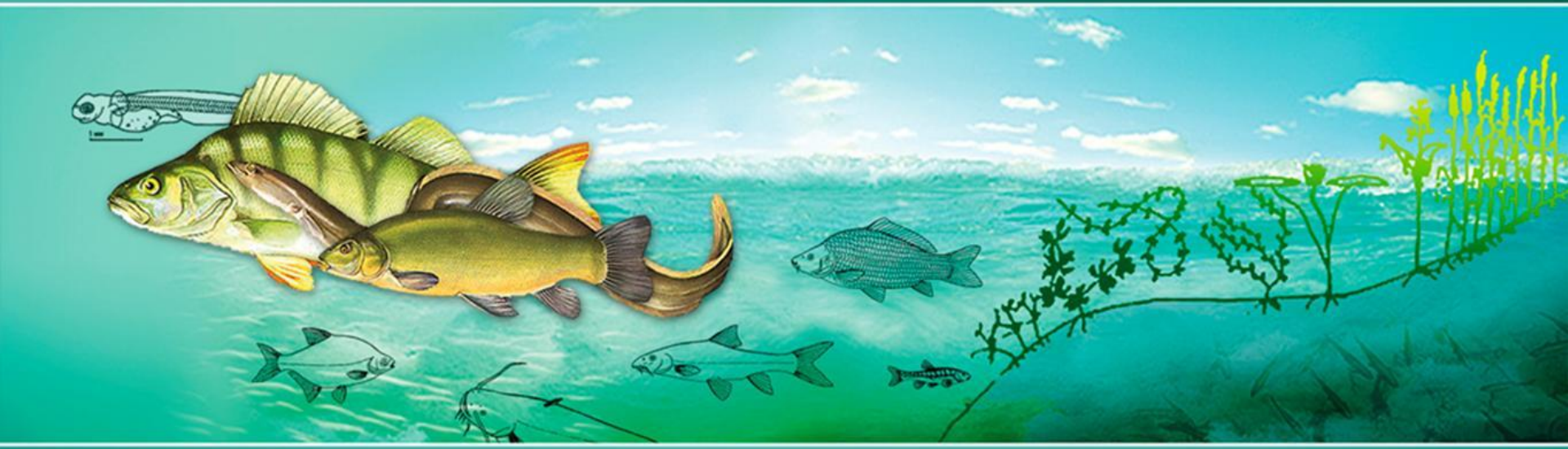
UNIVERSITY OF SOUTH BOHEMIA IN ČESKÉ BUDĚJOVICE
FACULTY OF FISHERIES & PROTECTION OF WATERS



MACROINVERTEBRATE ASSEMBLAGES OF FISH POND LITTORAL IN RESPONSE TO HABITAT QUALITY AND MANAGEMENT MEASURES

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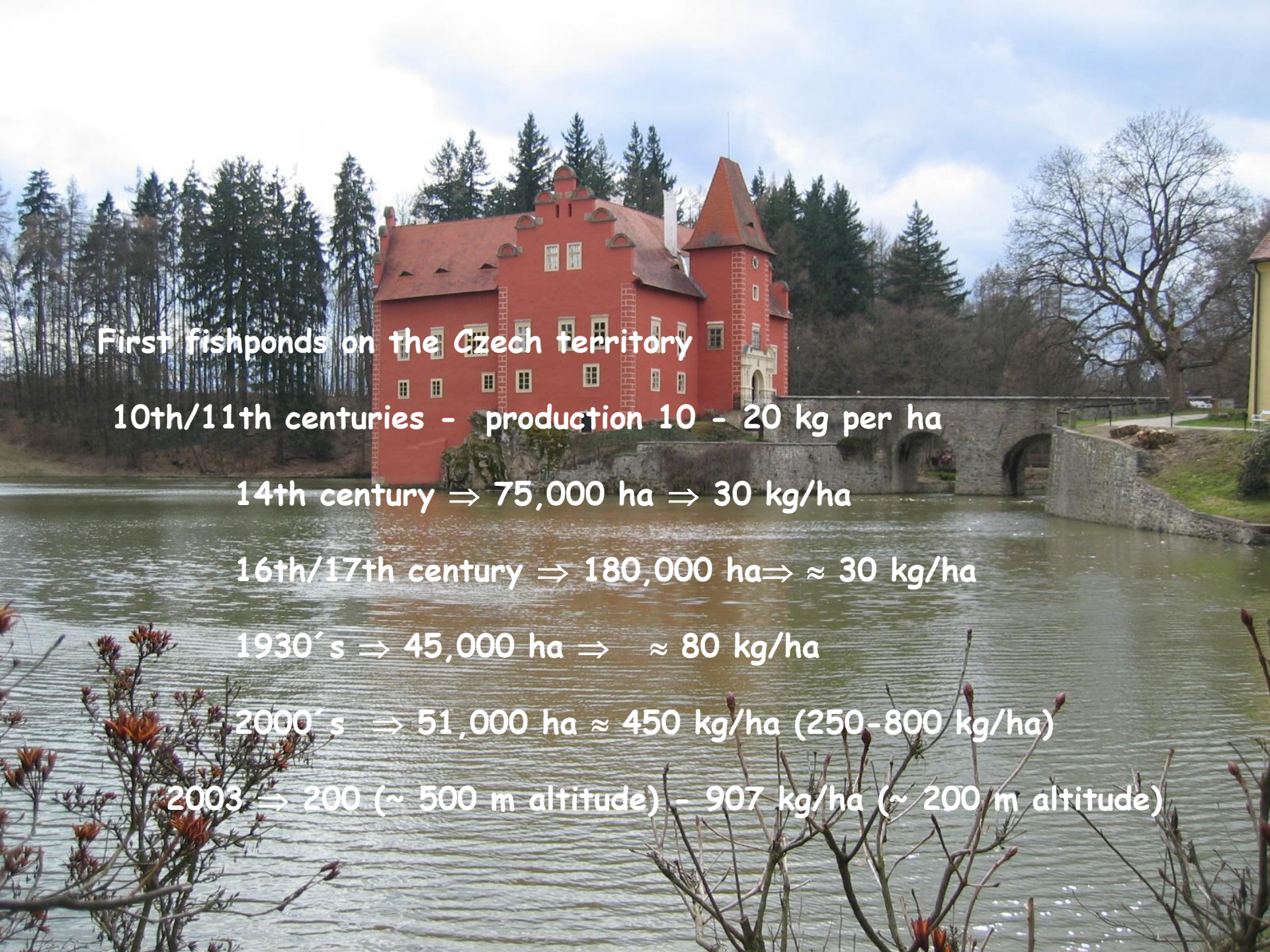
and USB, MU & UNESCO students

History of fishponds in Czech Republic

- wetlands formerly in moist depressions, in rivers alluvium, in flooded forests...
- since the Middle Ages the fishponds were built on places of former wetlands (development in 16th century)
- gradual disappearance of standing waters from the landscape (draining of wetlands, amelioration etc.)
- fishponds became the centre of biodiversity of limnophilous organisms



