Sampling methods for effective young fish monitoring in Koopmanspolder

MSc internship Dian Oosterhuis May – August 2022

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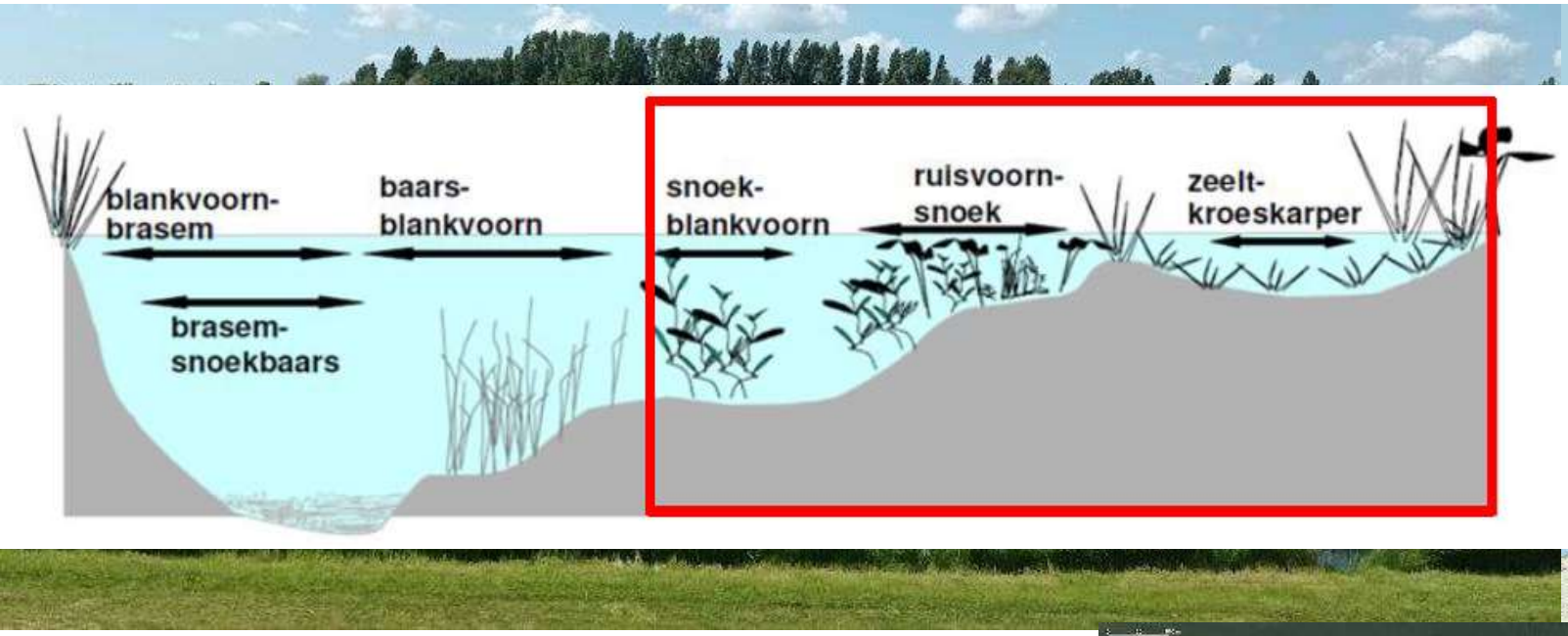
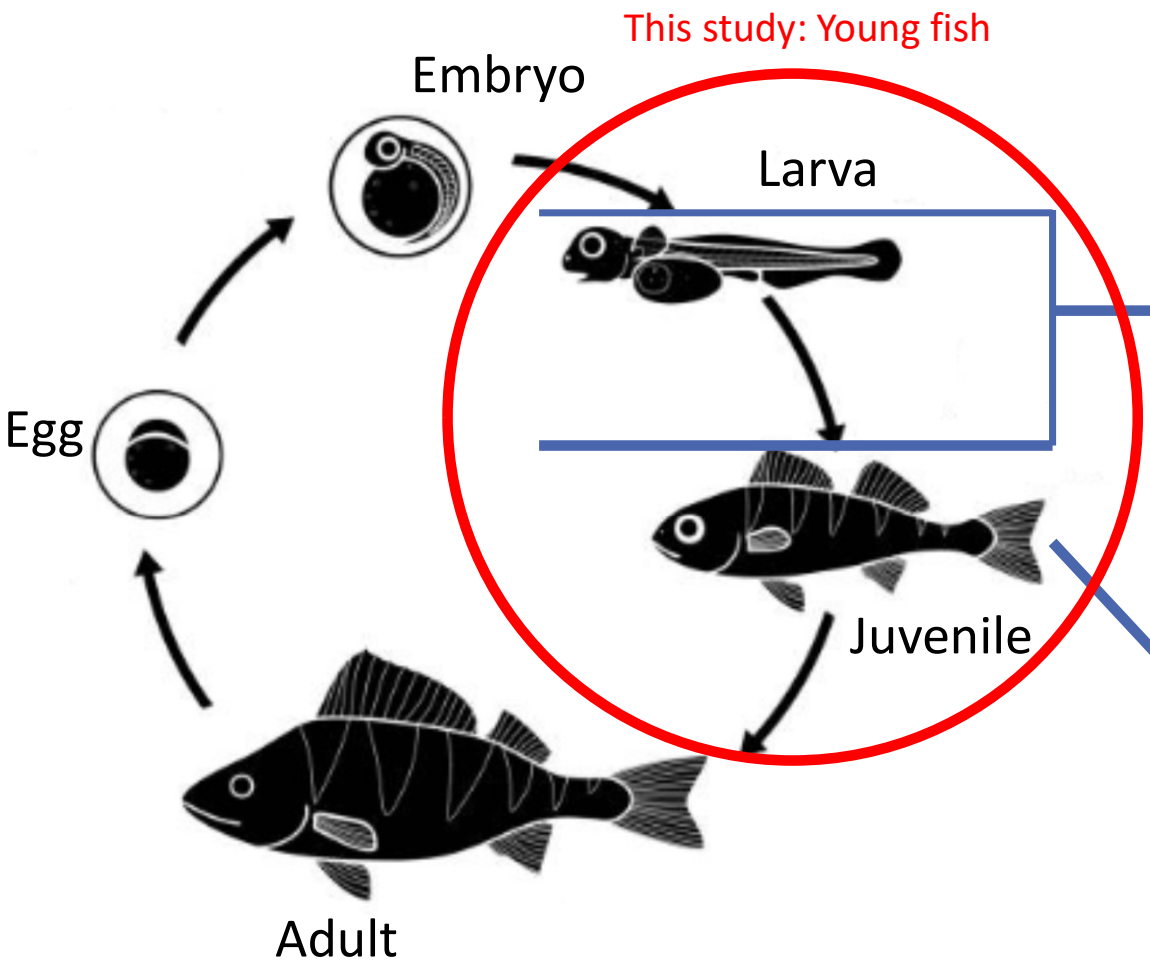


