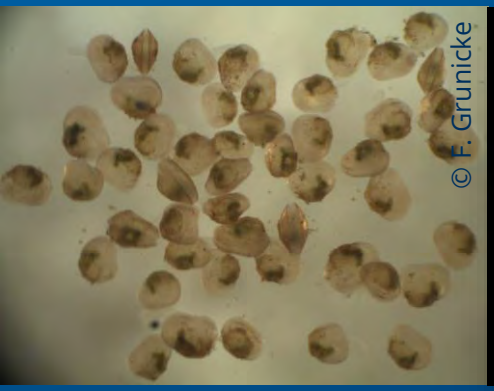
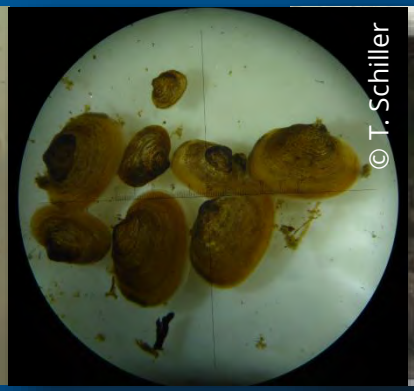
TECHNISCHE UNIVERSITÄT DRESDEN
Institut für Hydrobiologie
CAWR Center for Advanced Water Research
FLUSSMUSCHELN
leben.natur.vielfalt die Strategie
Fakultät Umweltwissenschaften Fachrichtung Hydrowissenschaften Institut für Hydrobiologie



Conservation of freshwater mussels by a combined approach of research and implementation









Thomas Berendonk, Jana Schneider, Annekatrin Wagner, Thomas Schiller, Sascha Krenek, Felix Grunicke

1. International freshwater mussel workshop in Dresden, 25.-27. March 2019

Jointly funded by BMBF and BMU/BFN (Funding Code: 01LC1313A-D and 3514685E13-I13)

Bundesministerium für Bildung und Forschung
Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit
BfN Bundesamt für Naturschutz
Bayerischer Naturschutzfonds

Welcome!



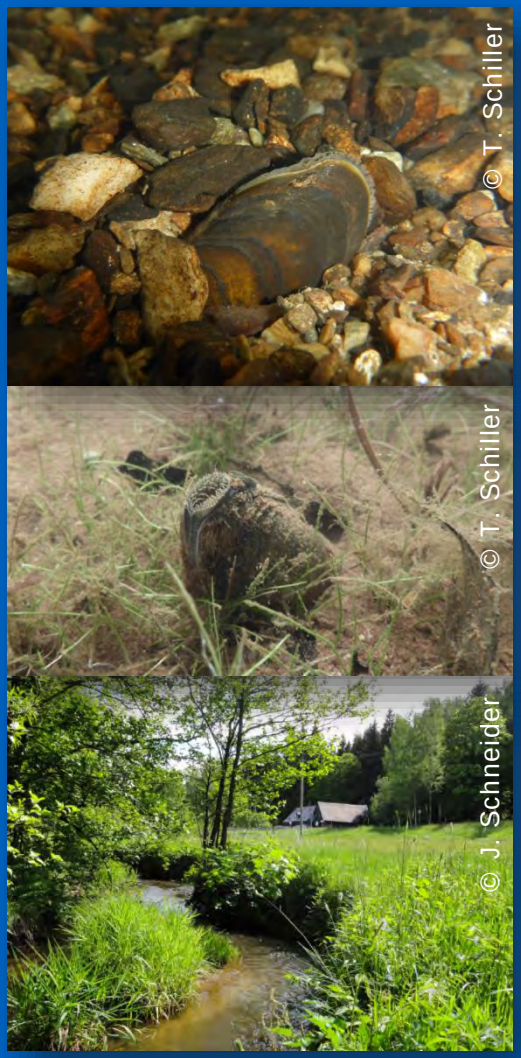
TECHNISCHE UNIVERSITÄT DRESDEN

FLUSSMUSCHELN

1st international Workshop

Just facts:

- **17 nations**
- **75 participants**
- **6 sessions**
- **27 talks**
- **10 posters**



Implementation of regional protective measures and development of a new national conversation program for priority species:

Freshwater pearl mussel
(*Margaritifera margaritifera*)

Painter`s mussel
(*Unio pictorum*)

- Restoration of their natural reproduction
- Conservation of genetic diversity
- Identification of suitable habitats

