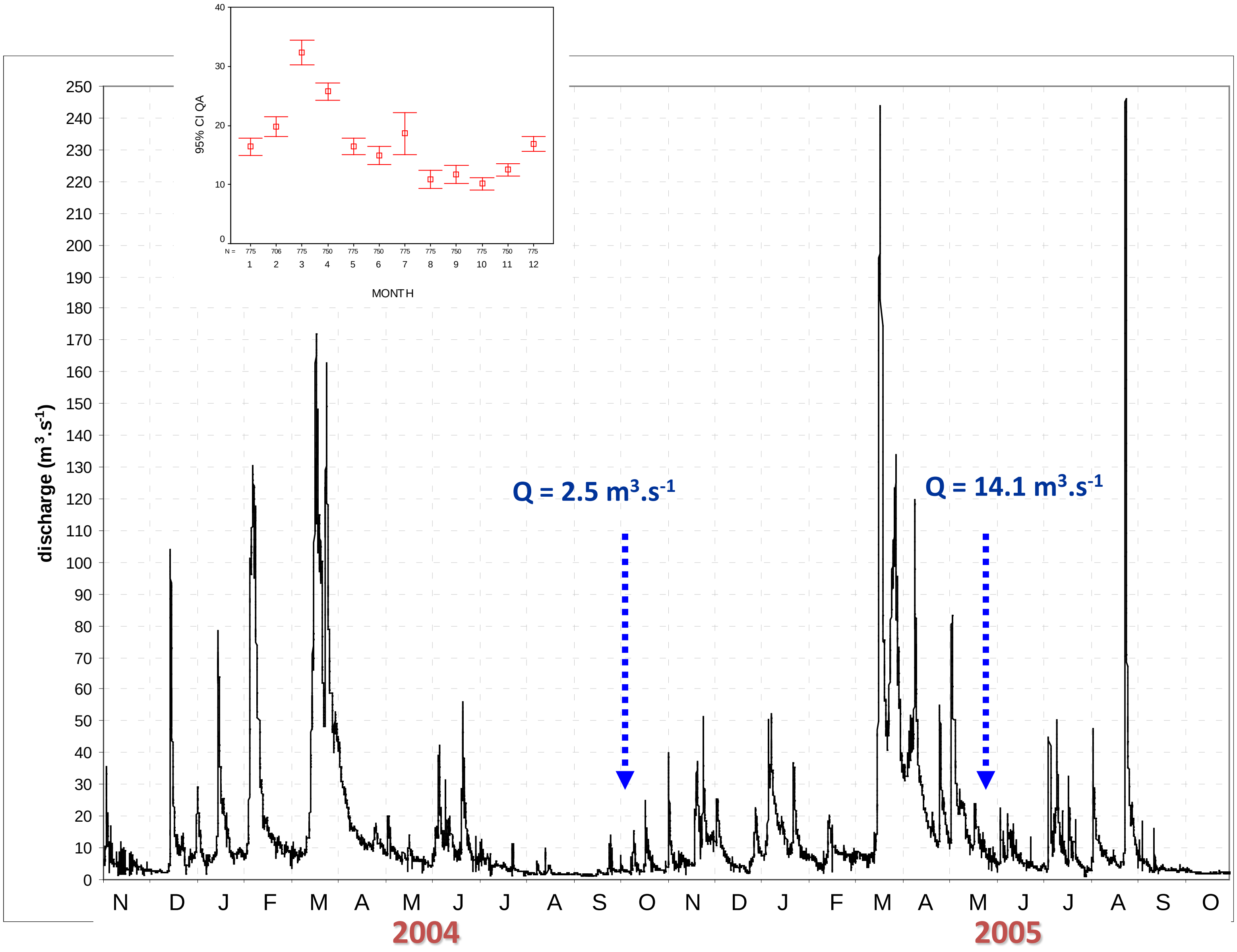








FLOW REGIME



95% CI QA
MONTH
discharge ($m^3.s^{-1}$)
Q = 2.5 $m^3.s^{-1}$
Q = 14.1 $m^3.s^{-1}$
N D J F M A M J J A S O N D J F M A M J J A S O
2004
2005