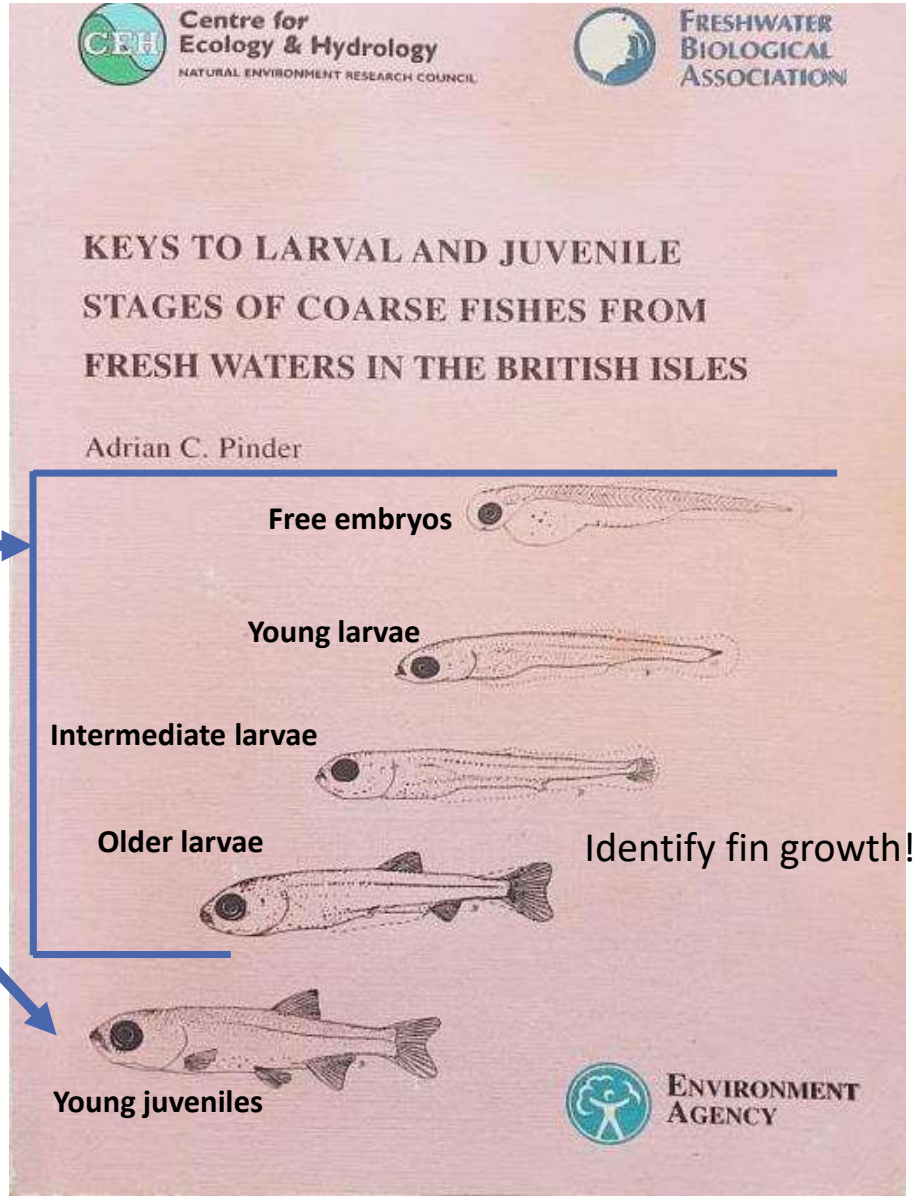
Introduction (1)