ArKoNaVera: research and implementation

F&U | NBS
Forschung zur Umsetzung der Nationalen BiodiversitätsStrategie

Eine gemeinsame Förderinitiative des Bundesministeriums für Bildung und Forschung (BMBF) und des Bundesministeriums für Umwelt, Naturschutz, Bau und Reaktorsicherheit (BMUB).



leben.natur.vielfalt
die Strategie



Ausgezeichnetes Projekt
UN-Dekade Biologische Vielfalt
2018

leben.natur.vielfalt
die UN-Dekade

- German government`s nature conservation policy: implementation of the national strategy on biological diversity
- 4 Research partners
- 4 Implementation partners

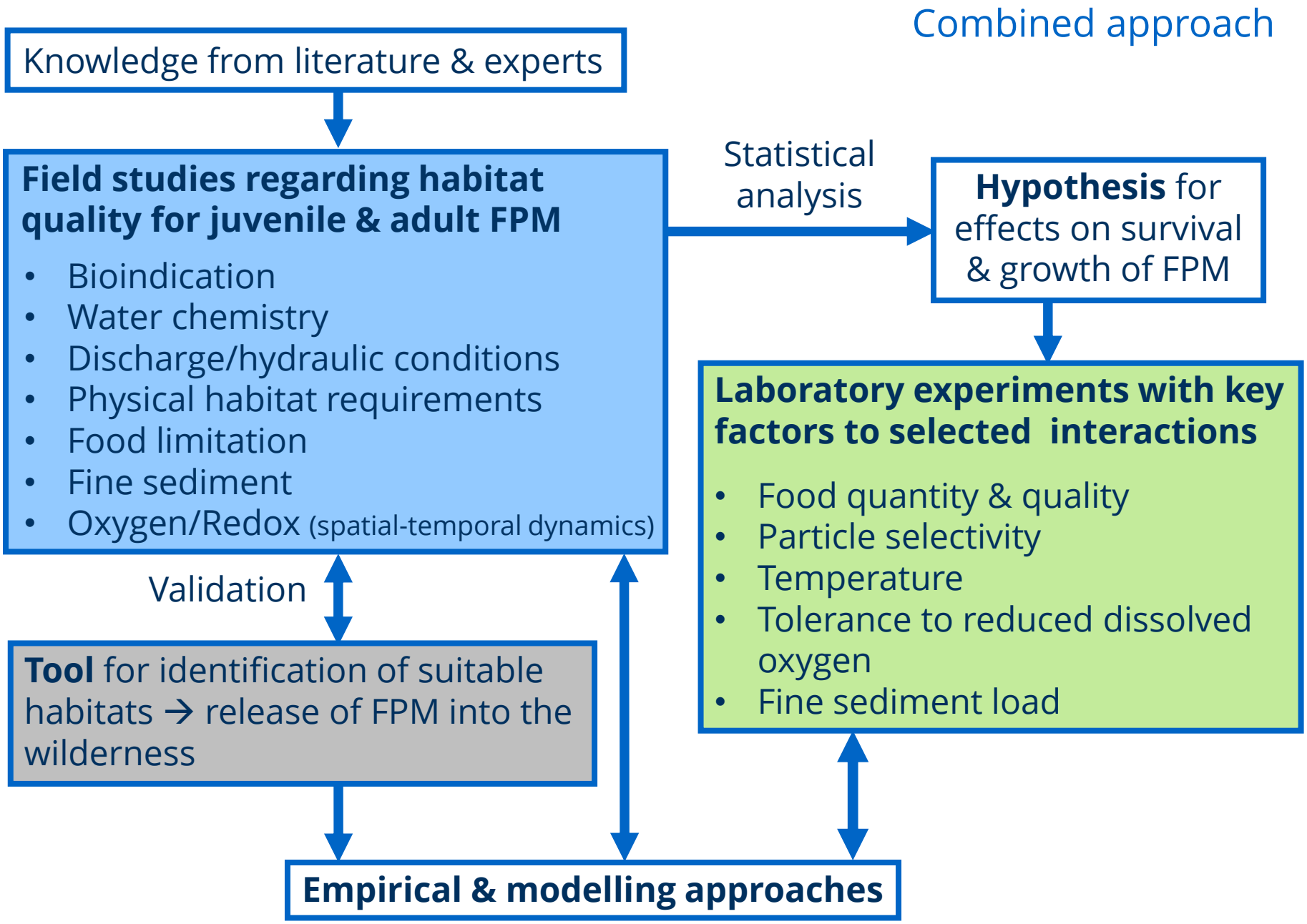
Technische Universität München
HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ
Fraunhofer IMW
Sächsische Landesstiftung Natur und Umwelt
VOGTLAND LANDKREIS
LANDKREIS PASSAU
WAGU

Local destinction

- 19th century Timber rafting, stamp mills, pearl fishing, industrial & communal sewage
- 1900-1950 Industrial & communal sewage, river regulation & maintenance work
- 1951-2000 Communal sewage & industrial agriculture
- 21st century Global warming?






