Freshwater Pearl Mussel in Europe: Status and Conservation Issues

Jürgen Geist

Aquatic Systems Biology Unit

geist@wzw.tum.de

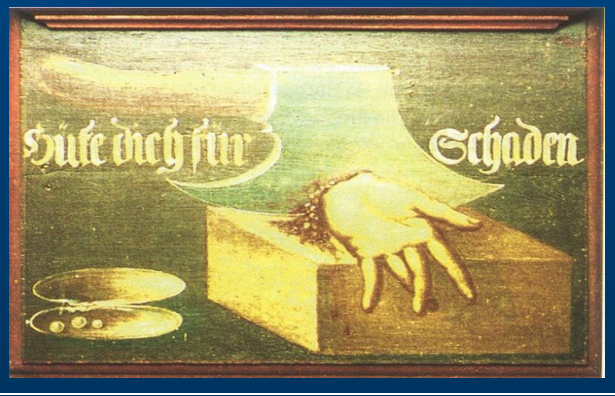
TECHNISCHE UNIVERSITÄT MÜNCHEN

The Freshwater Pearl Mussel: Target Species for Conservation

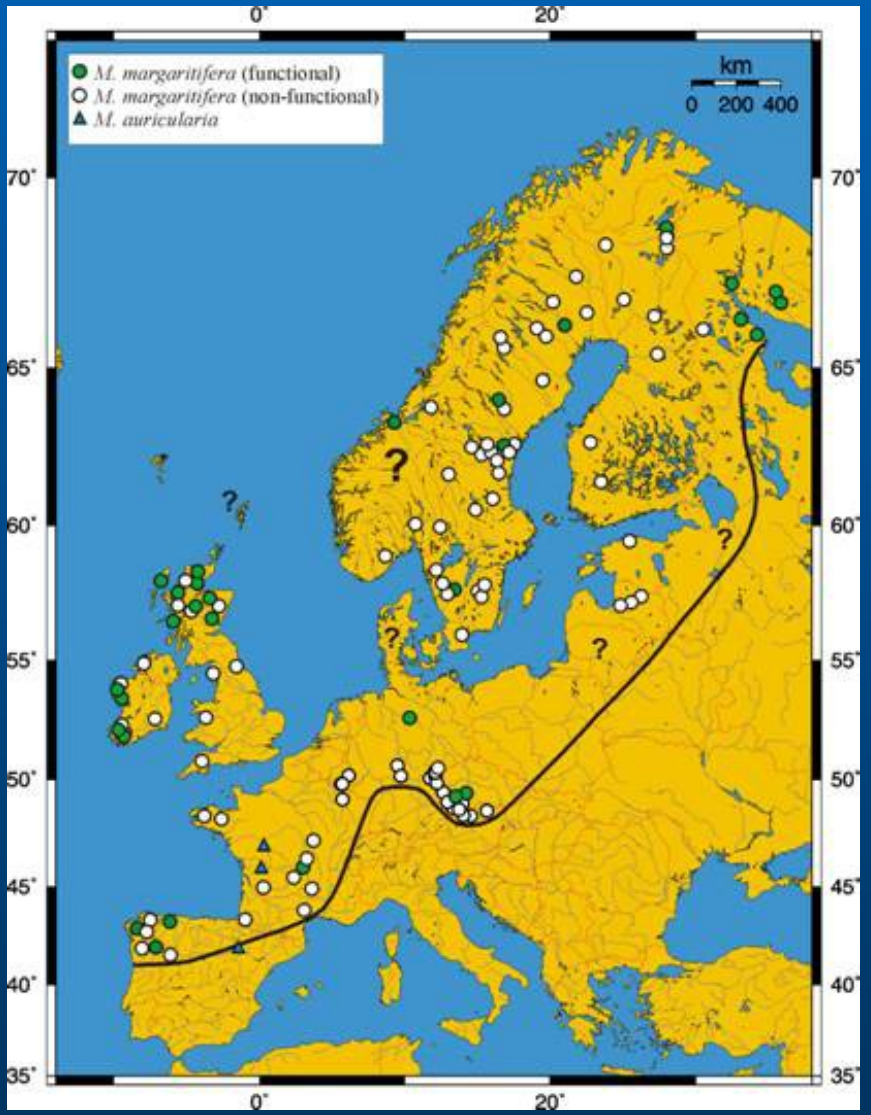
- Indicator species
- Keystone species
- Umbrella species
- Flagship species

- Core problem: recruitment

Geist (2010) *Hydrobiologia*

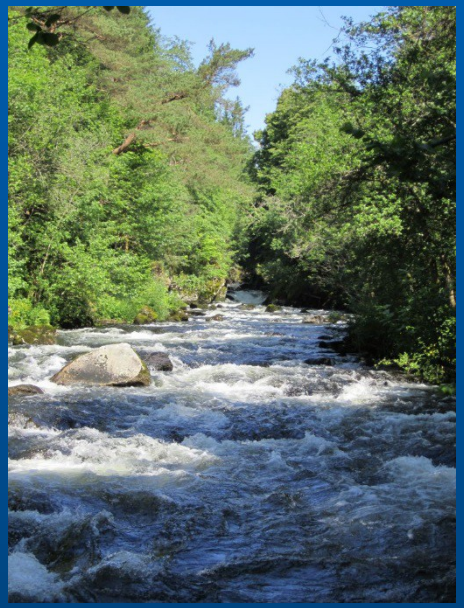
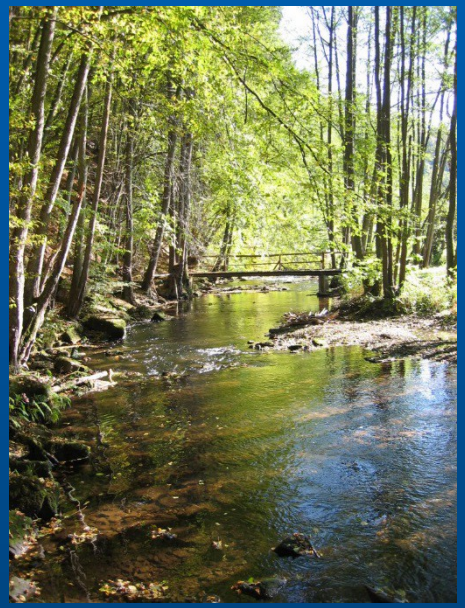