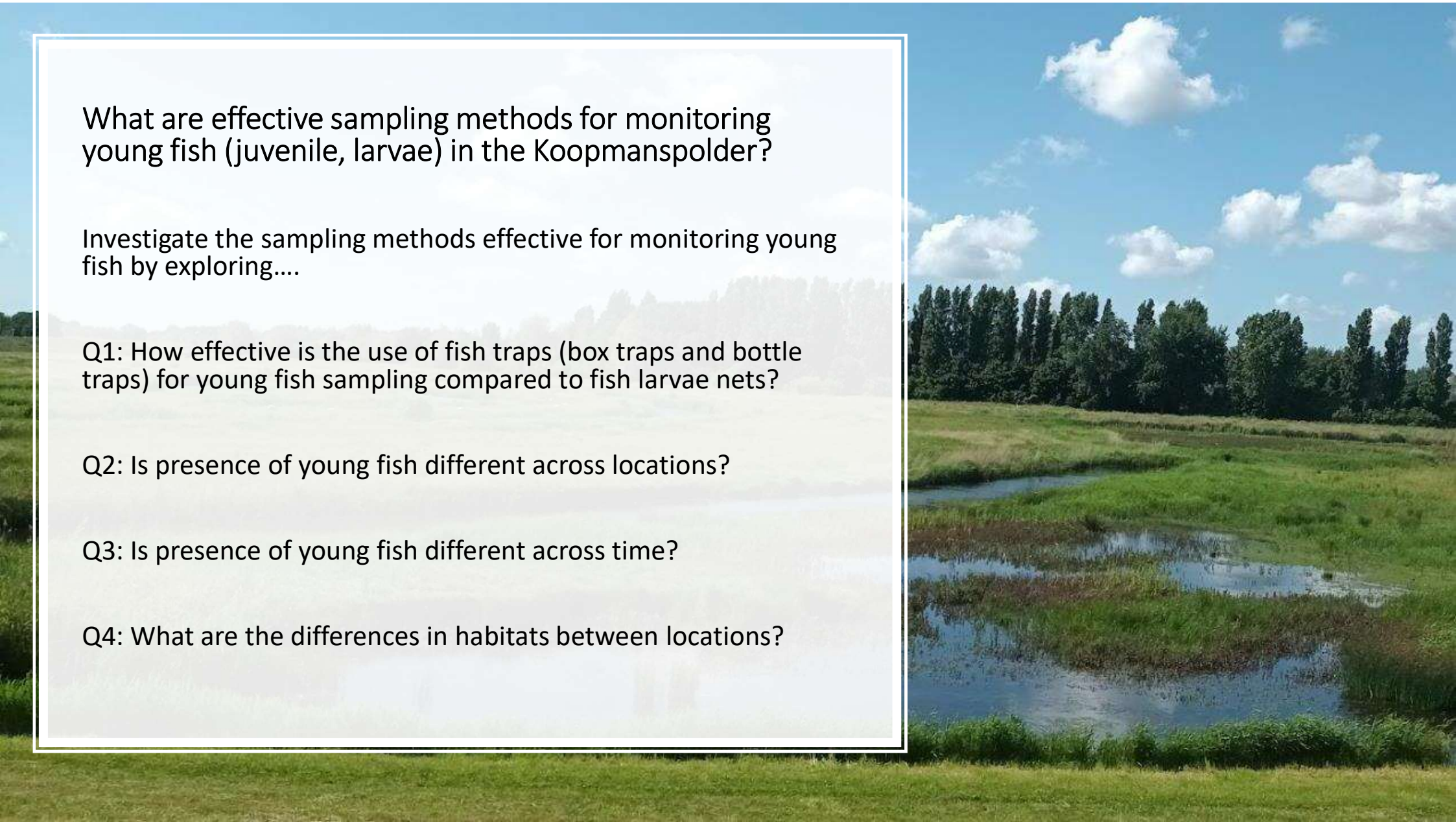
Living lab Koopmanspolder: concept "Achteroever" / **Inland buffer zones**

Natural dynamic water level, vegetation, birds, fish

Introduction (2)







What are effective sampling methods for monitoring young fish (juvenile, larvae) in the Koopmanspolder?

Investigate the sampling methods effective for monitoring young fish by exploring….

Q1: How effective is the use of fish traps (box traps and bottle traps) for young fish sampling compared to fish larvae nets?