Combined approach
Knowledge from literature & experts
Field studies regarding habitat quality for juvenile & adult FPM
• Bioindication
• Water chemistry
• Discharge/hydraulic conditions
• Physical habitat requirements
• Food limitation
• Fine sediment
• Oxygen/Redox (spatial-temporal dynamics)
Statistical analysis
Hypothesis for effects on survival & growth of FPM
Laboratory experiments with key factors to selected interactions
• Food quantity & quality
• Particle selectivity
• Temperature
• Tolerance to reduced dissolved oxygen
• Fine sediment load
Validation
Tool for identification of suitable habitats → release of FPM into the wilderness
Empirical & modelling approaches

1. Ecology of freshwater mussels
2. Quantitative characterisation & assessment of mussel habitats
3. Selection of suitable habitats
4. Evaluation of captive-bred mussel release
5. Nutritional requirements of freshwater mussels
6. Significance of global warming for freshwater mussels

Current work status within the project ArKoNaVera

1st steps in establishment captive breeding of Painter`s mussel



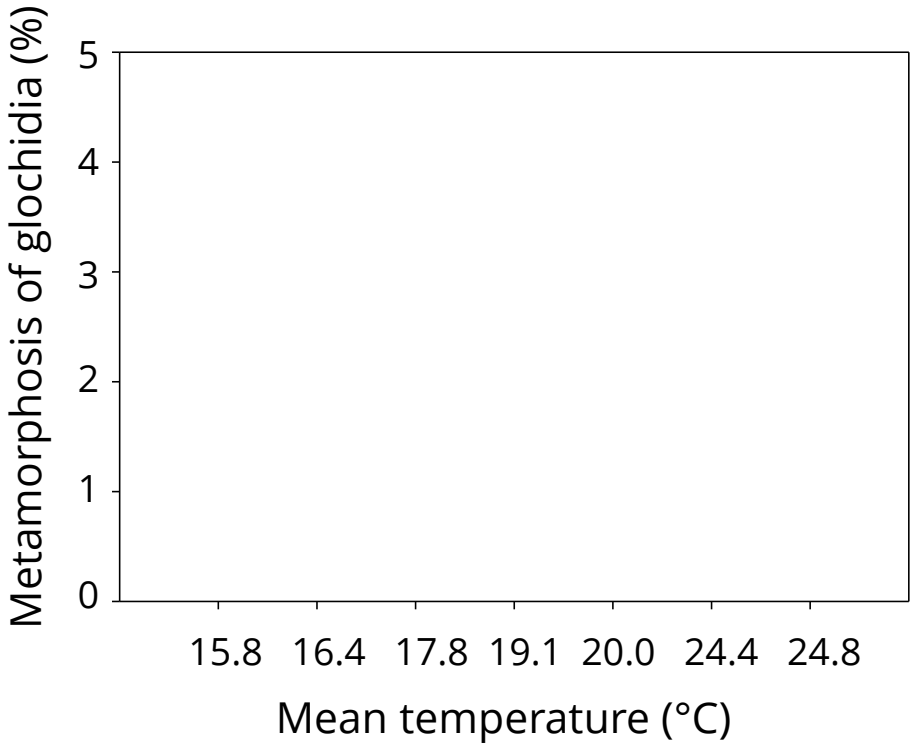


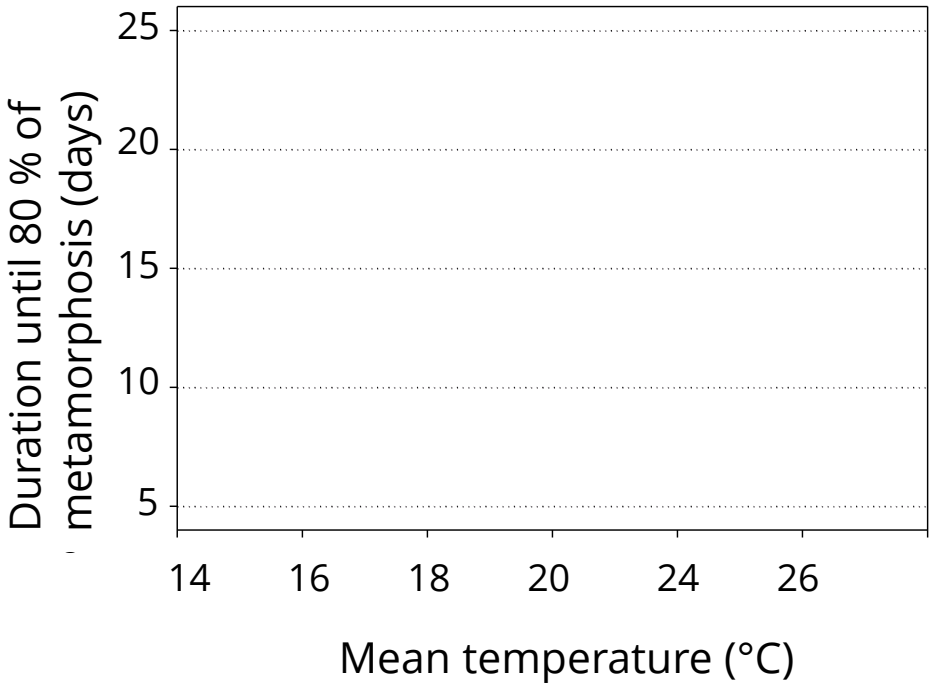


General questions:

infection & caging of host fish (*Perca fluviatilis*)
metamorphosis of glochidia
conditions for reared mussels
→ effect of temperature & food

First findings of captive breeding Painter's mussel

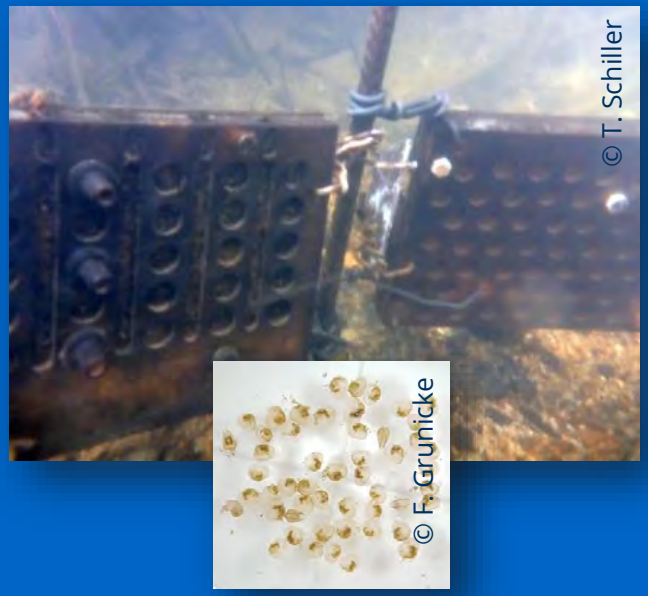




- **Optimal breeding & caging temperature:** 18°C
- **Development time:** 11 to 22 days
- **Optimal diet:** natural detritus & *Nanochloropsis sp.* (once a week)

2. Quantitative characterisation & assessment of mussel habitats

Buddensiek cages
Flowing water



Wire mesh tubes
Hyporheic zone



Sediment cages
Flowing water



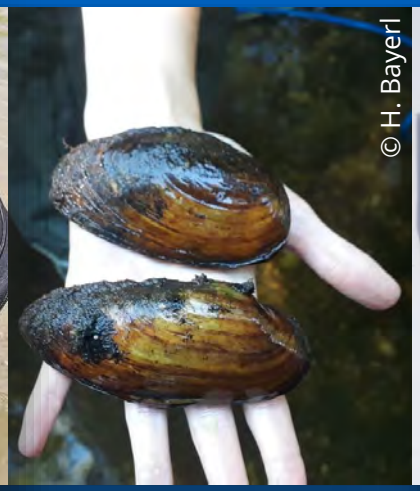


Different bioindication methods with captive-bred FPM
→ identification of suitable habitats

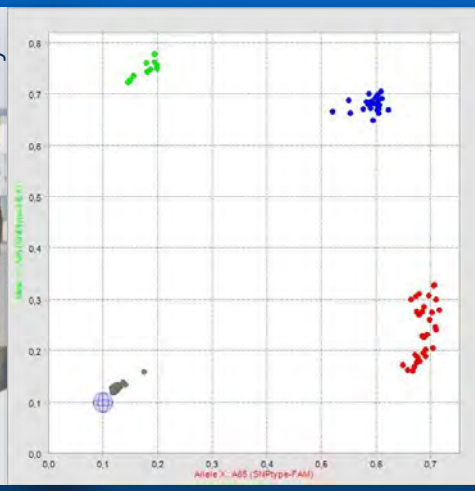
Presentation at Tuesday held by T. Schiller (10:20)