CASE STUDIES
2004-2015

environmental conditions

- habitat typology
- hydraulic model
- thermal regime
- substrate (size structure)

algae

- main channel x side arms
- particle size / substrate stability
- chlorophyll

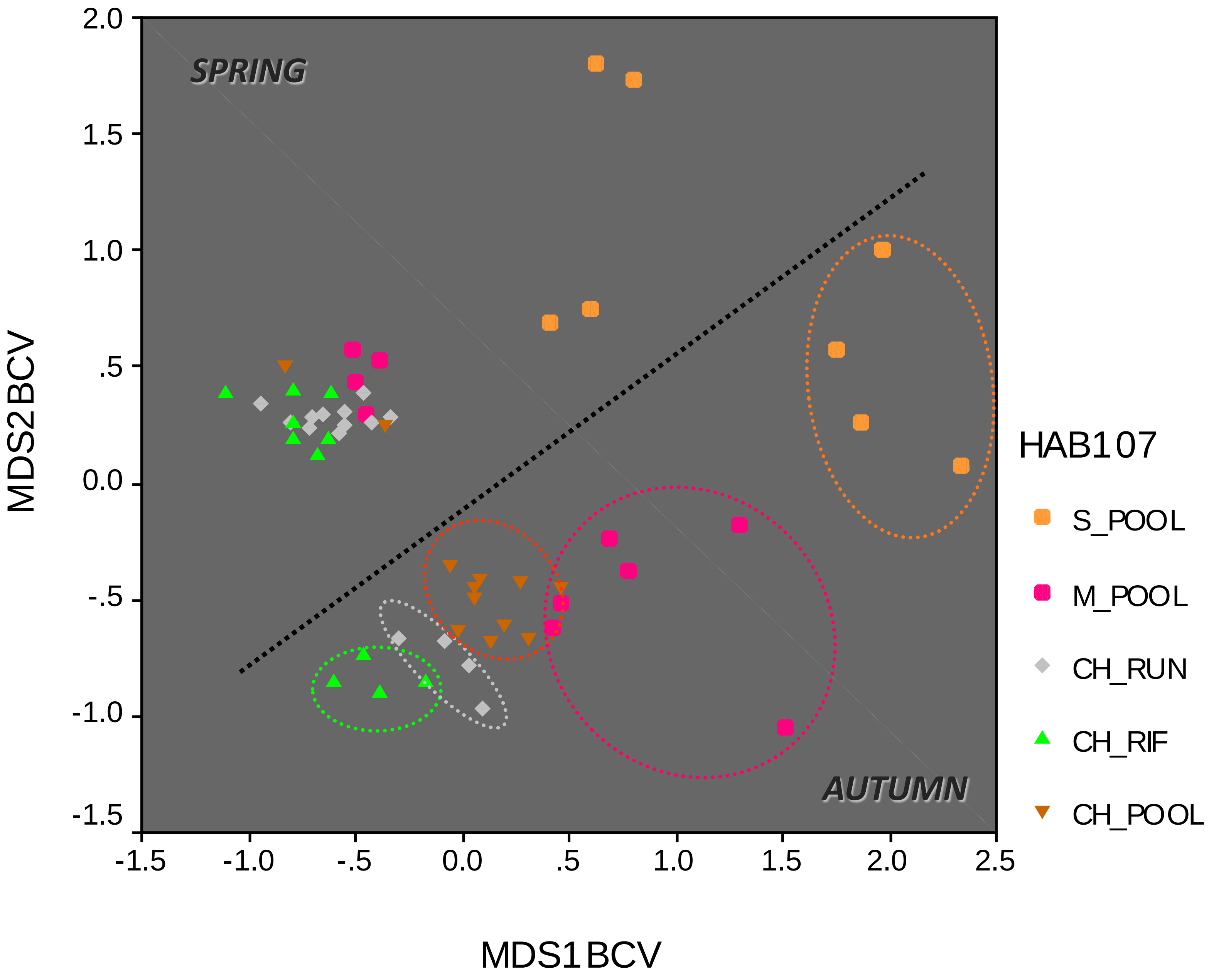
macroinvertebrates