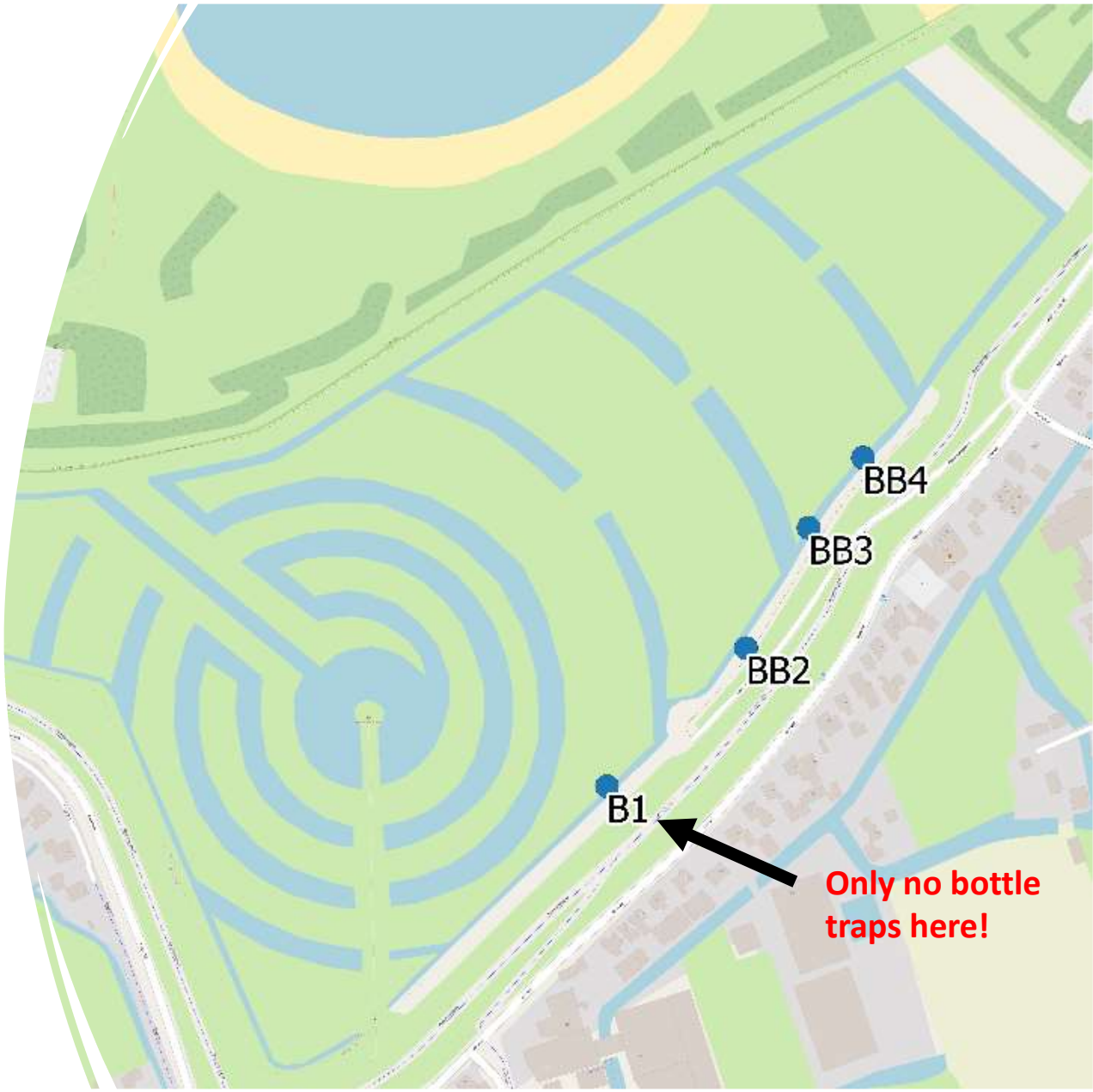
Q2: Is presence of young fish different across locations?

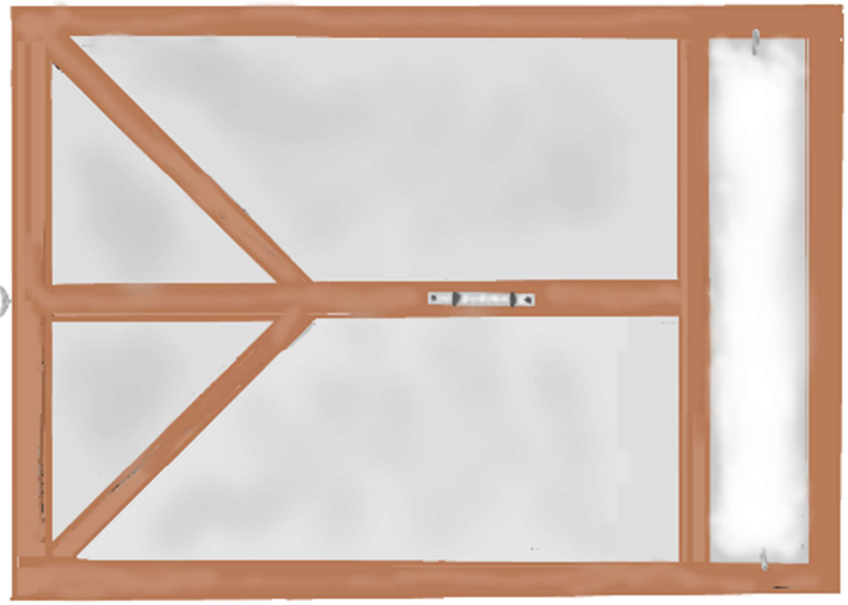
Q3: Is presence of young fish different across time?

Q4: What are the differences in habitats between locations?