2. Quantitative characterisation & assessment of mussel habitats









Habitat assessment as prerequisite in freshwater mussel conservation:

Methodologies & implications using the Painter`s mussel as example



Presentation at Tuesday held by H. Bayerl (13:30)

3. Selection of suitable habitats

	EB	GB	HB	RB	TB	Tettw	WB
Chemical criteria							
Physical criteria (FW)							
Discharge							
Substrate quality							
Fine sediment input							
Water temperature							
Brown trout							
Bioindication 0+FPM							
Bioindication older FPM							

very good good satisfactory bad

3. Selection of suitable habitats

Mean values (Jun-Aug 2016-2018)

	Threshold value *		EB	GB	HB	RB	TB	Tettw	WB
Hardness	5,6	dH	3,0		2,6	3,0	3,9	6,0	3,2
NO3-N	1	mg/l	2,9	1,8	2,1	1,9	3,6	2,5	0,9
Total phosphorous	0,07	mg/l	0,08	0,08	0,05	0,06	0,05	0,19	0,05
Ca	10	mg/l	13,8	14,3	9,9	12,4	19,6	21,8	11,5
Mg	6	mg/l	5,3	5,4	5,1	6,0	6,1	8,8	4,3
NH4-N	0,3	mg/l	0,12	0,50	0,05	0,03	0,09	0,04	0,03
Conductivity	179		189	199	158	210	218	302	163
pH	6,7-7,3		7,1	7,0	7,0	7,1	7,0	7,2	6,9
mean O2-saturation	95	%	93	89	99	97	95	99	97
min O2-saturation	90	%	88	30	89	87	83	89	70
Turbidity	10	NTU	13,0	6,9	7,6	10,9	16,0	13,5	11,7
min Discharge	5	l/s	4,7	0,4	26,5	7,6	9,8	1,2	0,2
Redox_5cm depth	300	mV	310	352	297	318	274	346	287
Redox loss	20	%	30	24	29	34	33	30	37
Fine sediment Substrat	15(20)	%	16	11	17	19	18	12	16
Fine sediment Input	150	gDW/m2*d	128	235		425	340	225	121
Max water temperature	23	°C	19,3	18,2	19,5	20,2	19,6	22,3	24,5
Brown trout	0,15	ind/m2	0,49	0,52	0,34	0,74	0,48	0,53	0,16

Better than threshold

Limits tempo-rarily exceeded

Limits permanently exceeded

Limits strongly exceeded

** from "Water quality - Guidance standard on monitoring freshwater pearl mussel (M. margaritifera) populations and their environment " BS EN 16859:2017*

3. Selection of suitable habitats







Freshwater pearl mussel conservation in Lower Bavaria:

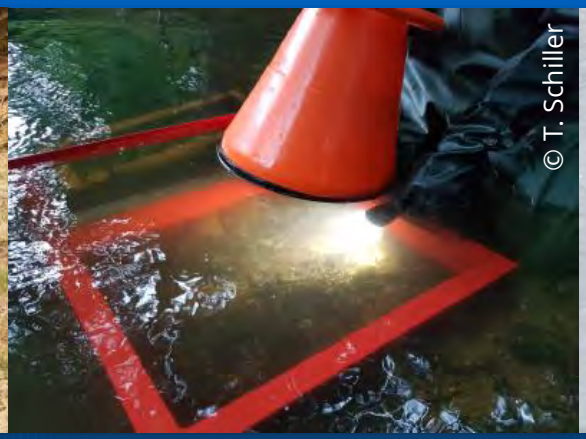
Breeding & releasing juvenile FPM



Presentation at Tuesday held by M. Denic (15:30)