Distribution



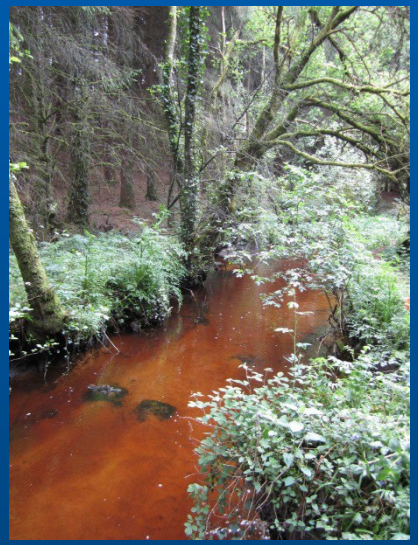
Geist (2010) *Hydrobiologia*

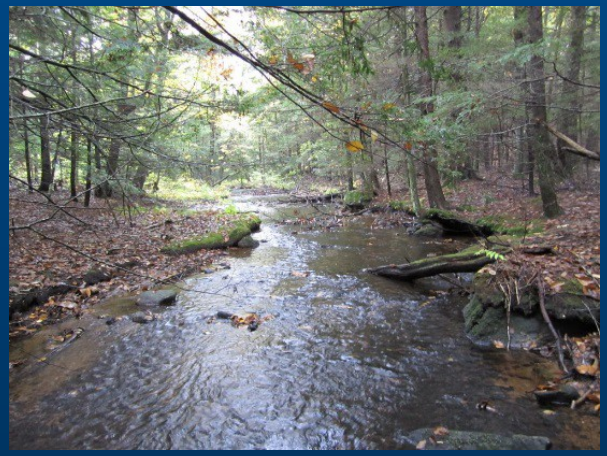
Diversity of Pearl Mussel Streams

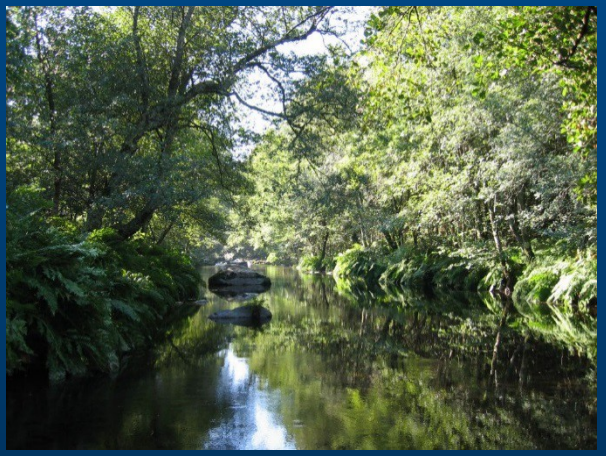






Diversity of Pearl Mussel Streams

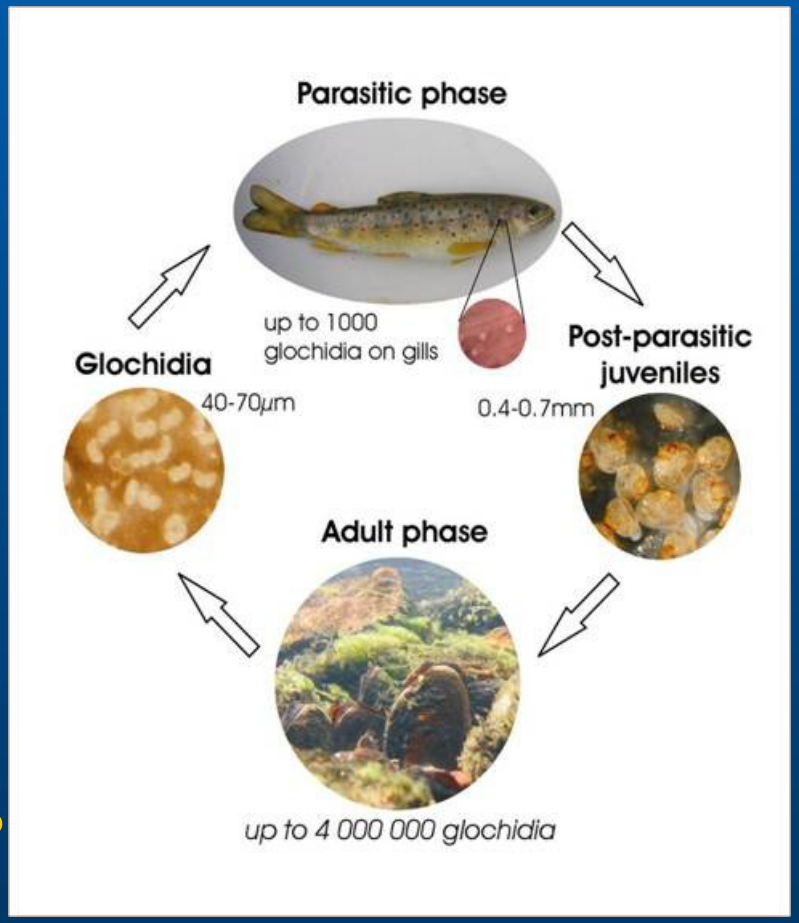





Environmental and Genetic Factors

Status of host fish stocks?



Habitat for juveniles / substratum?

Fertility / Gravidity?

+ Genetics?

+ Environmental change?

Geist (2010) *Hydrobiologia*

The First Step: Gravidity of Populations

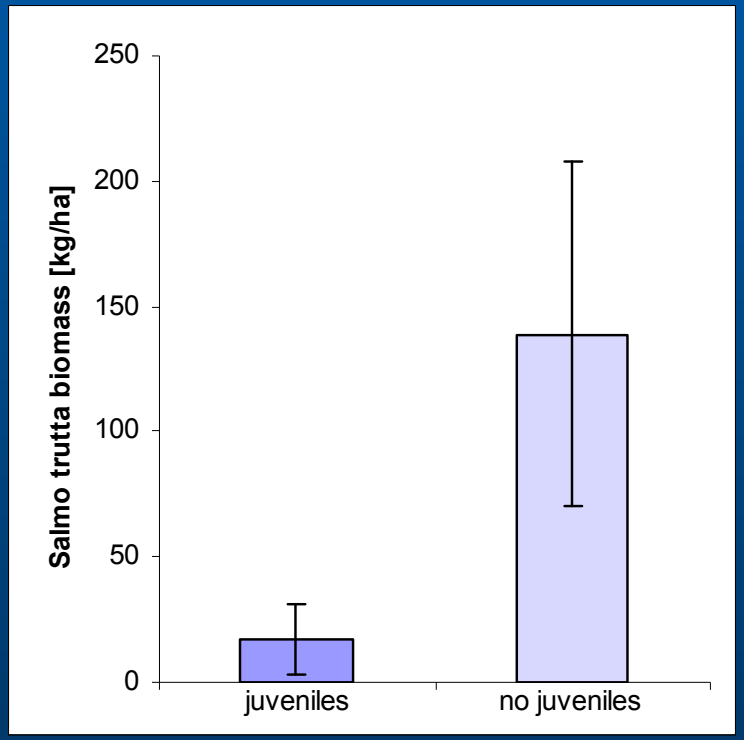
- Normal levels of gravidity in most streams
- No decrease of gravidity with age
- High reproductive potential
- Induced release of glochidia