- habitats, hydromorphology
- hydraulic drivers
- seasons / habitats

fish

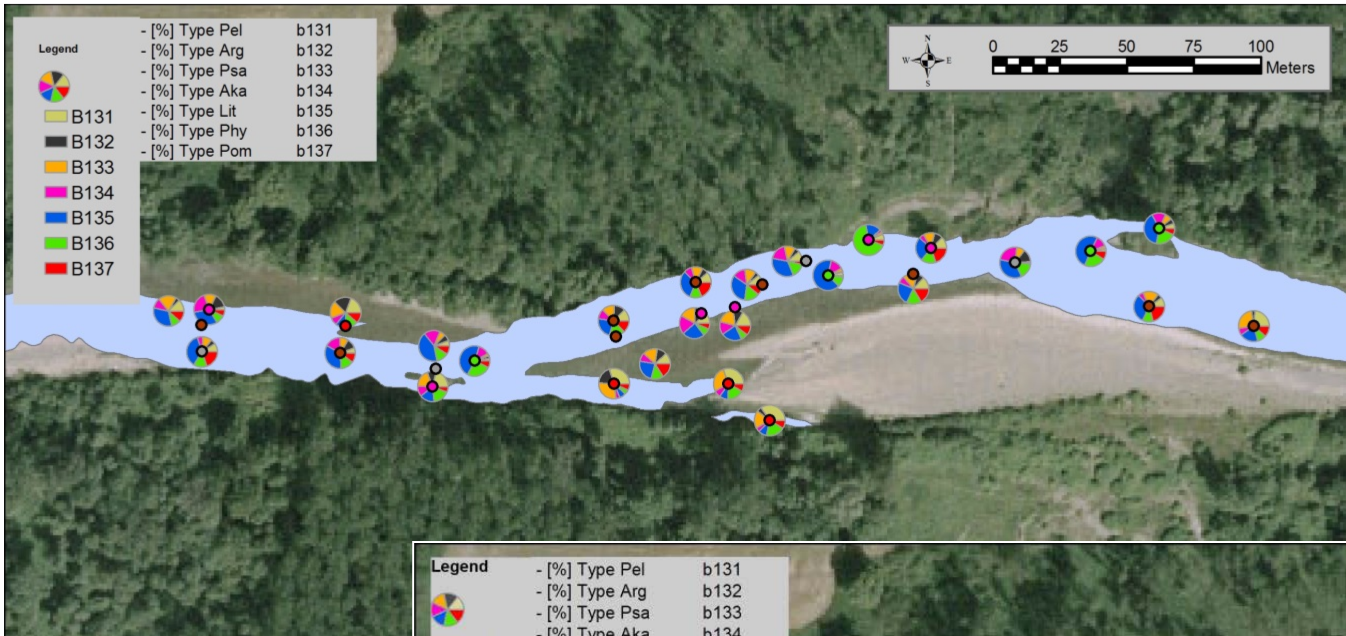
- habitats, hydromorphology

MACROINVERTEBRATES - habitats

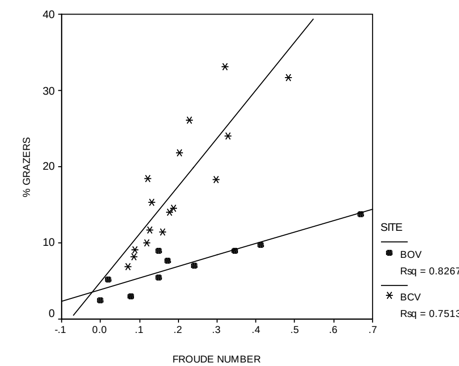


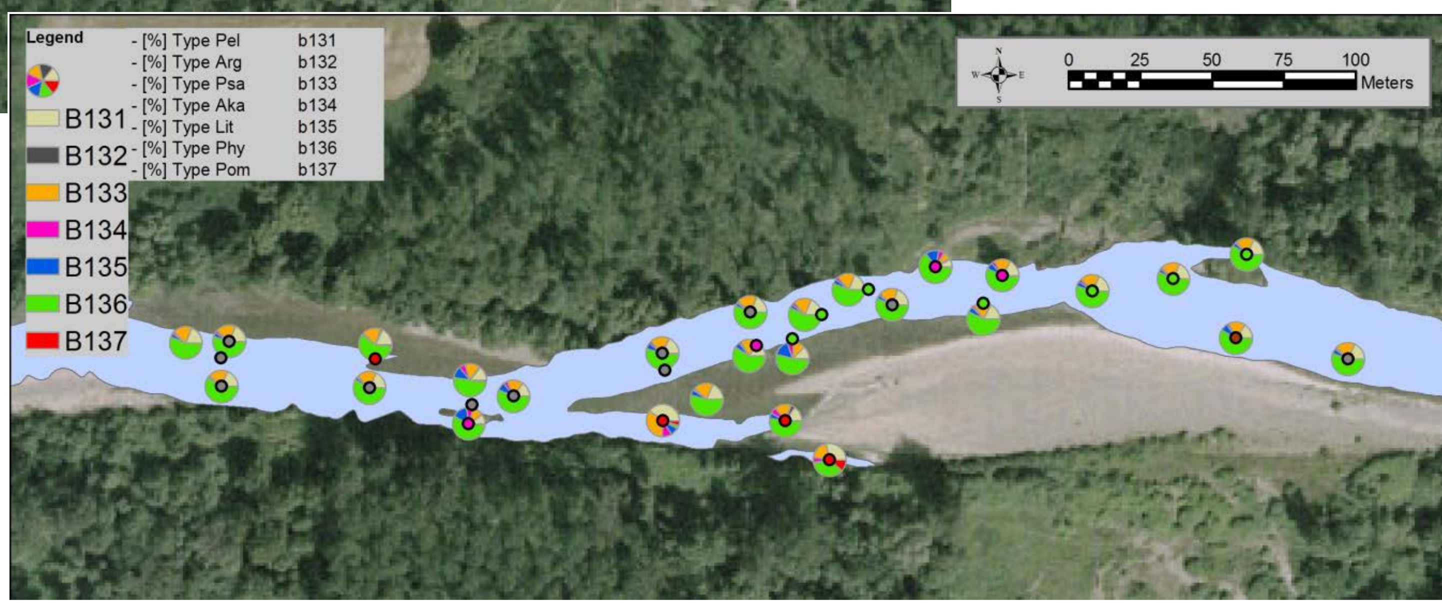
MACROINVERTEBRATES

habitat preference



grazers % vs. Froude number





PHYTOBENTHOS

substrate type

	2.5.2005	25.5. 2005	21.7. 2005	3.10.2005	**total**
microlithal	31	34	20	35	57
mesolithal	32	35	33	27	58
technolithal	25	30	33	14	46
total	41	39	46	42	75

gravels (microlithal)

cobbles (mesolithal)

large fixed boulders (technolithal)