4. Evaluation of captive-bred mussel release







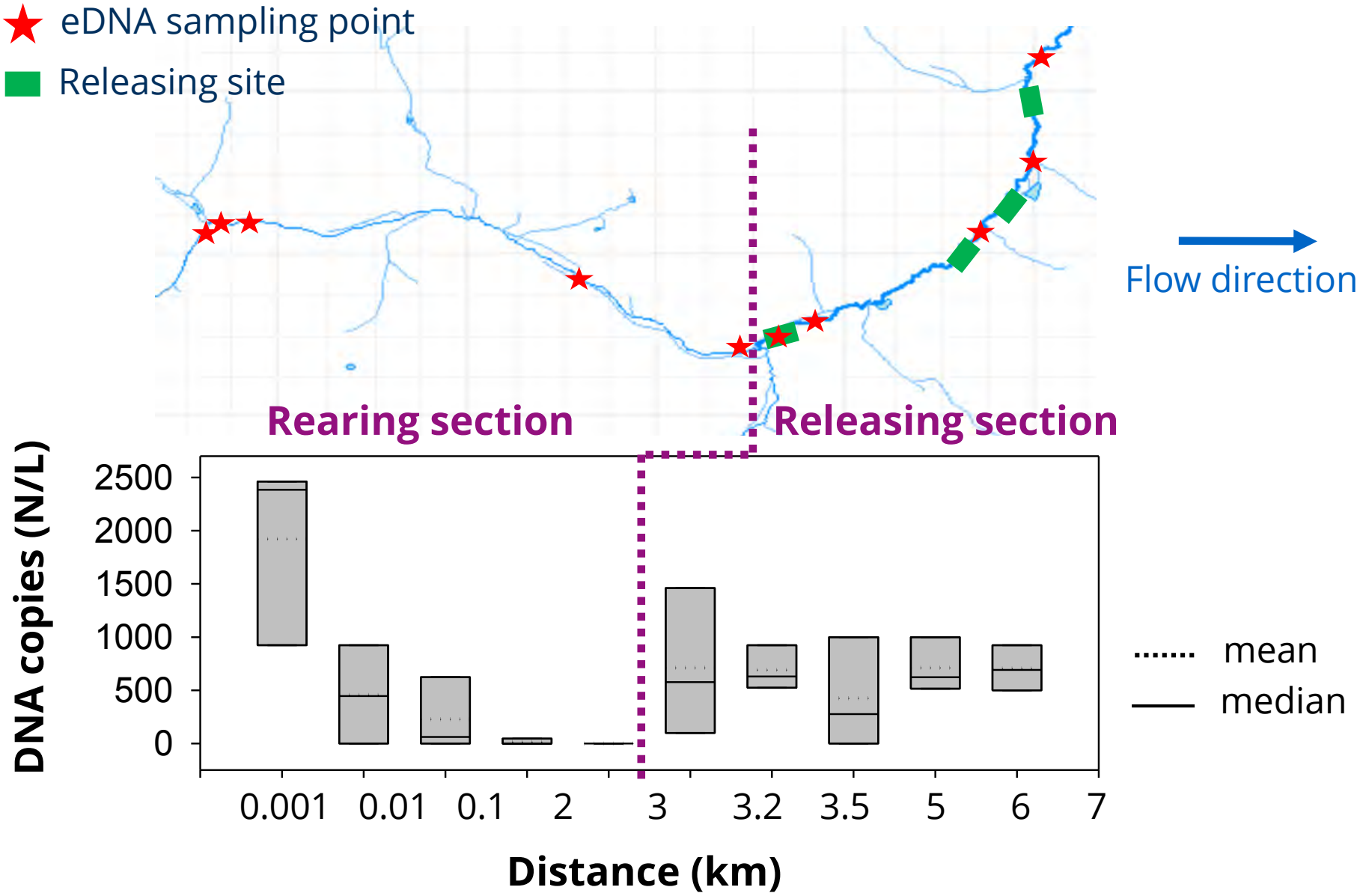
First monitoring of released captive-bred juvenile FPM