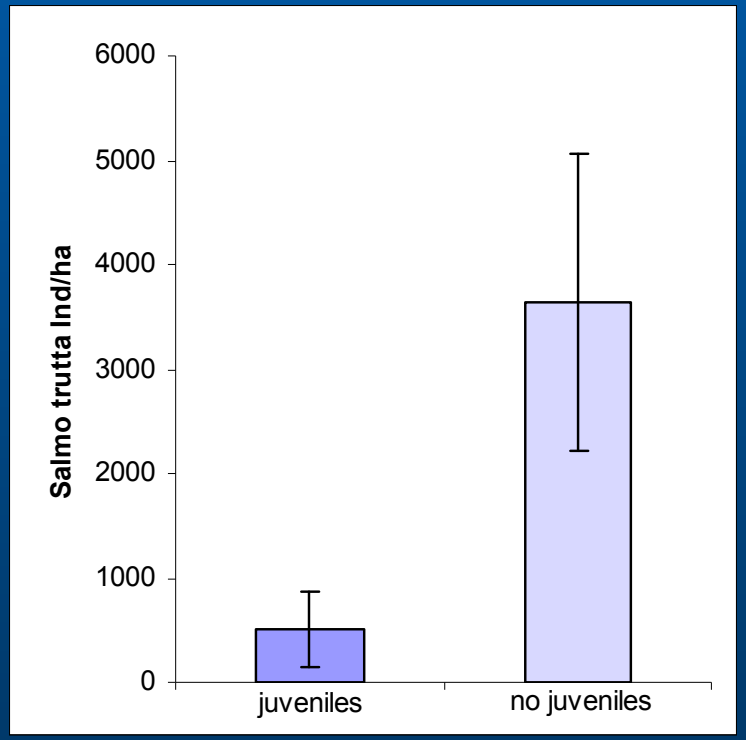
The Parasitic Phase on the Host Fish

Salmo trutta

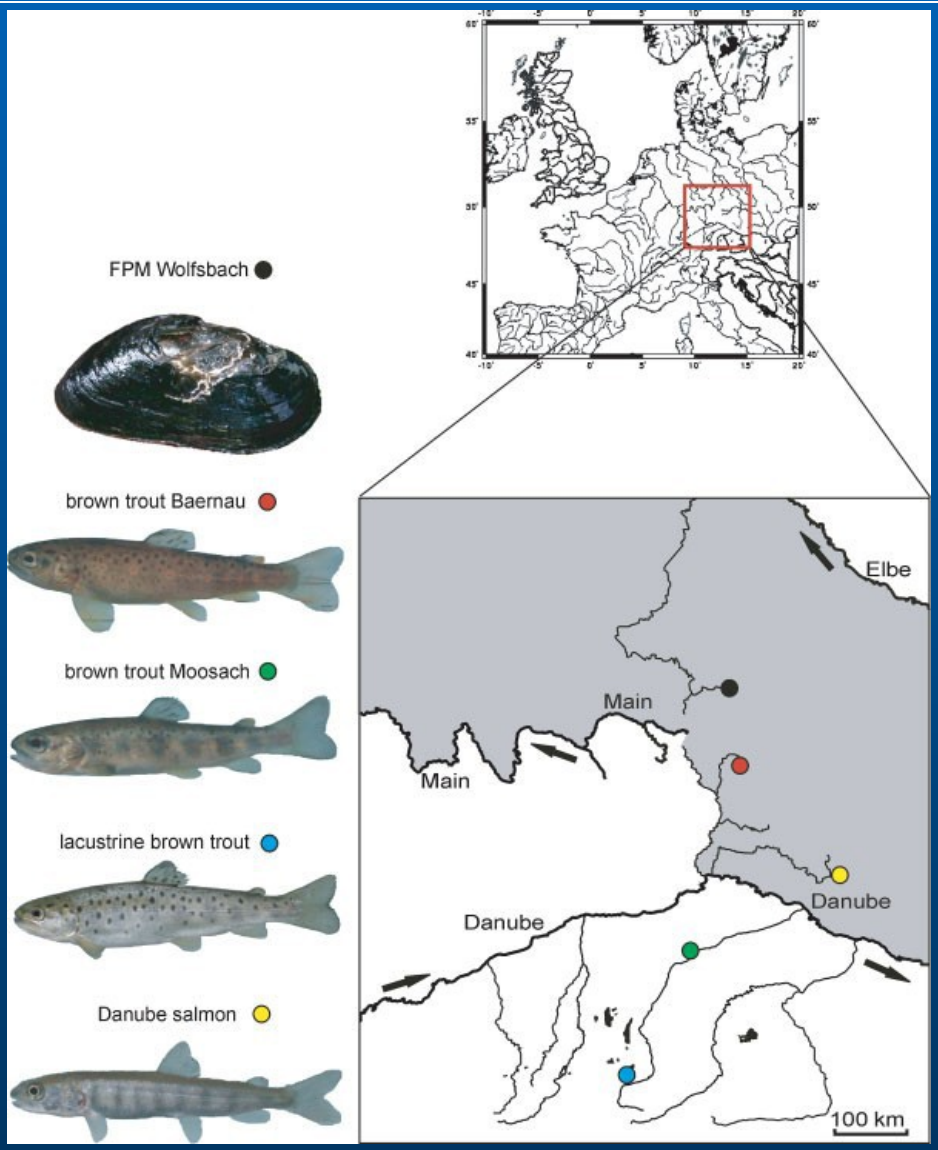
Gill of *S. trutta* with encysted glochidia

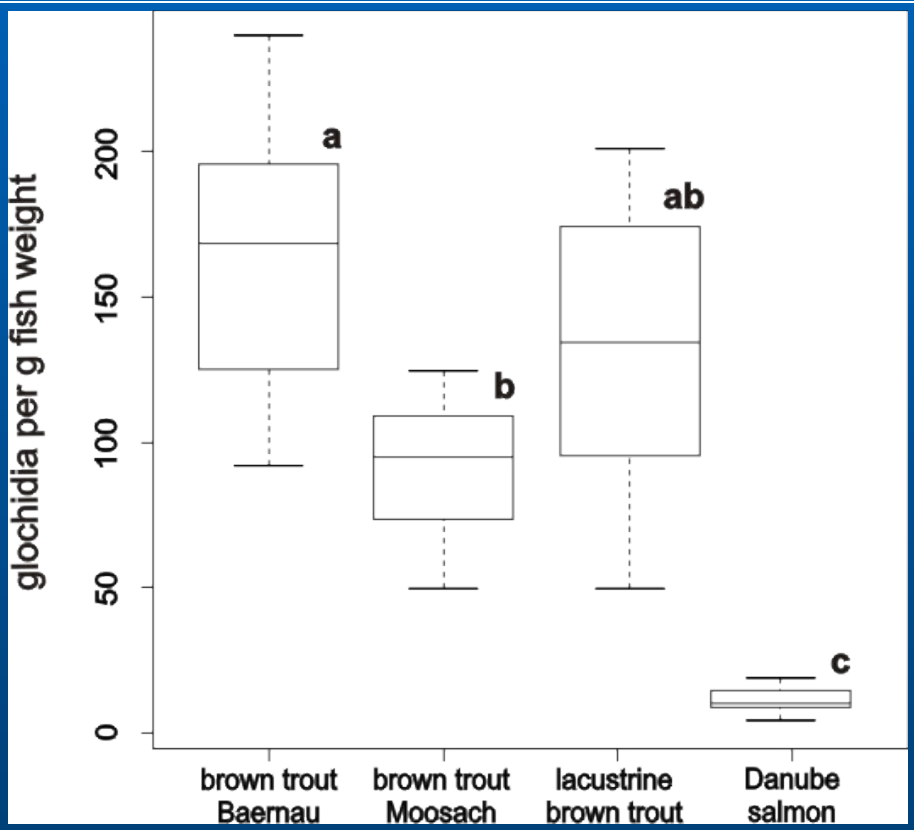
Host Fish Densities in Functional and Non-Functional Pearl Mussel Populations