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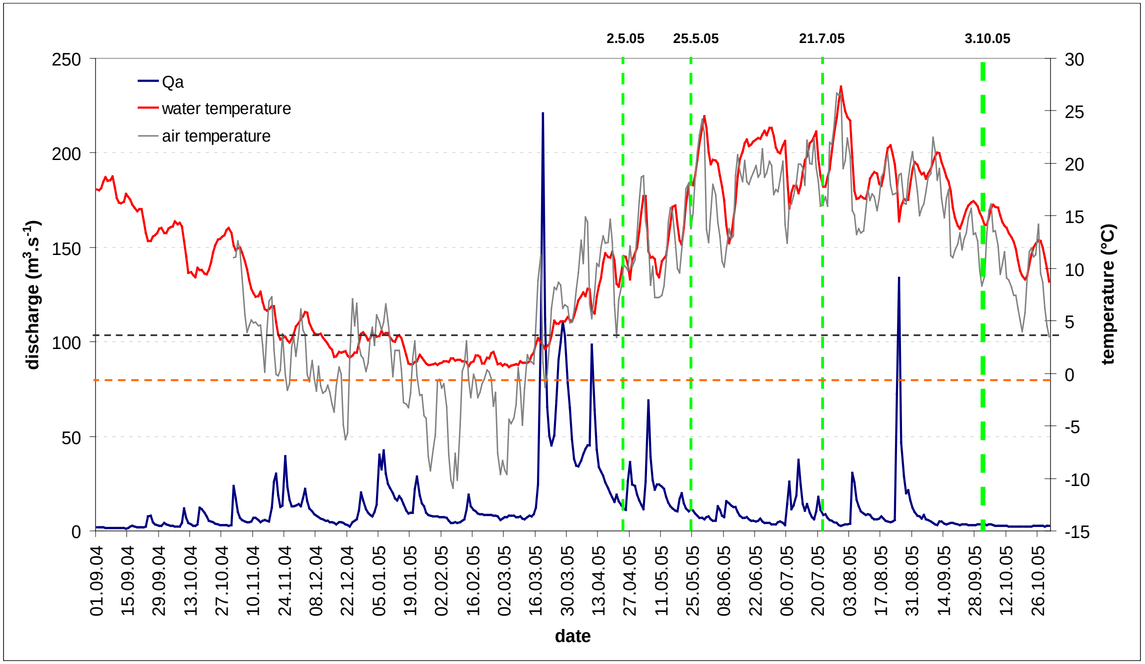
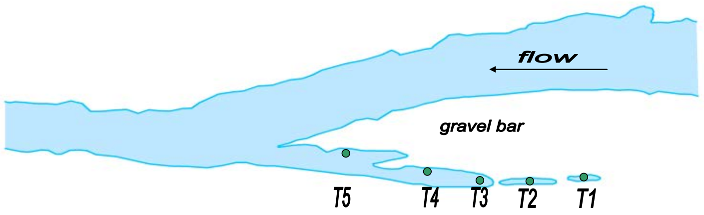
PHYTOBENTHOS