First fishponds on the Czech territory

10th/11th centuries - production 10 - 20 kg per ha

14th century ⇒ 75,000 ha ⇒ 30 kg/ha

16th/17th century ⇒ 180,000 ha⇒ ≈ 30 kg/ha

1930´s ⇒ 45,000 ha ⇒ ≈ 80 kg/ha

2000´s ⇒ 51,000 ha ≈ 450 kg/ha (250-800 kg/ha)

2003 ⇒ 200 (~ 500 m altitude) – 907 kg/ha (~ 200 m altitude)

Pond polycultures composition

Common carp (*Cyprinus carpio*) – 90.8%

Tench (*Tinca tinca*) – 1.0%

Herbivorous fish

- grass carp (*Ctenopharyngodon idella*) – 1.5%
- bighead and silver carp (*Aristichthys nobilis* and *Hypophthalmichthys molitrix*) – 3.0%

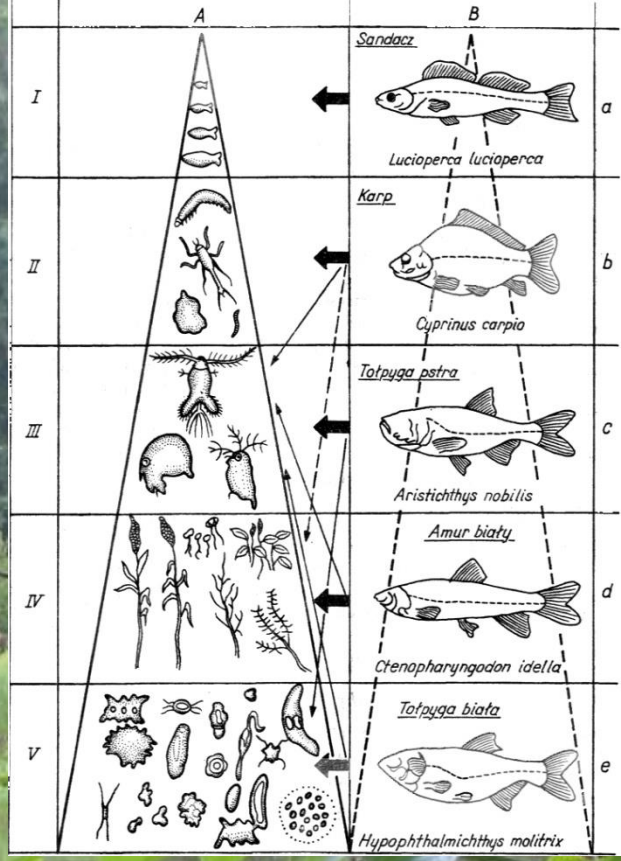
Predatory fish

- pike (*Esox lucius*) – 0.4%
- zander (*Sander lucioperca*) – 0.3%
- wels (*Silurus glanis*) – 0.3%
- perch (*Perca fluviatilis*) – 0.1%

Rainbow trout (*Oncorhynchus mykiss*) – 0.1%

Coregonids – (*Coregonus lavaretus* and *C. peled*) – 0.1%

Others – 2.3%




Carp pond farming is a kind of cultural and historical heritage with almost one thousand-year history

Littoral emergent macrophytes

- the most common littoral vegetation type on fishponds in central Europe
- especially common reed (*Phragmites australis*) and cattails (*Typha* spp.)
- littoral bed degradation: improper mud remove, high fish stock
- littoral beds degrade fish farming capacity

Objectives:

- How can be the littoral macroinvertebrates efficiently studied?
- How is the spatial distribution of macroinvertebrate diversity changing in extensive reed beds?
- Are extensive reed beds suitable for conservation of aquatic macroinvertebrate diversity?
- How does the recolonization processes proceed in ponds subject to mud and sediment removal?

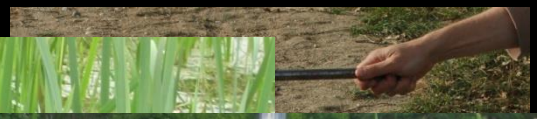
Methods

- the sampling using the hand sweep net (a), Gerking sampler (b) and corer (c)
- (a) semiquantitative sampling
- (b) quantitative sampling