Analysis of **eDNA** in water samples

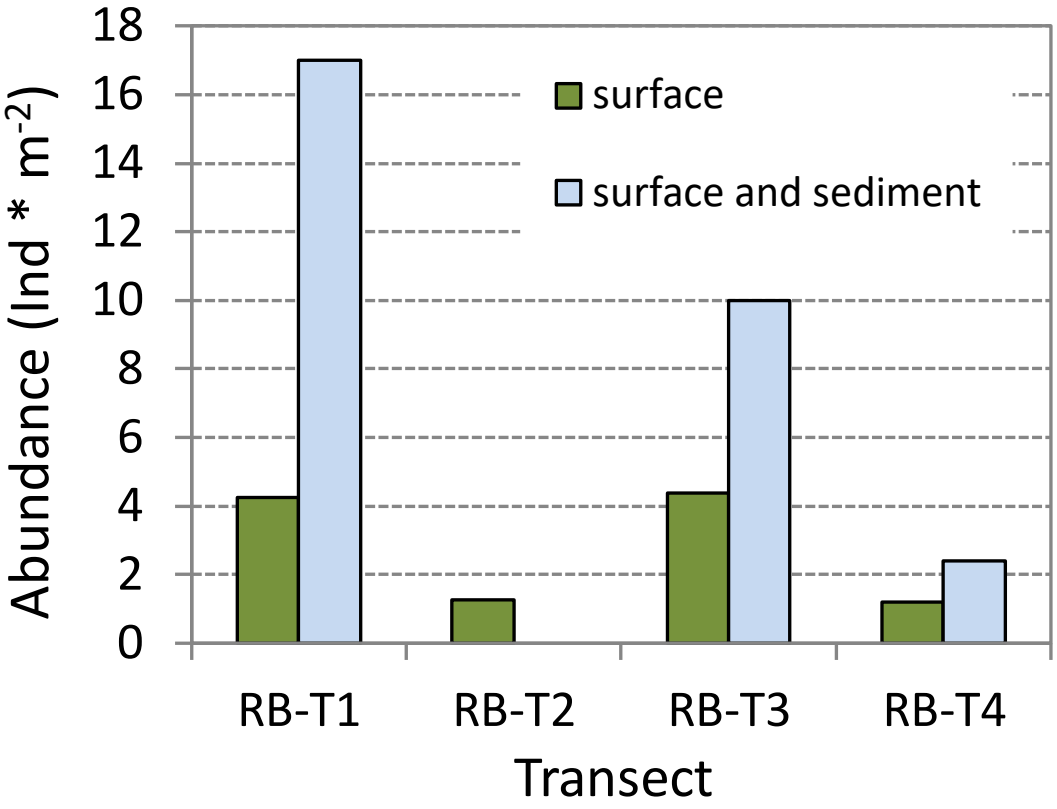
Visual search in transects

Combined search: sediment surface & in river bed sediment

eDNA analysis in rearing & releasing sections



Search on sediment surface & in river bed sediment





Visual vs. combined search → **1 : 2,18**

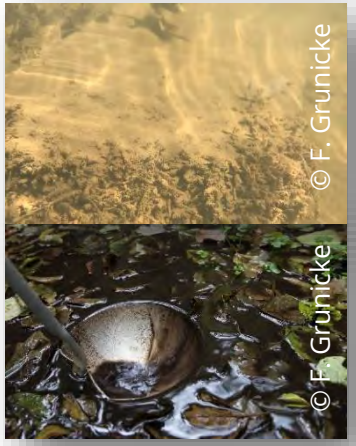
Survival 18 % (= 750 FPM) : survival 39 % (= 1633 FPM)

→ **Overall survival ~ 30 %**

5. Nutritional requirements of freshwater mussels

Feeding experiments

- **30 mussels** per replicate
- **Sedimented seston** collected from the river bottom
- **Detritus** from wet meadows & floodplain forests
- **No addition of algae** (e.g. *Nannochloropsis sp.*)