Geist et al. (2006) *Aquatic Conserv.*

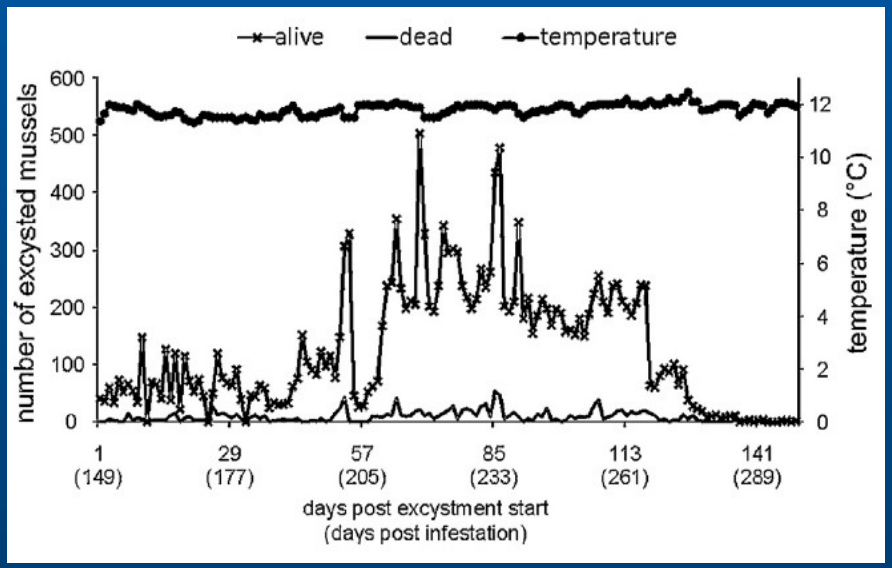




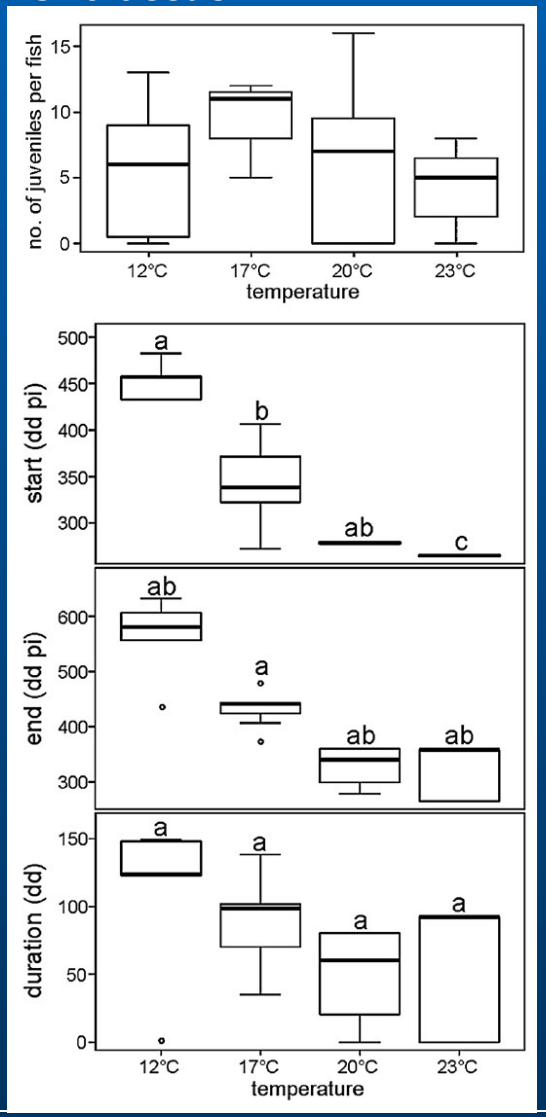
Taeubert et al. (2010) *Aquatic Conserv.*

Temperature-Dependence of Metamorphosis

M. margaritifera



U. crassus



Taeubert, Gum & Geist (2013) *Limnologica*

Taeubert, El-Nobi & Geist (2014) *Aquatic Conserv.*

Stream Bed:
The Core Problem for Juvenile Recruitment

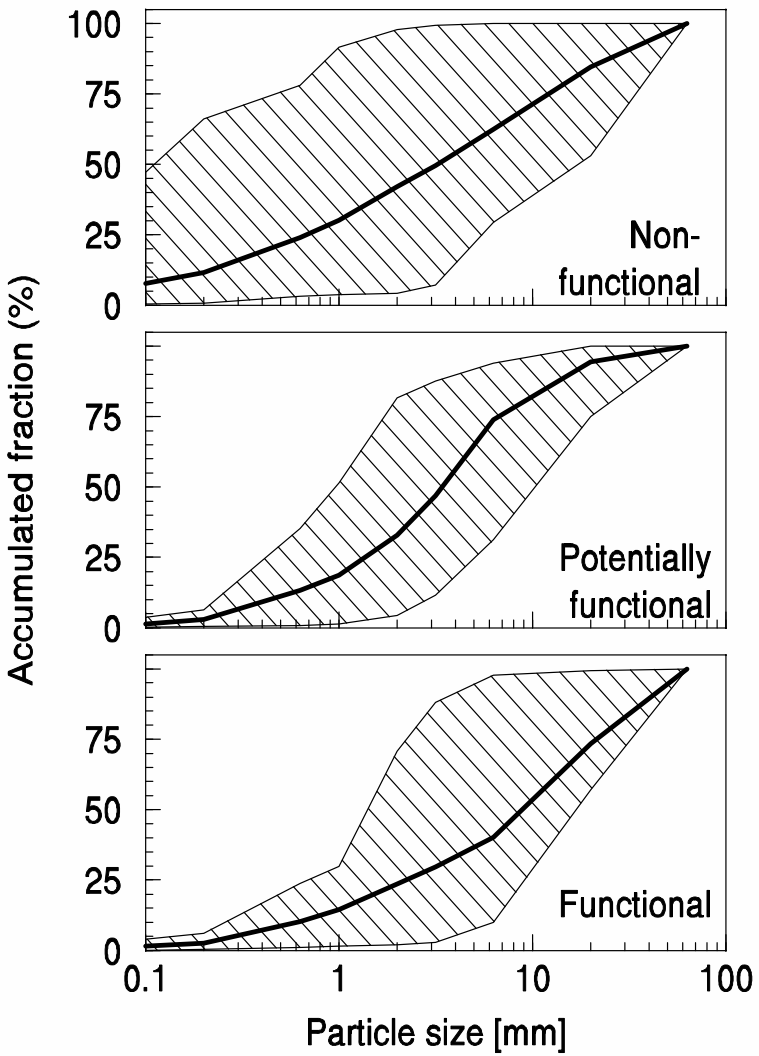
Texture

Functional populations:

- Well-sorted gravel
- Low percentage of fines

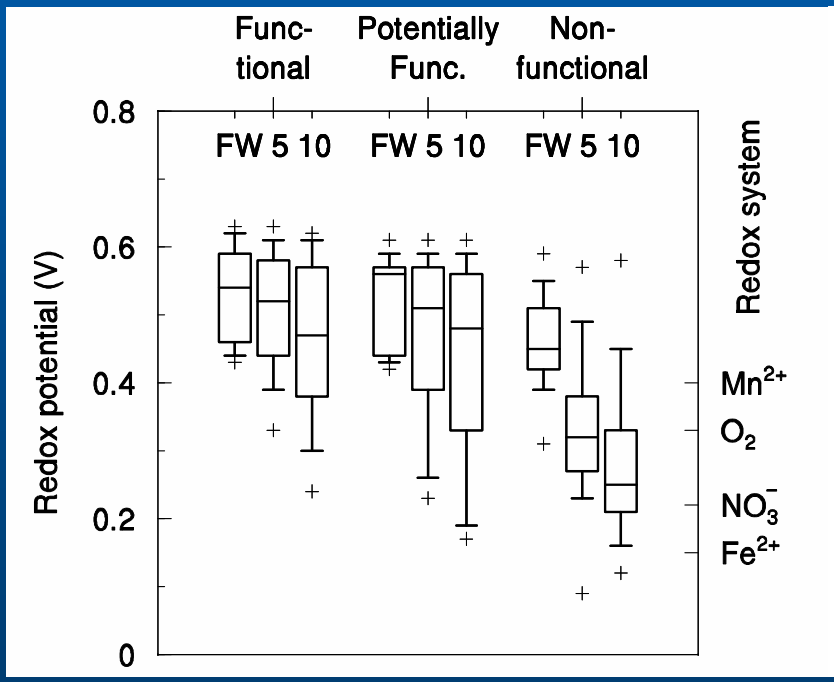
Non-functional populations:

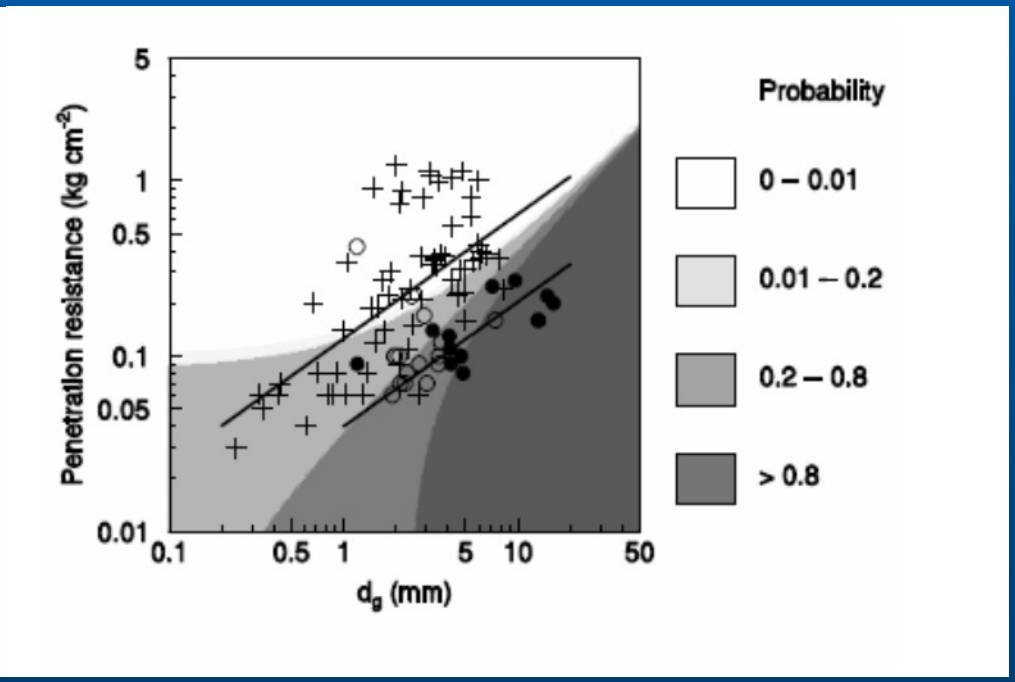
- Mixed texture
- High percentage of fines



Geist & Auerswald (2007) *Freshw. Biol.*

Determining Functional Substrate Conditions

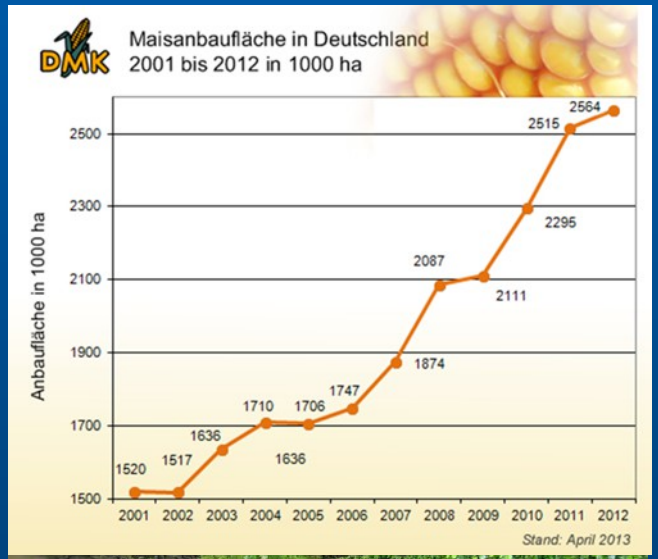




Geist & Auerswald (2007) *Freshw. Biol.*

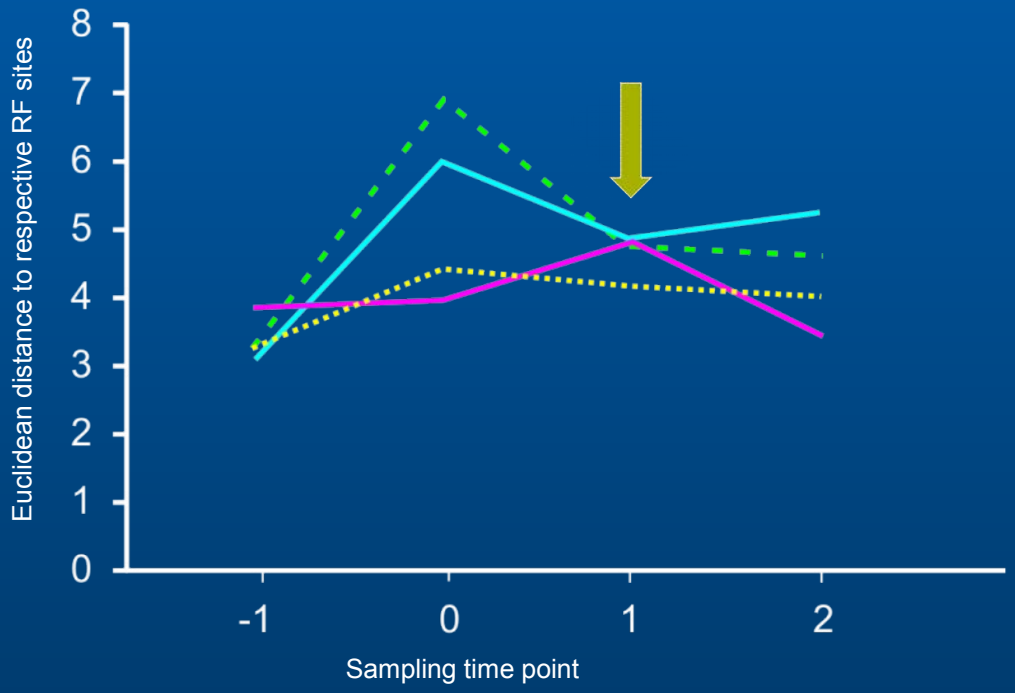
Changes in the Erosion – Sedimentation Patterns