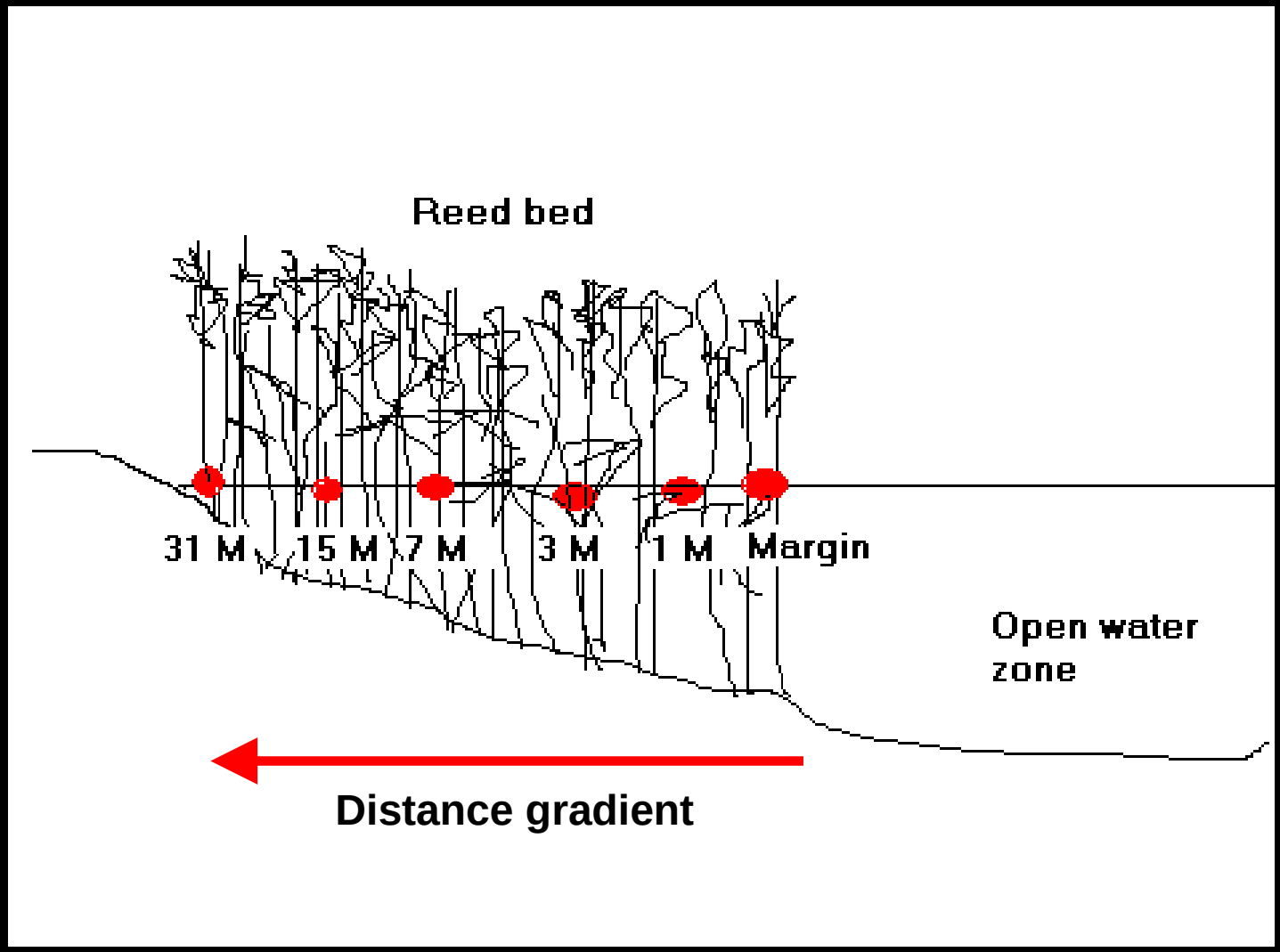
b

(c) corer for sampling in root systems of macrophyte beds

allows quantitative sampling

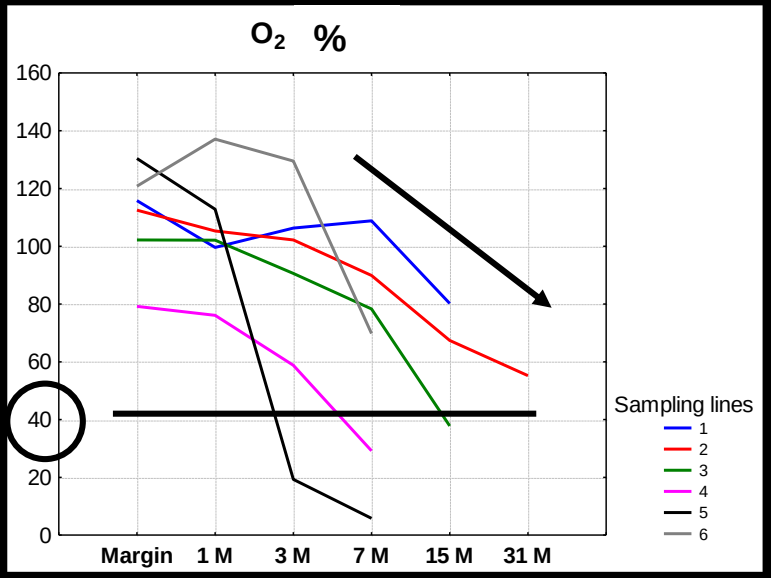


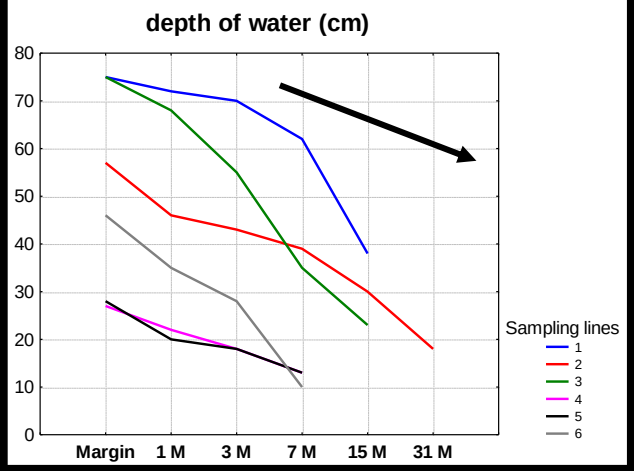
Horizontal distribution of phytophilous invertebrates in extensive reed beds