Methods: *overview*

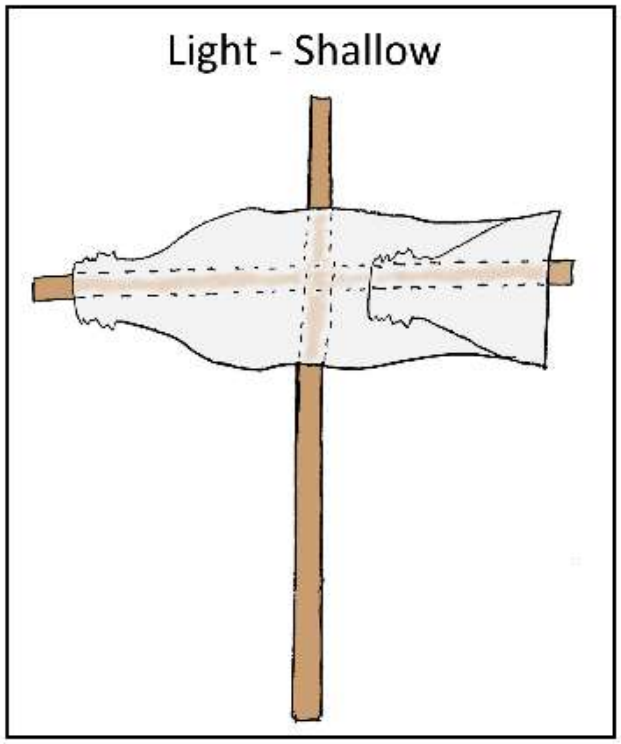
- May 25, June 1, June 9 and June 16
- Fish sampling and laboratory analysis
- Habitat
  - Incl. Zooplankton sampling and laboratory analysis
- Statistical analysis (fish)

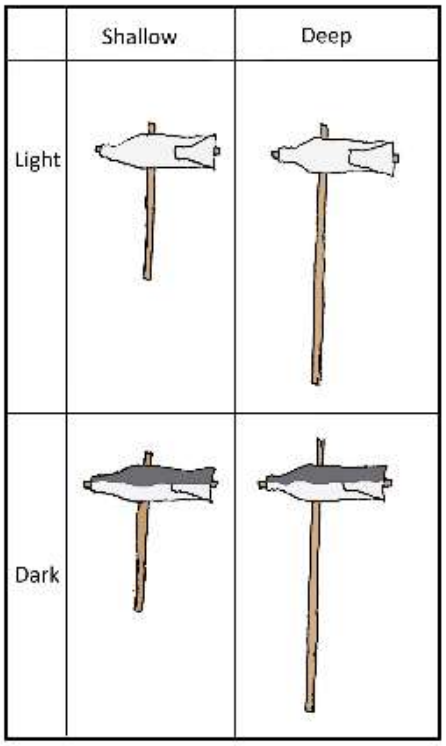


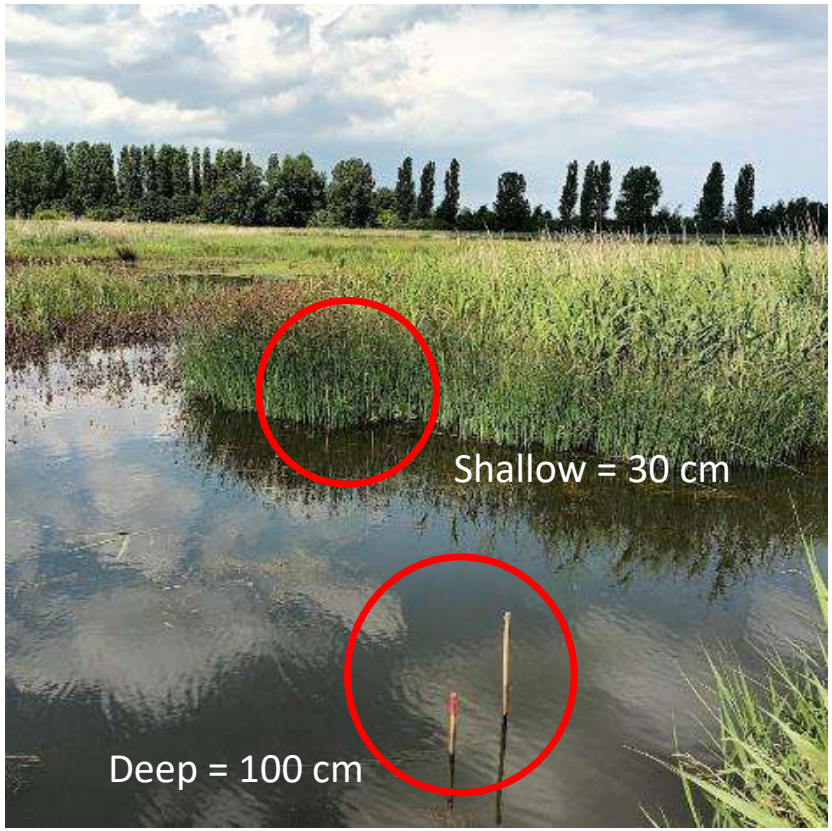


- Box traps (Cottrell et al., 2021), provided by SVN

Methods: *Box traps*







- Self-designed
- Bottles (1L)
- 12 bamboo sticks (2.30 m)
- black tape
- iron wire
- aquarium glue

Methods: *Bottle traps*

Methods: *Fish larvae net*

Fish larvae net

Mesh size: 0.5 mm

Provided by Aquaculture & Fisheries Group (Leo Nagelkerke & Twan Stoffers)