- **Global / Climatic change**
- **Catchment area**
  - Landuse / vegetation
  - Reduced water retention
  - Lack of buffer strips
  - Nutrient loads
- **Endogenous factors**
  - Geomorphology / Structure (dead wood!)
  - Stream regulation
  - „natural flow regime“ and dynamics

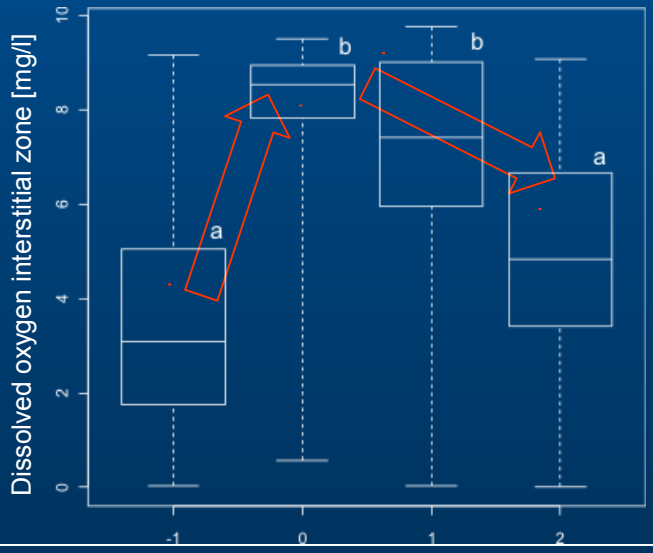


Comparisons of Different Stream Substratum Restoration Measures

Changes of Physicochemical Habitat Characteristics



Dissolved oxygen at 16/32 sites

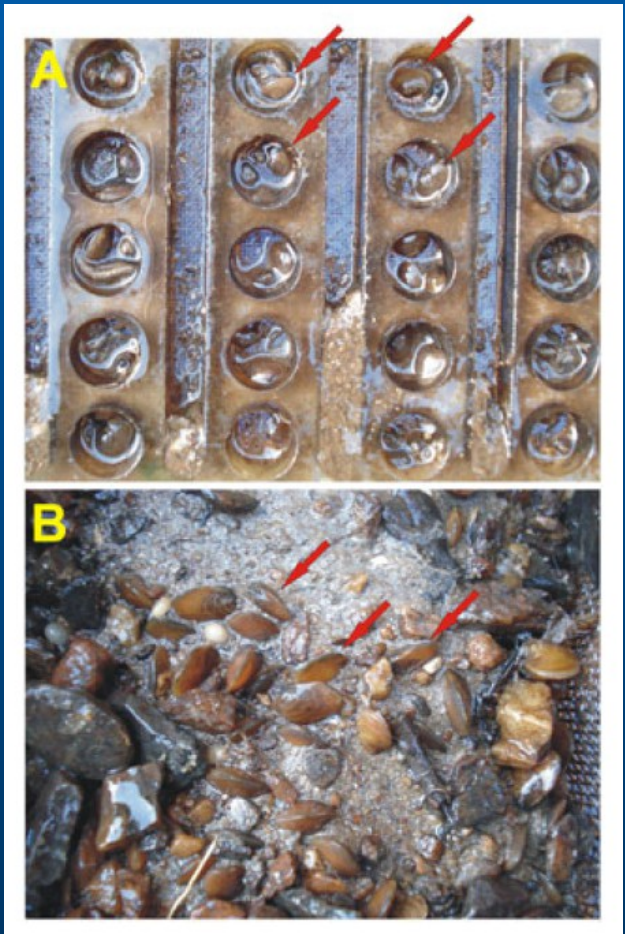


Pander, Mueller & Geist (2014) *River Res. Appl.*

Mueller, Pander & Geist (2014) *Ecolog. Engineering*

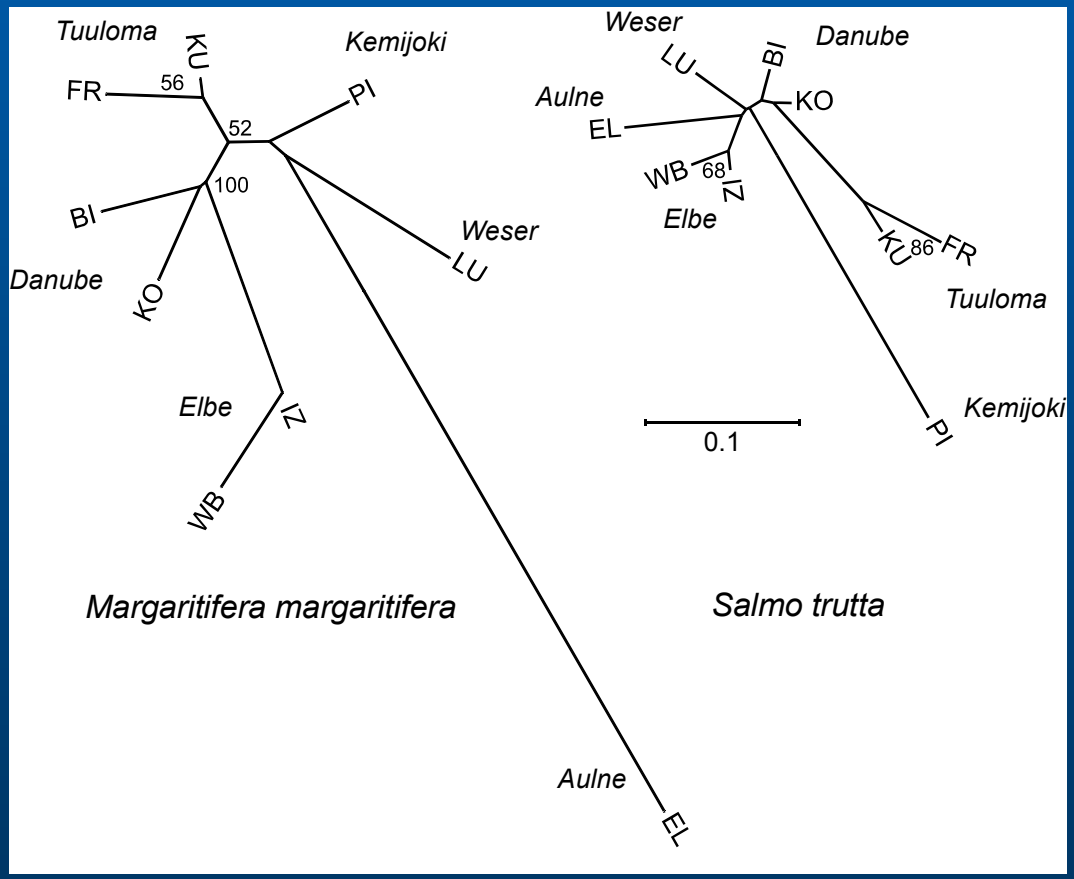
Kruskal-Wallis-ANOVA: $p < 0.001$, pairwise Mann-Whitney-U-Test: $p < 0.05$