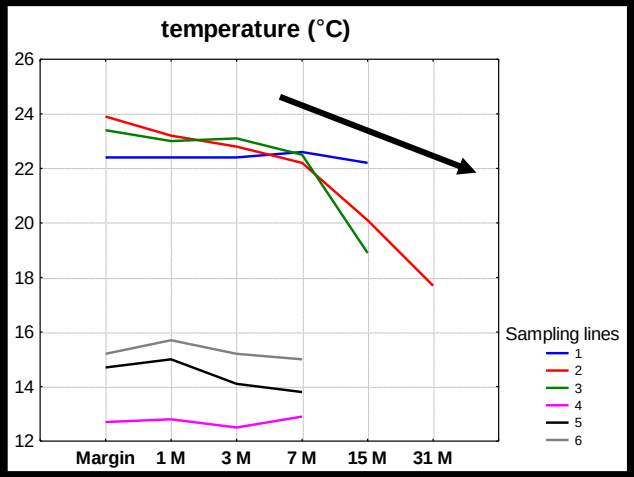


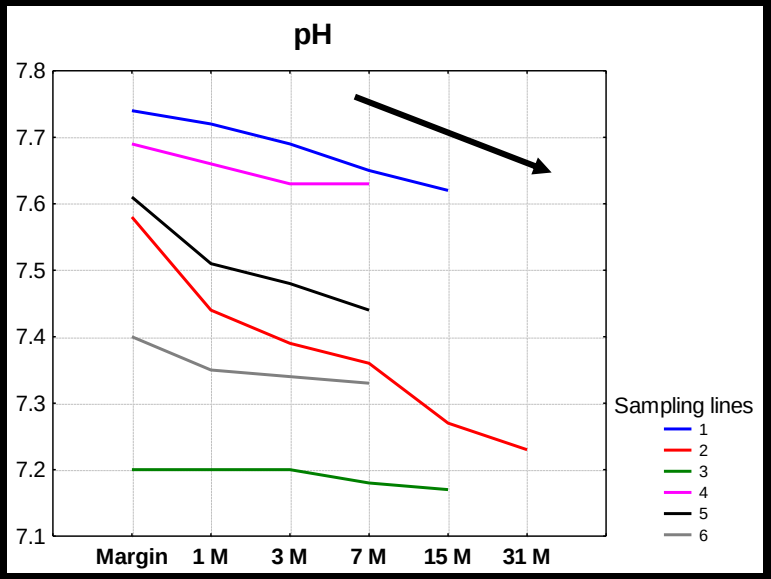
RESULTS

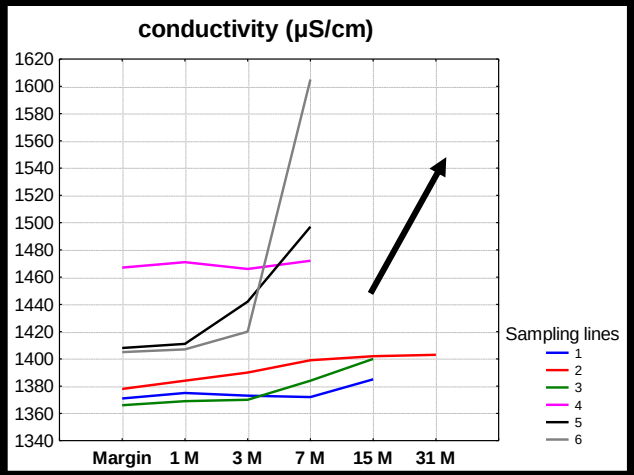
Environmental factors











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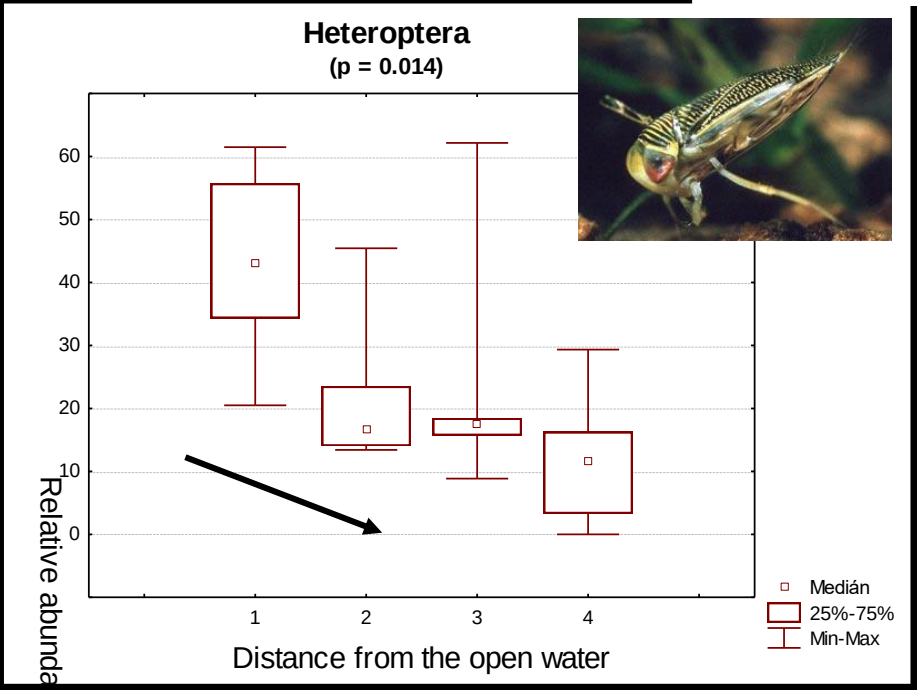
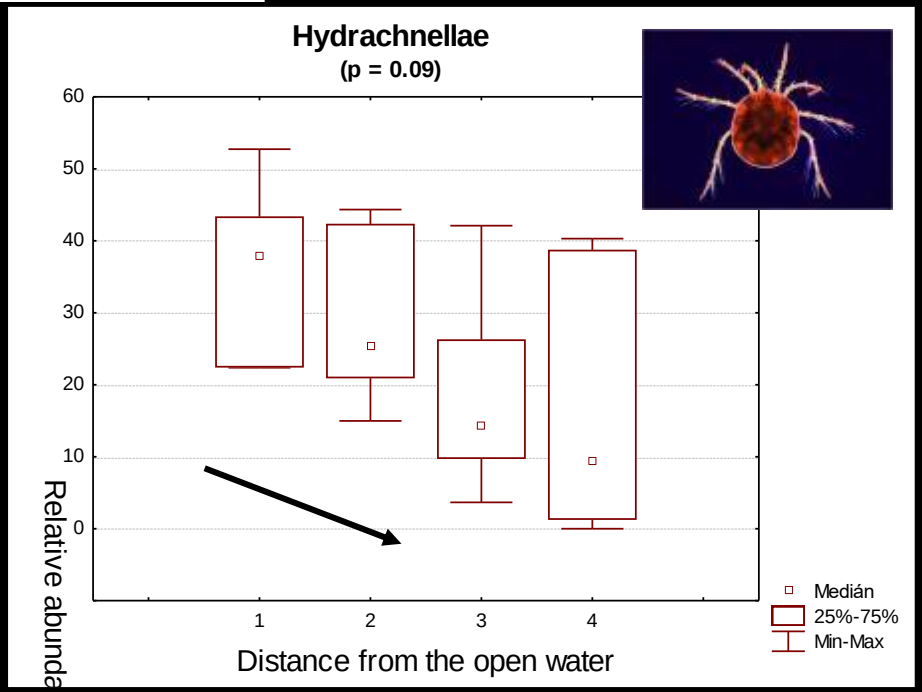
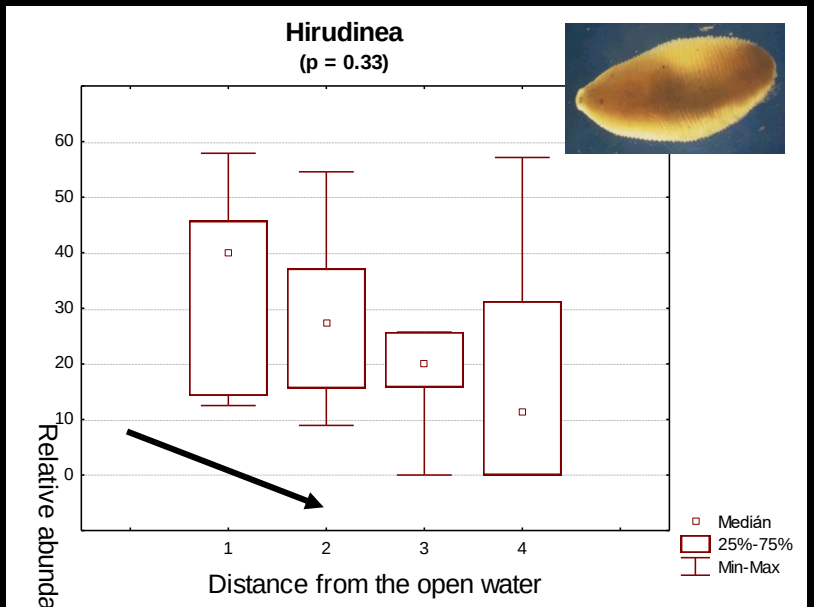