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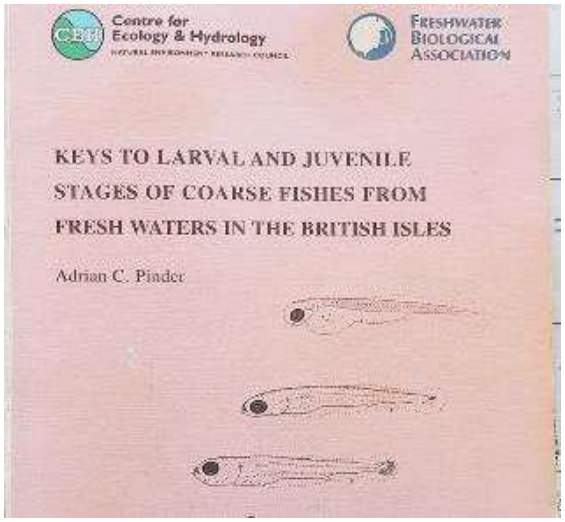
Methods: *sampling*

- Fish: sort in white bucket, subsampling (%), ethanol (96%)
- Zooplankton: 80 µm planktonnet (Twan Stoffers WUR), lugol

Methods: *Habitat*

- Coverage substrate & vegetation
- Dimensions
- Temperature logger



Methods: *Laboratory analysis*

- Fish: Species, Life stage, TFL, Twan Stoffers (WUR), Pinder (2001)

- Zooplankton: Protocol Marie-claire (WUR) and counting cell Graticules optics

Methods: *Statistical analysis*

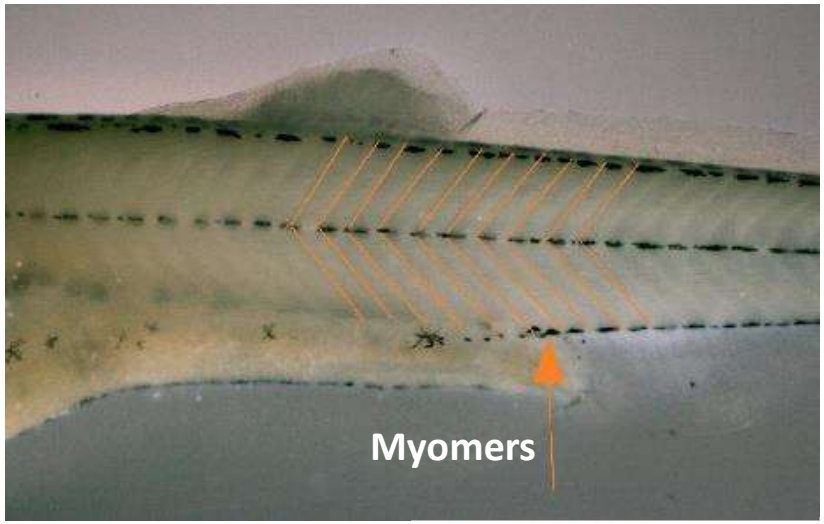
Response variable	**Method**	**Location**	**Time**
Fish count	X	X	X
Fish count *R. amarus*		X	X
Fish count *K. caucasica*		X	X
Fish length *R. amarus*			X
Fish length *K. caucasica*			X

- All data = non-normal
- Kruskal Wallis χ^2
- Dunn test: Pairwise comparisons

Results: *Fish identification*

Difficulty of **morphological identification:**
looks very similar but different species