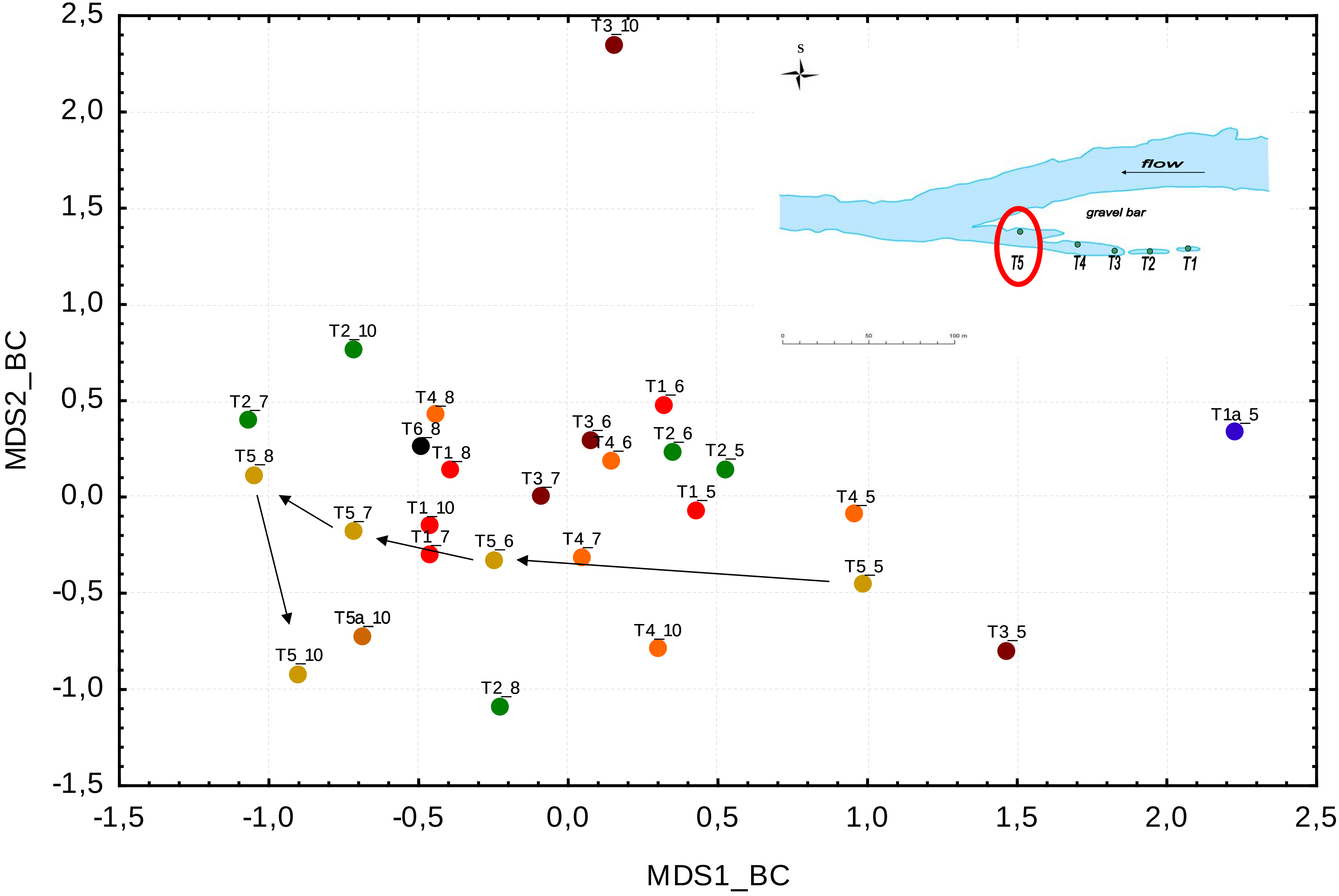
channel x side arms





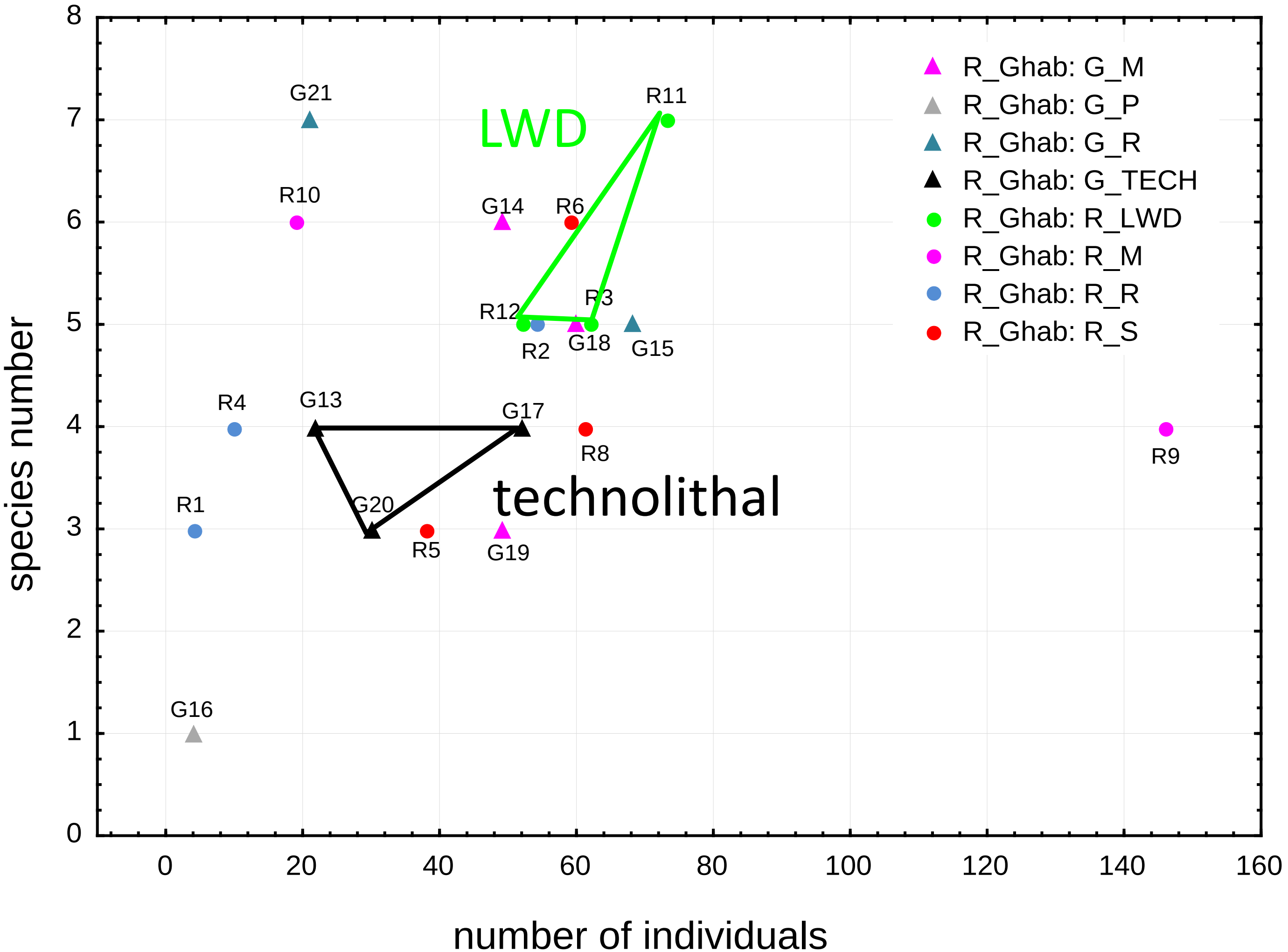
PHYTOBENTHOS

channel x side arms



FISH

habitat-scale study
(**Becva-Cernotin**, 2006)



Research centre
for toxic compounds
in the environment

FISH

site-scale study (**Becva-Osek**, 2014)

total number of taxa 12 12

Becva-Osek	**REG**	**REST**	
Species	Total	Total	Species-English
Blicca bjoerkna	1		Silver Bream
Tinca tinca	1		Tench
Carassius auratus	2		Goldfish
Vimba vimba	5		Vimba
Rhodeus amarus	3	1	Bitterling
Gobio gobio	3	53	Gudgeon
Gobio kessleri	4	17	Kessler`s Gudgeon
Alburnoides bipunctatus	4	155	Riffle minnow
Perca fluviatilis	6	2	Perch
Pseudorasbora parva	9	5	Stone moroco
Alburnus albidus	10	163	Stoneloach
Squalius cephalus	195	136	Chub
Barbatula barbatula		4	Stoneloach
Leuciscus leuciscus		15	Dace
Chondrostoma nasus		37	Nase
Barbus barbus		303	Barbel

critically threatened species

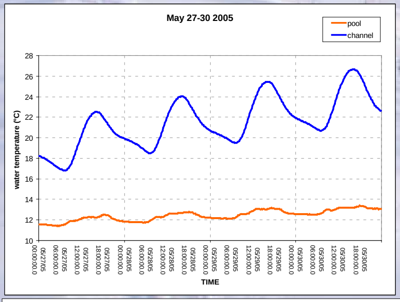
macroinvertebrates 11 vs 33 (main sample)
18 vs 33 (marginal habitats only)