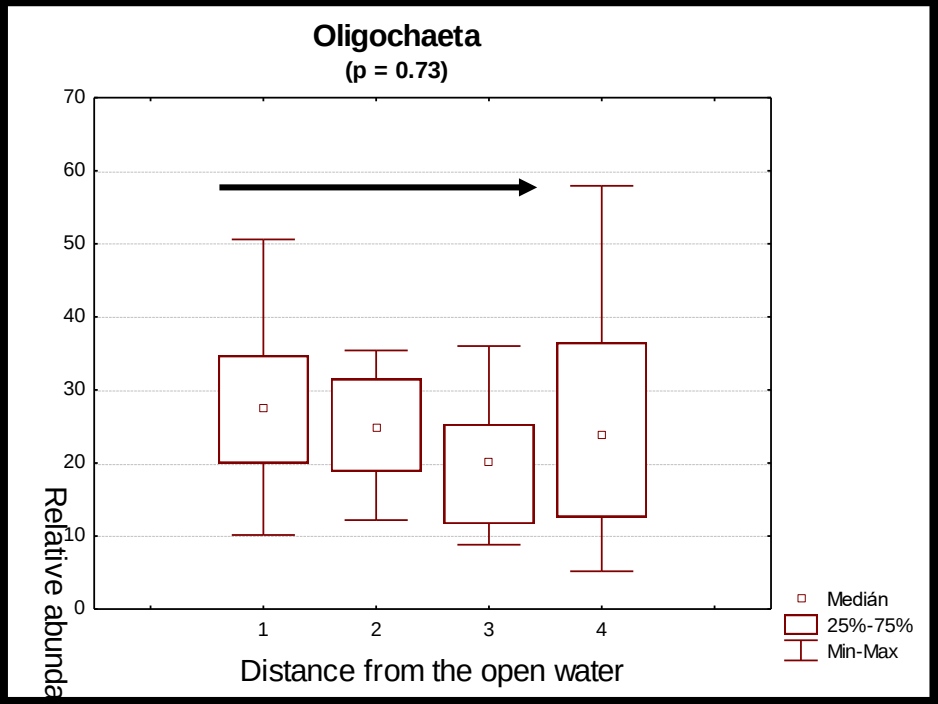


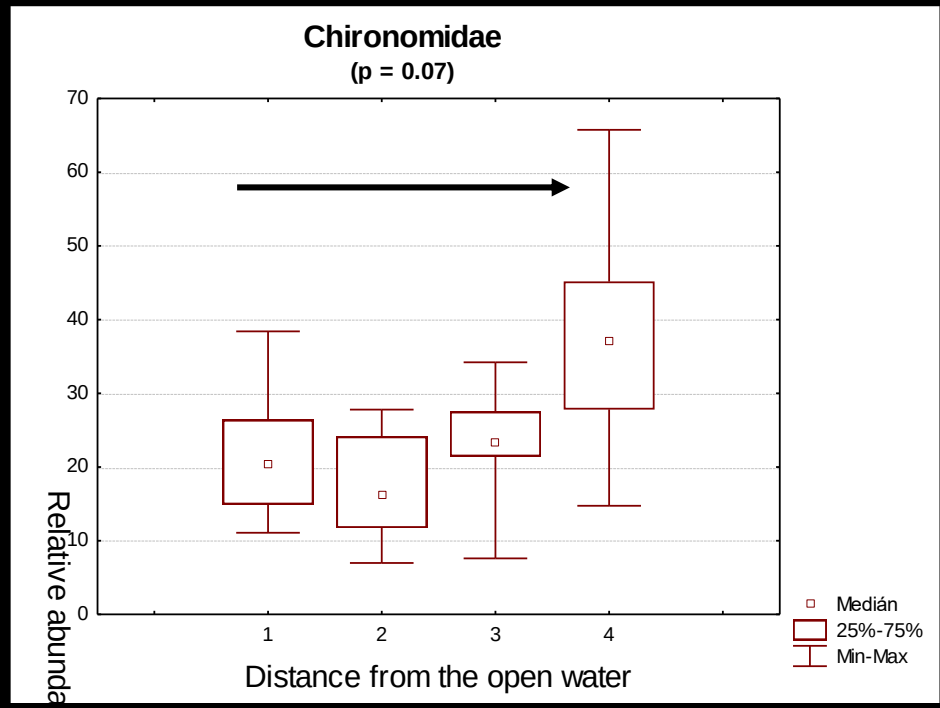


- Kruskal-Wallis ANOVA
- free-swimming invertebrates, ectoparasites and others, which need open water zone and/or enough of oxygen

(Heteroptera, Hydrachnellae, Hirudinea, Ephemeroptera, Odonata)

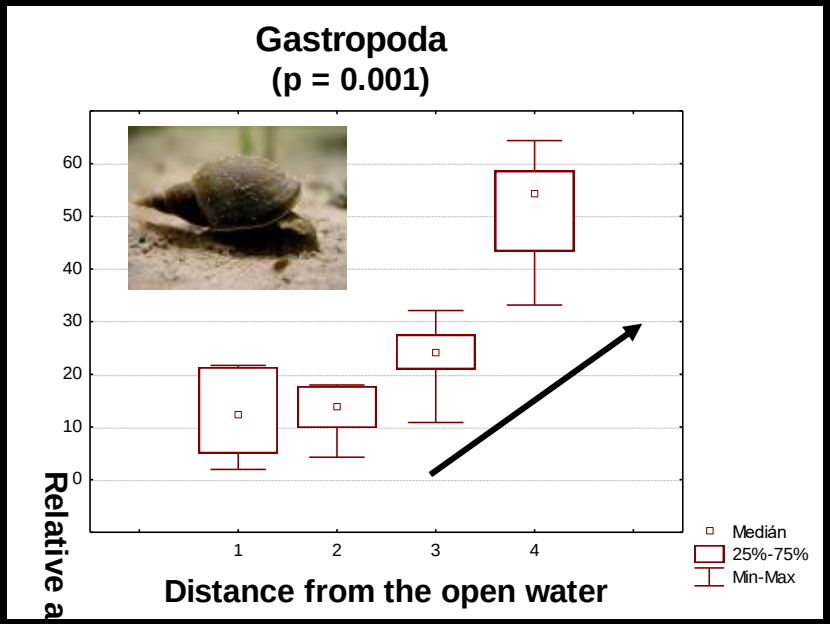
RESULTS: Macroinvertebrate groups separately

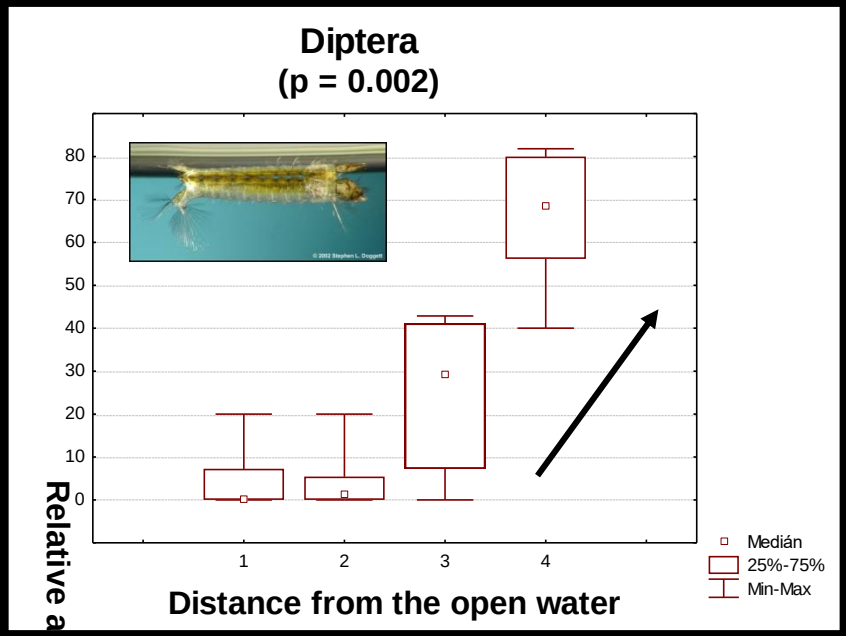


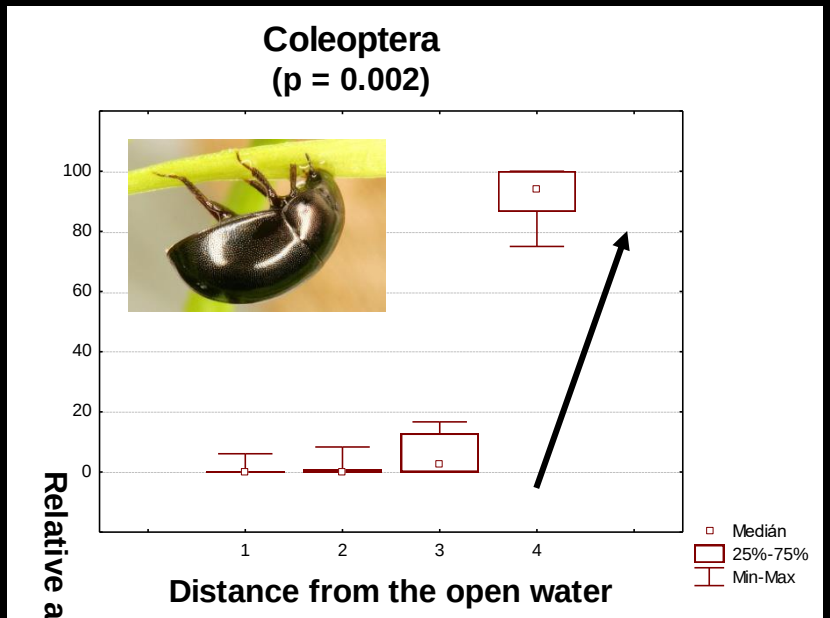


- abundant invertebrates in reed beds habitat and also along the whole studied gradient (Oligochaeta, Chironomidae)