Pigmentation



Stage 4

Stage 3

Stage 4

Alburnus Alburnus

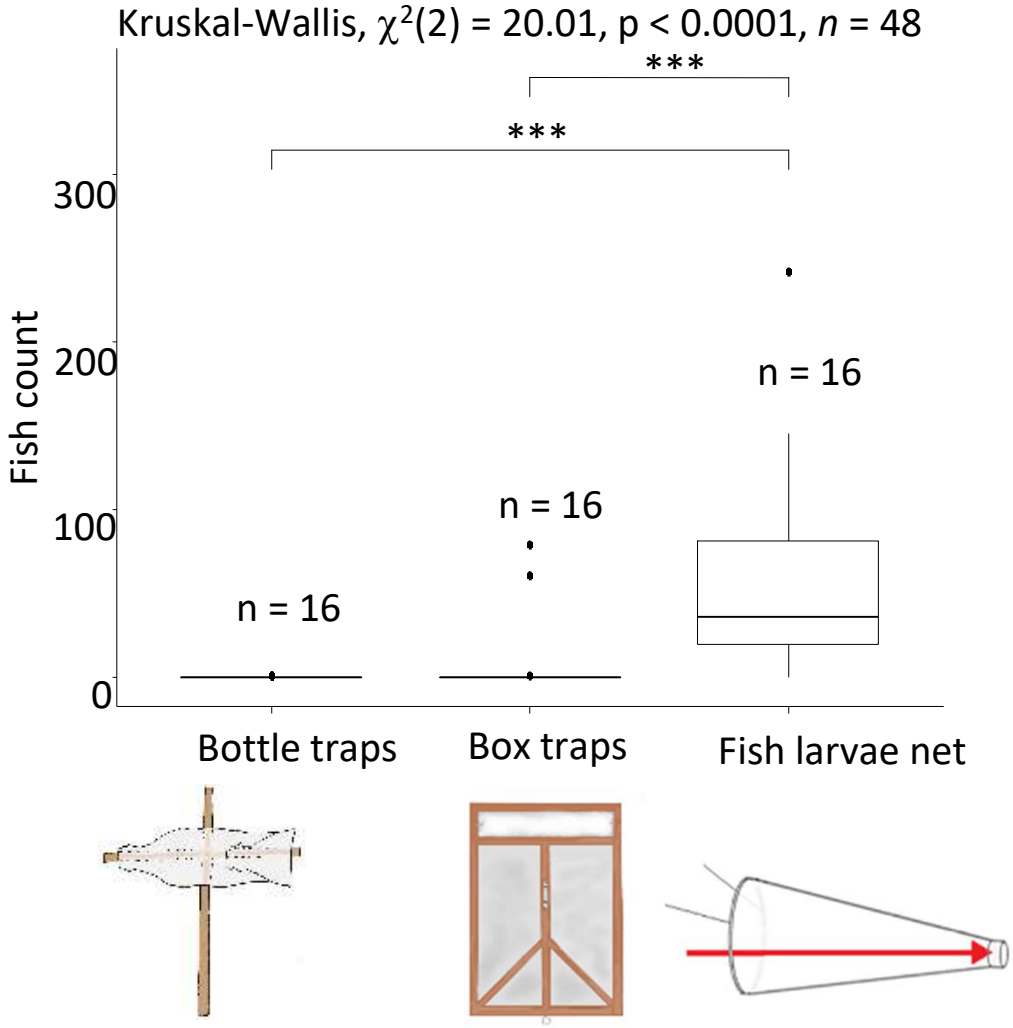
Leucaspius Delineatus

Rhodeus amarus

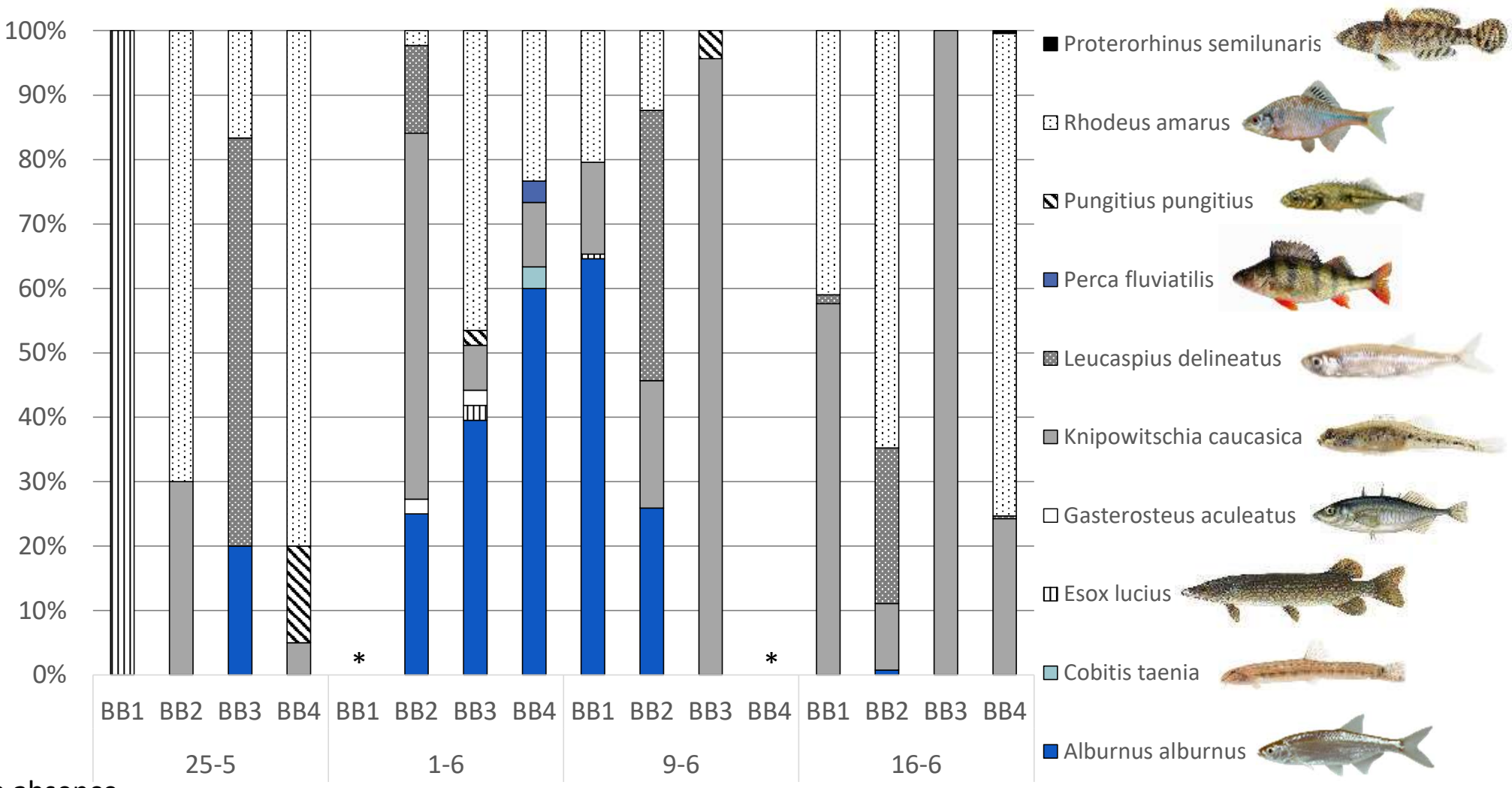
Common hybrid

Results: *Sampling methods*

Species	Bottle trap shallow dark	Bottle trap shallow light	Box trap	Fish larvae net
Alburnus alburnus				170
Cobitis taenia	1			
Esox lucius	1		2	
Gasterosteus aculeatus				2
Knipowitschia caucasica		1	77	282
Leucaspius delineatus				125
Perca fluviatilis				1
Pungitius pungitius	1			4
Rhodeus amarus			63	450
Proterorhinus semilunaris	1			