Artificial Culturing in Cages and Boxes



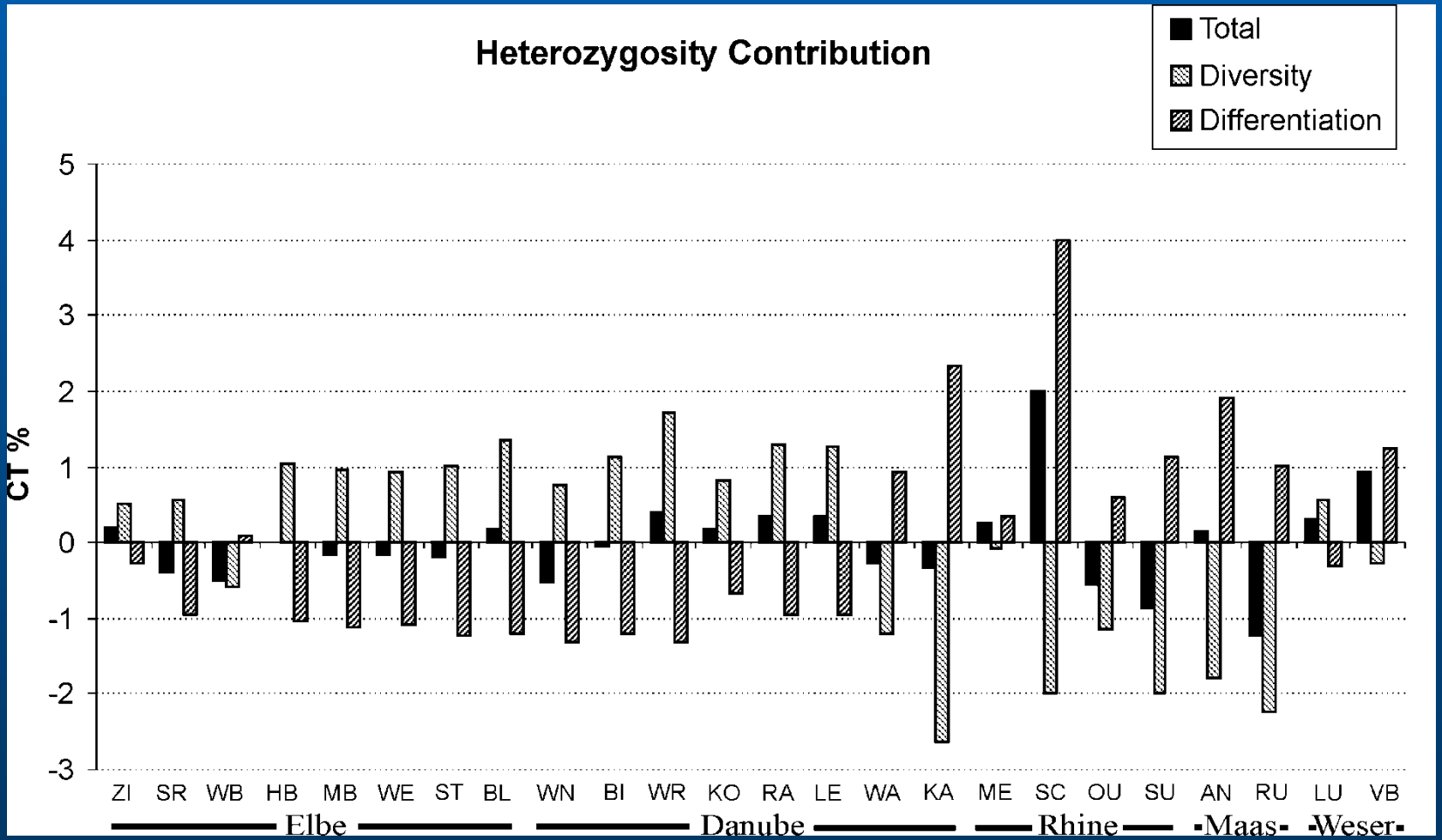
Gum, Lange & Geist (2011) *Aquatic Conserv.*