RESULTS: Macroinvertebrate groups separately

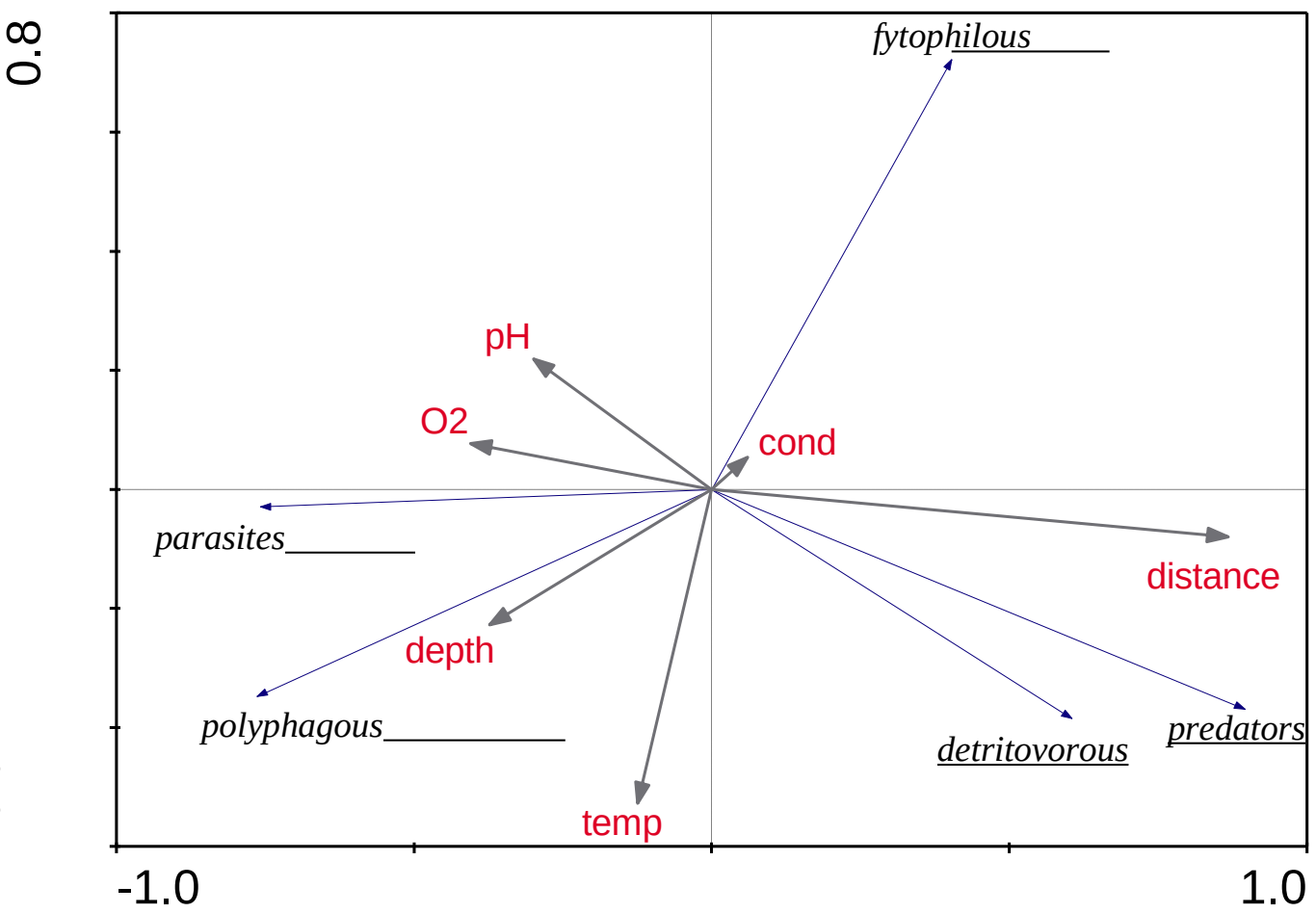






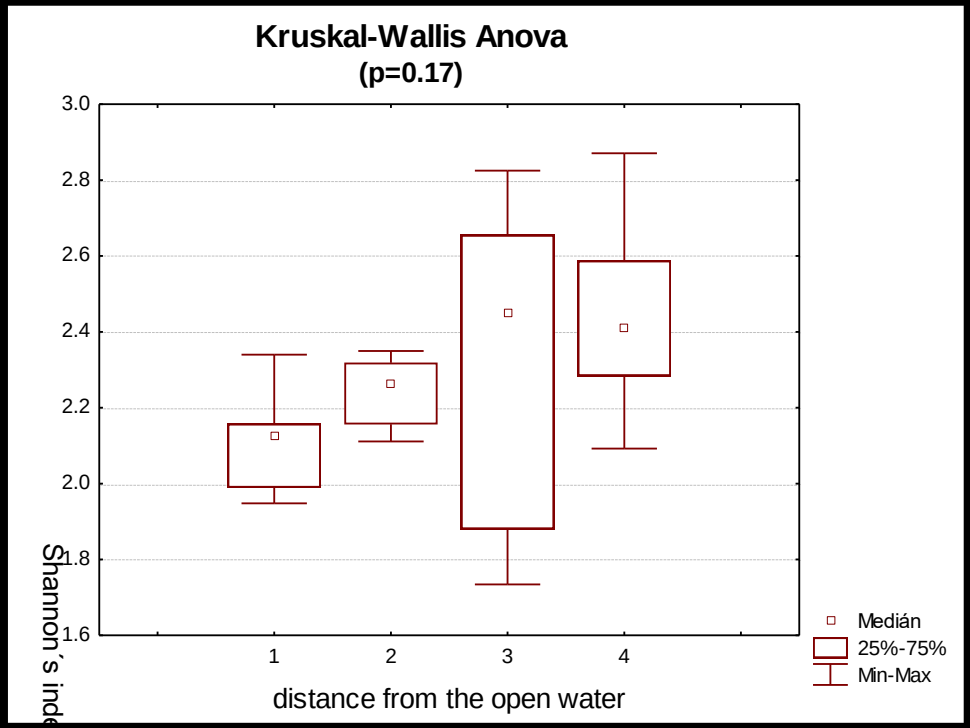
- „pool" invertebrates, with strong preference for macrophytes and low oxygen demands, refuges against fish predation (Gastropoda, Asellus aquaticus, Coleoptera, Diptera)