Metagenomic profiling for dietary analyses

Samples from food ressources & mussel intestine



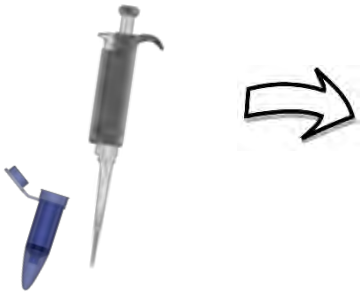


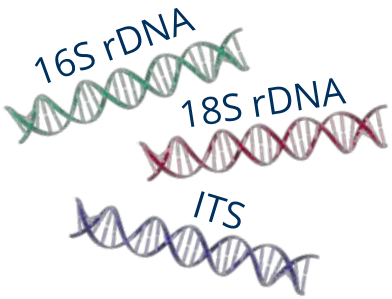


DNA extraction

DNA marker amplification

High-throughput sequencing



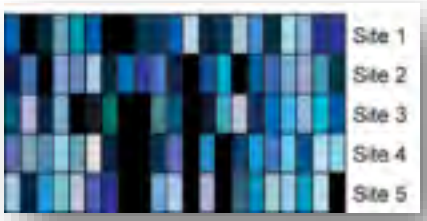


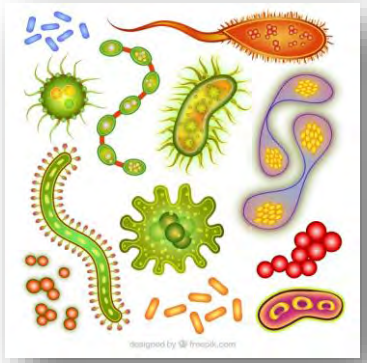


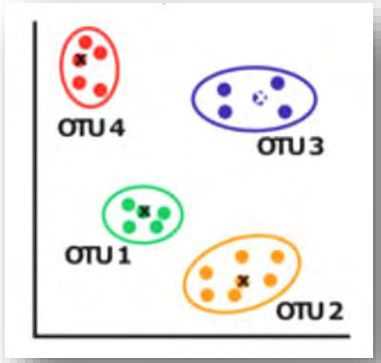
Food composition & consumption

Taxonomic assignment

Bioinformatic processing





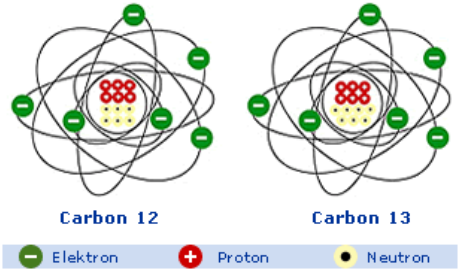


Combined dietary analysis approach

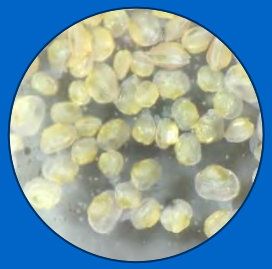


Metagenomics

(Eukaryotes, Bacteria, Fungi, Archaea)



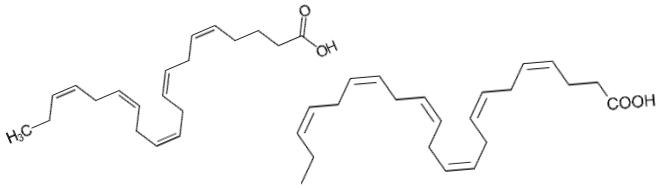
Stable isotope analysis



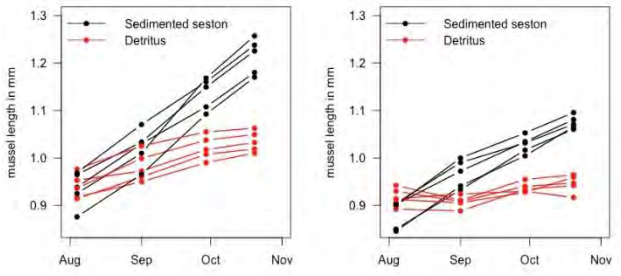
Identification of preferred food resources



Analysis of fatty acid profiles

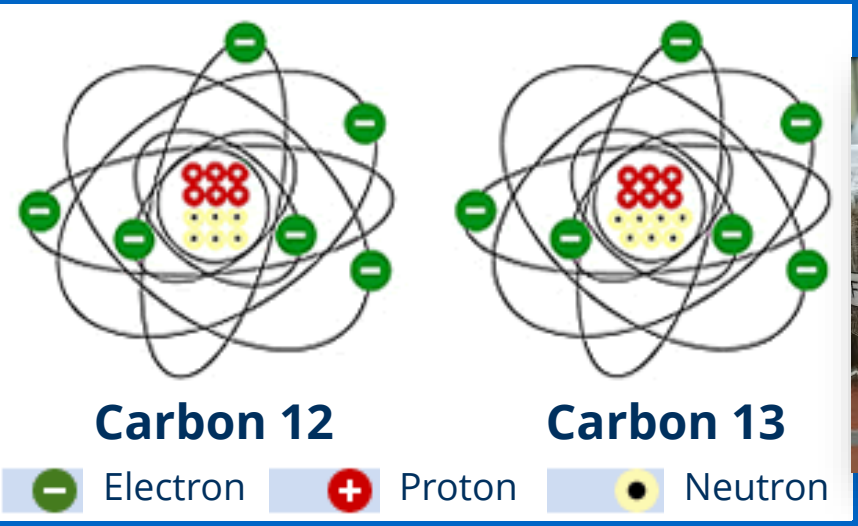


Feeding experiments



5. Nutritional requirements of freshwater mussels

Stable isotope analysis



© http://www.agroisolab.de/isotopen-analyse-funktion.htm







Quantifying the diet of freshwater pearl mussels using stable isotopes

Presentation today held by M. Brauns (16:50)

6. Significance of global warming for freshwater mussels

May & June 2019:
Several floods in the project region



July 2019:
Some streams dries out





Possible consequences of climate warming on survival & growth of juvenile FPM

Presentation at Wednesday held by A. Wagner (12:00)



Thank you for your attention!

Mussels help our water.
We help mussels!

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