Population Genetic Information



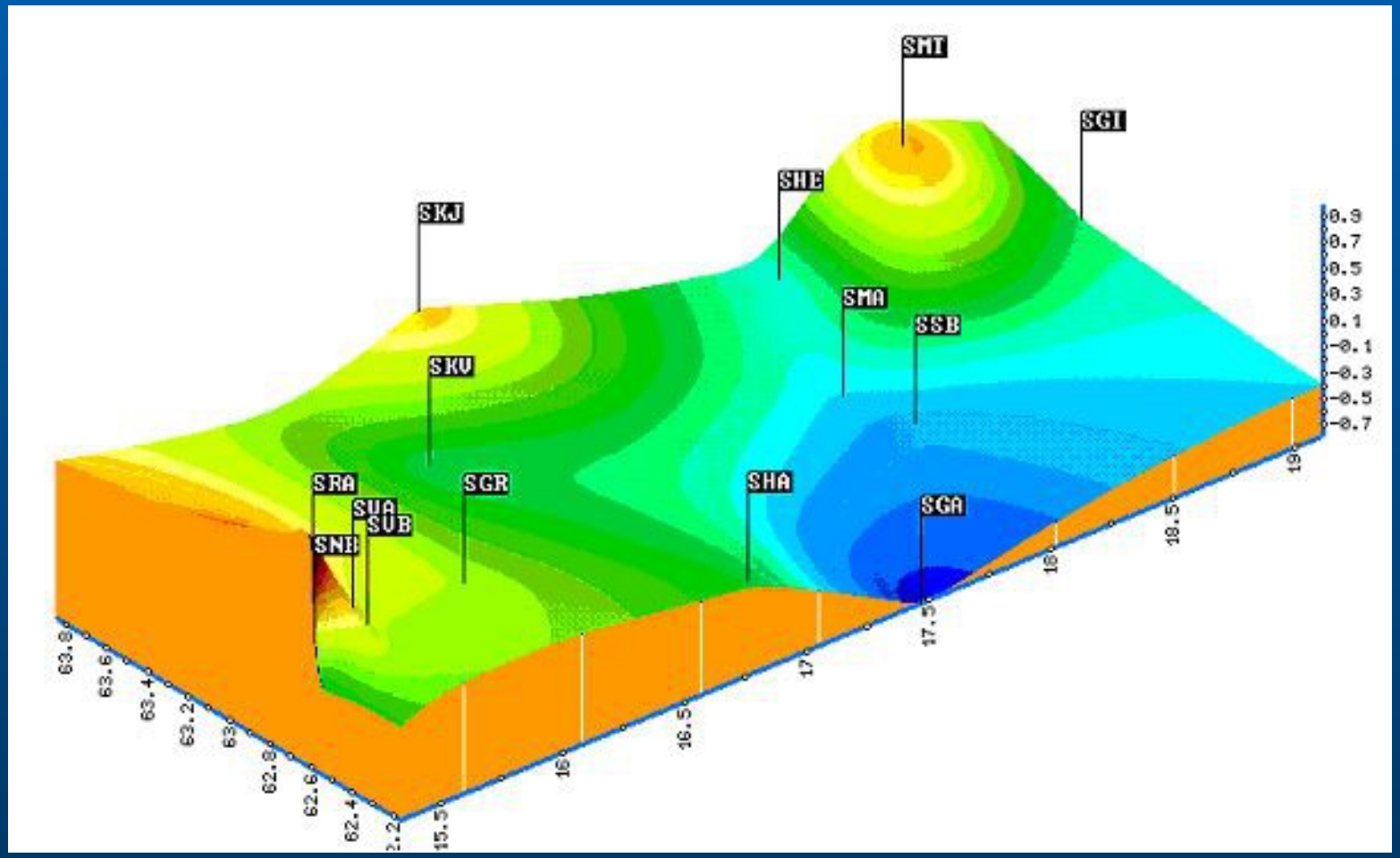
Geist & Kuehn (2008) *Mol. Ecol.*

Identification of Priority Populations



Geist & Kuehn (2005) *Mol. Ecol.*

Landscape Genetics

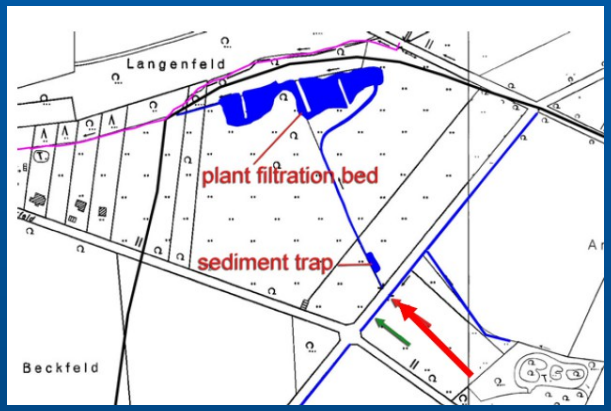


Geist et al. (2009) *Conserv. Genetics*

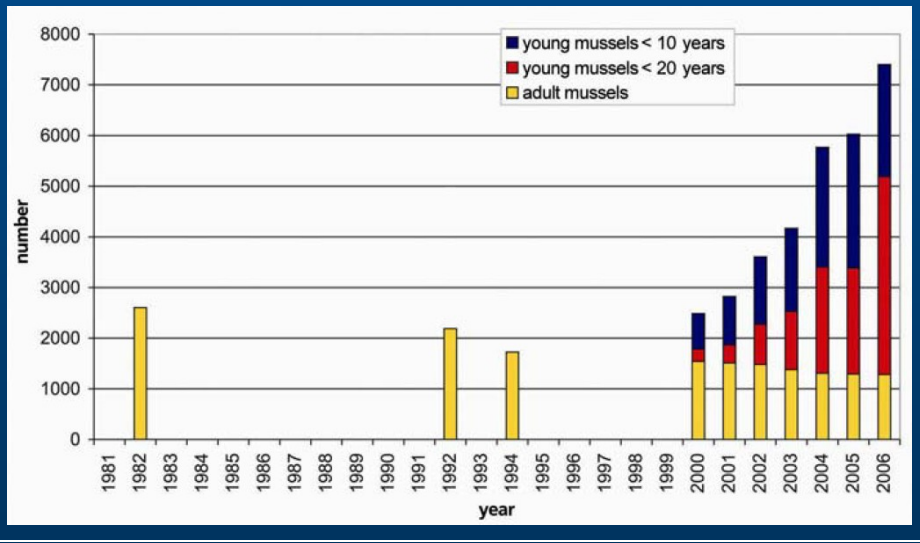
Examples of Currently Applied "Conservation" Approaches and their Problems

Approach	Problem
Infestation and release of host fishes from hatcheries into natural populations	Does often not address the bottleneck Low persistence of allochthonous fishes Possible gene swamping, disease
Release of early post-parasitic juveniles into wild populations	Trial and error based Poor monitoring possibilities
Population surveys / counts of mussels, Water quality control	Only a monitoring tool No conservation action
Gradivity monitoring of adult mussels	Not a powerful indicator No conservation action

Successful Examples of Restoring Freshwater Mussel Populations



Dr. Reinhard Altmüller
and the Lutter Project



Altmüller & Dettmer (2006)

Effective Conservation Management: A Stepwise Approach

Step 1: Decisions on conservation objectives

Step 2: Determination of status quo

Step 3: Identification of bottlenecks and problems

Step 4: Decisions on conservation action with stakeholders and sponsors

Step 5: Conservation action

Step 6: Evaluation and adaptive management

Step 7: Publication of results

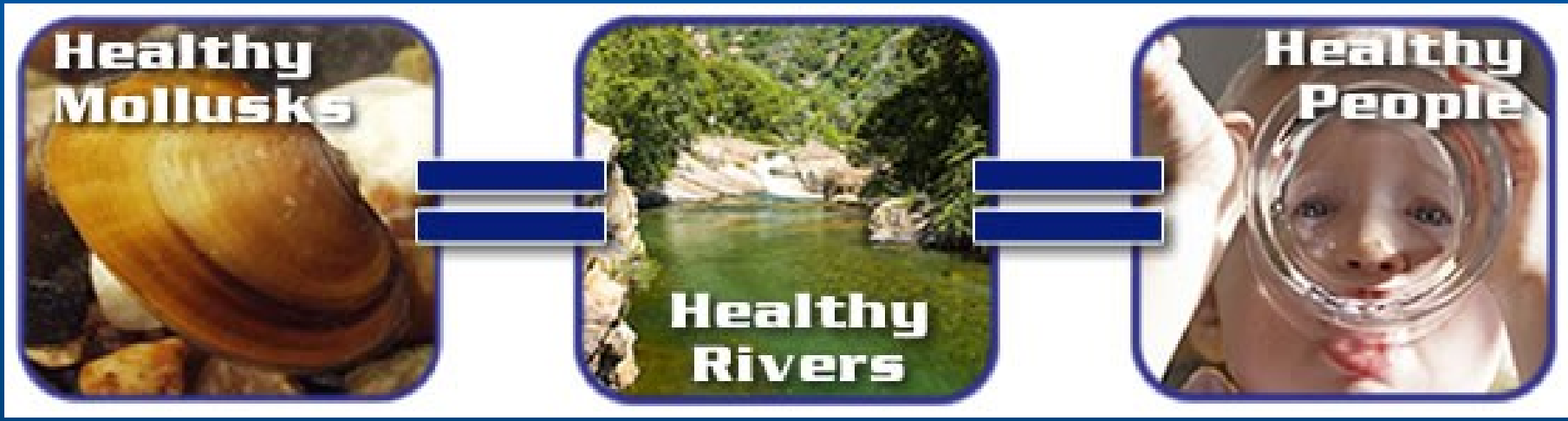
Conservation of Functionally Intact Populations (Kola peninsula)






Conservation of Functionally Intact Populations (North America)

Public Awareness and Communication



Motto of the Freshwater Mollusk Conservation Society Meeting 2009

in Baltimore, USA

Conclusions

- Freshwater pearl mussel populations continue to be in trouble, despite of knowledge on the limiting factors for recruitment
- Prioritization of populations / areas of conservation based on ecological and genetic data is important
- Catchment conservation in functionally intact populations should have highest priority
- Combination of short-term remediation (culturing) with long-term objectives (catchment restoration) is essential
- Conservation needs to be more systematic and requires evaluation plus publication of positive and negative results

Merci beaucoup pour votre attention!

www.fisch.wzw.tum.de