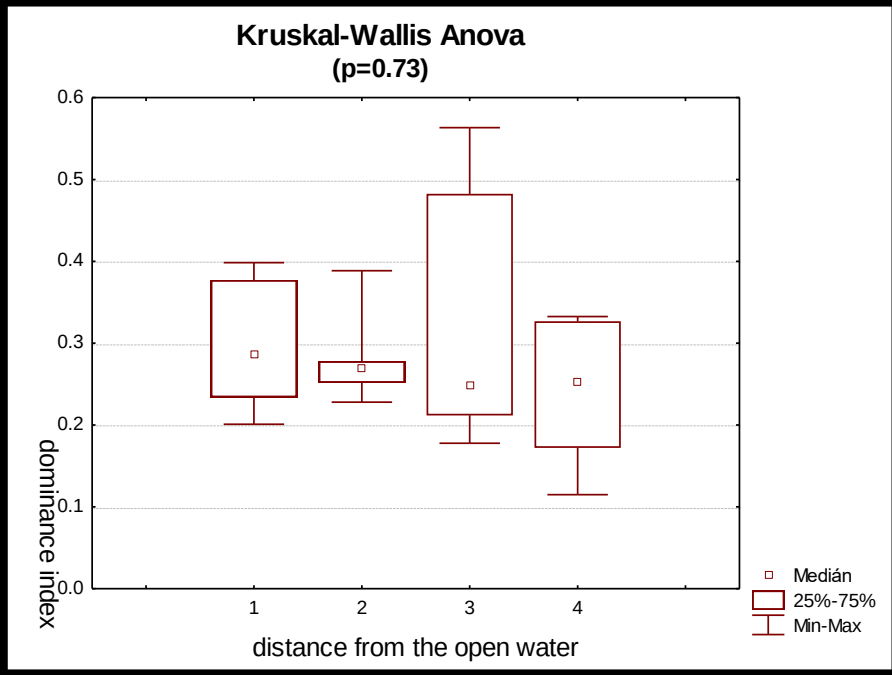
Results: feeding preferences

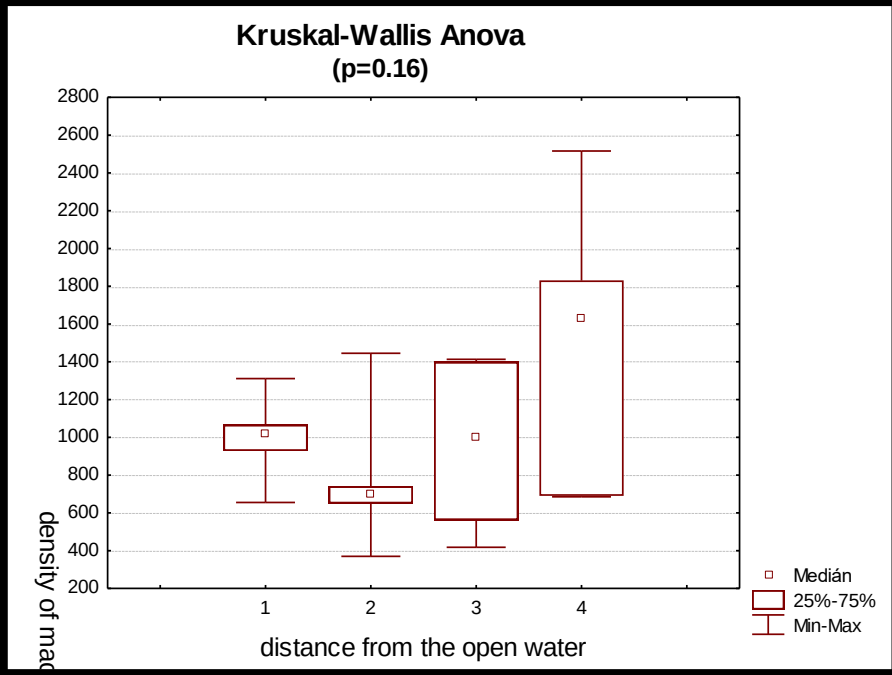


detritovorous: 50 taxa (gastropods, oligochaetes, Asellus aquaticus, mayflies, caddisflies, beetles, Chironominae, Diptera)
predators: 23 taxa (Chaetogaster, Erpobdella, dragonflies, some water bugs, dytiscid beetles, Tanypodinae, some Diptera)
fytophilous: 7 taxa (aquatic butterflies, hydrophilid beetles, Orthocladiinae, some Diptera)
ectoparasites: 6 taxa (leeches, Hydrachnellae, Argulus)
polyphagous: 5 taxa (corixids)

Results: biodiversity







In extensive reed beds, the macroinvertebrate diversity is not decreasing towards the shore (even increasing trend)

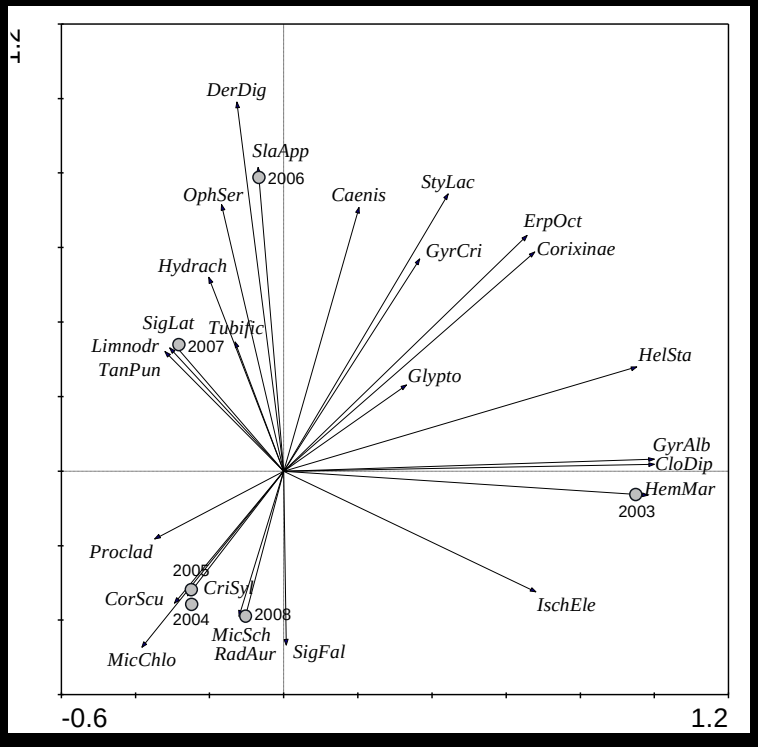
This habitats are important especially for „pool animals" diversity