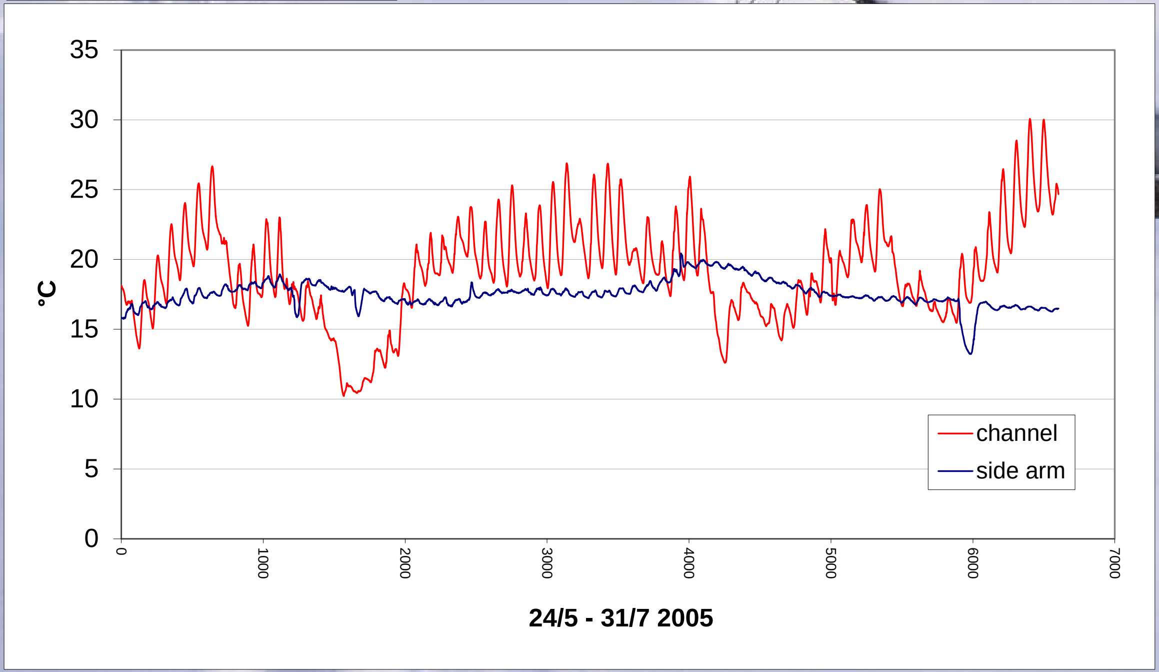
habitat-scale study (**Becva-Cernotin**, 2006)

total number of taxa 11 12

Becva - Cernotin			
species	**short code**	**REG**	**REST**
Anguilla anguilla	AN	1	0
Chondrostoma nasus	CN	1	1
Perca fluviatilis	PF	1	4
Rutilus rutilus	RR	1	6
Alburnus alburnus	AA	1	23
Phoxinus phoxinus	PP	3	2
Barbatula barbatula	NB	17	6
Alburnoides bipunctatus	AP	20	48
Barbus barbus	BB	57	67
Gobio gobio	GG	59	59
Leuciscus cephalus	LC	194	360
Pseudorasbora parva	PR	0	1
Tinca tinca	TT	0	1

SIDE ARMS





- *hydraulics*
- *substrates*
- *temperature*
- *ice cover*
- *water chemistry*
- *surface-groundwater*

STOJATÉ VODY

- vlnobití v pobřežní zóně
- pohyb vodní masy (vítr, gradienty teploty/hustoty)
- vliv přítoku a odtoku