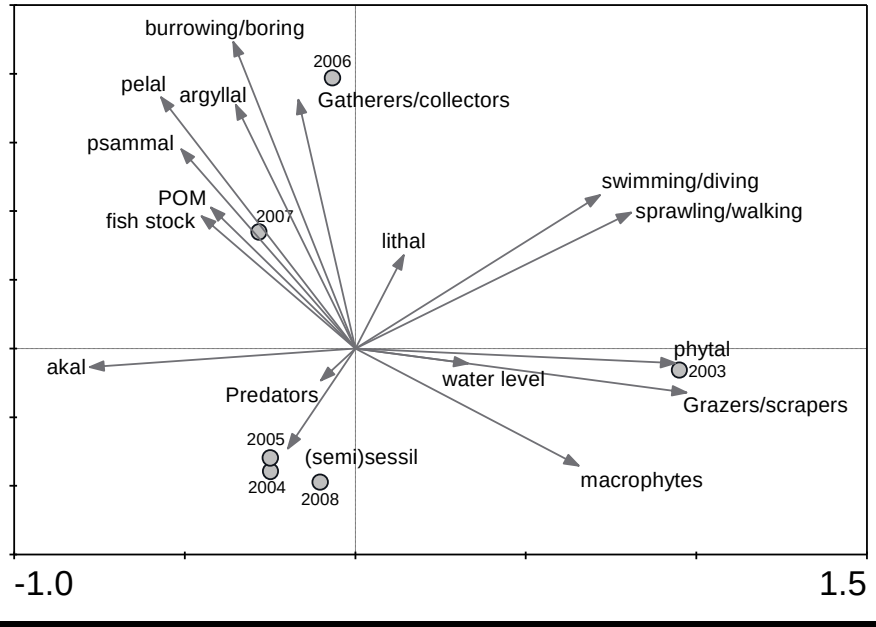
Conclusions

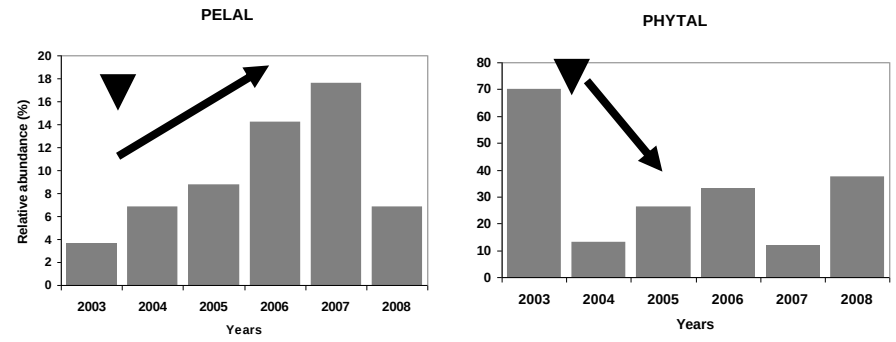
- along the distance gradient, the composition of macroinvertebrate community changes gradually
- in the community near the open water dominate free-swimming invertebrates, fish ectoparasites and invertebrates with higher oxygen demands (corixids, leeches, mayfly and dragonfly larvae and others)
- in habitats near the shore, the community is quite different and is composed of „pool animals", which have lower oxygen demands, may be fixed on macrophytes which create refuges against fish predation (aquatic beetles, dipteran larvae, gastropods and others)
- in the community of dense reed beds, most of the macroinvertebrates are detritovors and predators
- the macroinvertebrate diversity and density is not decreasing in the direction of dense reed beds
- extensive reed beds are very important and valuable habitats for aquatic macroinvertebrates

Impact of sediment removal on macroinvertebrate assemblages in fishpond littoral

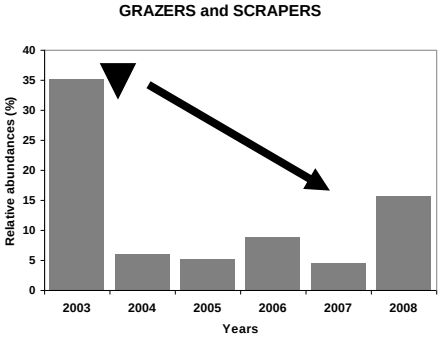
Results

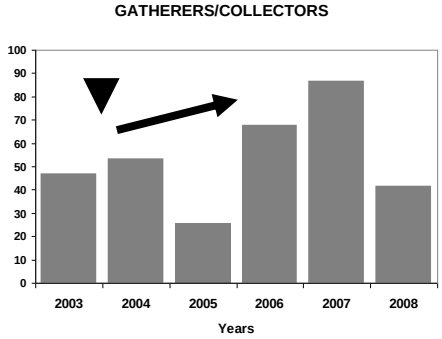

DerDig
SlaApp
2006
OphSer
Caenis
StyLac
ErpOct
GyrCri
Corixinae
Hydrach
SigLat
Tubific
Limnodr
2007
TanPun
Glypto
HelSta
GyrAlb
CloDip
HemMar
2003
Proclad
2005
CriSyl
CorScu
2004
2008
MicSch
RadAur
SigFal
MicChlo
IschEle
-0.6
1.2

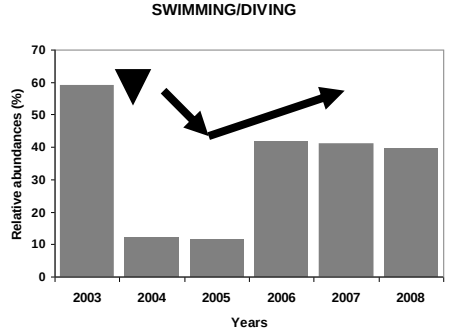

burrowing/boring
2006
pelal
argyllal
Gatherers/collectors
psammal
swimming/diving
POM
fish stock
2007
sprawling/walking
lithal
phytal
2003
akal
water level
Predators
Grazers/scrapers
2005
(semi)sessil
2004
2008
macrophytes
-1.0
1.5

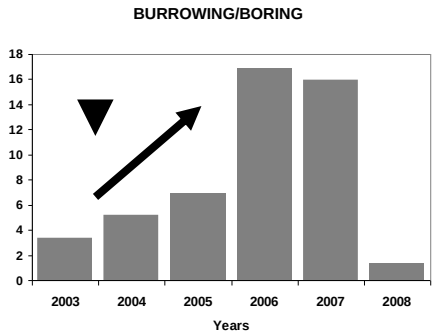

PELAL
Relative abundance (%)
Years
2003
2004
2005
2006
2007
2008

PHYTAL
Years
2003
2004
2005
2006
2007
2008


GRAZERS and SCRAPERS
Relative abundances (%)
Years
2003
2004
2005
2006
2007
2008


GATHERERS/COLLECTORS
Years
2003
2004
2005
2006
2007
2008


SWIMMING/DIVING
Relative abundances (%)
Years
2003
2004
2005
2006
2007
2008


BURROWING/BORING
Years
2003
2004
2005
2006
2007
2008

Conclusions

Pond mud (sediment) removal

- is associated with elimination of littoral plant beds and surface pond bottom layers which eradicates both plant and animal seed banks
- can be partly compared to succession in newly established still waterbody – rapid colonization, high diversity followed by subsequent dominance of several „successful" taxa
- „speedy" colonizers – mainly chironomids, water beetles and bugs are blocked for several seasons by high fish density and lack of macrophytes
- stable ratio between temporary and permanent fauna and persistence of approx. half of permanent taxa after mud removal prove that not all stages were removed with muddy sediments (rapid recolonization from upstream ponds
- littoral plant removal and their subsequent succession are most important for composition of macroinvertebrate assemblage (decline of grazers/scrapers and phytophilous macroinvertebrates)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