Results: *Location and time (relative)*



*Fish absence

Results: *Location and time (absolute)*

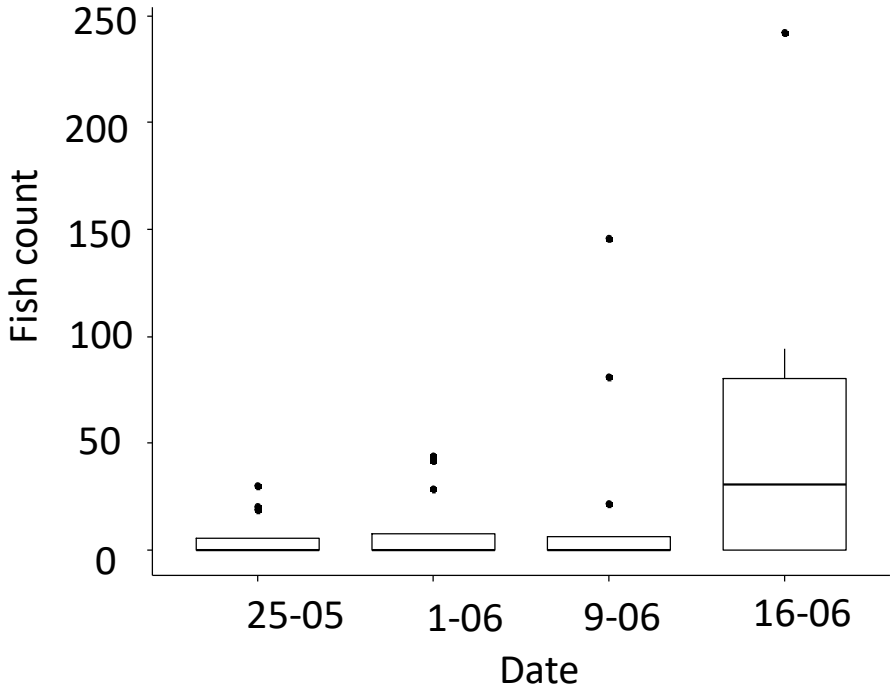
Many

	BB1	BB2	BB3	BB4	BB1	BB2	BB3	BB4	BB1	BB2	BB3	BB4	BB1	BB2	BB3	BB4
	25-5				1-6				9-6				16-6			
Proterorhinus semilunaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Rhodeus amarus	0	14	5	16	0	1	20	7	30	10		0	59	169	0	182
Pungitius pungitius	0	0	0	3	0	0	1	0	0	0	1	0	0	0	0	0
Perca fluviatilis	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Leucaspius delineatus	0	0	19	0	0	6	0	0	0	34	0	0	2	63		1
Knipowitschia caucasica	0	6	0	1	0	25	3	3	21	16	22	0	83	27	94	59
Gasterosteus aculeatus	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Esox lucius	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Cobitis taenia	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Alburnus alburnus	0	0	6	0	0	11	17	18	95	21	0	0	0	2	0	0

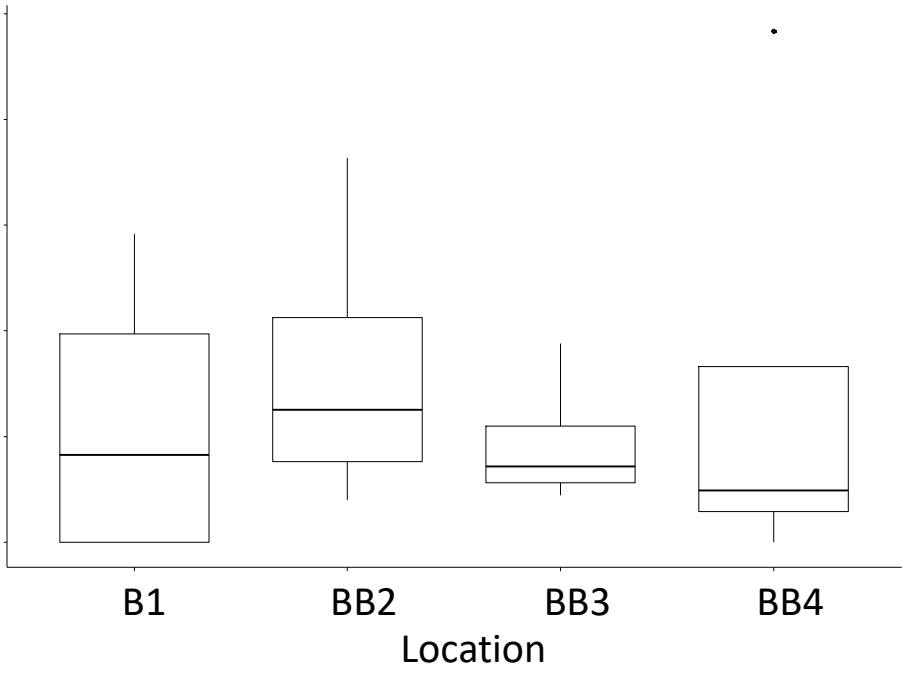
Many

Results: *Location and time*

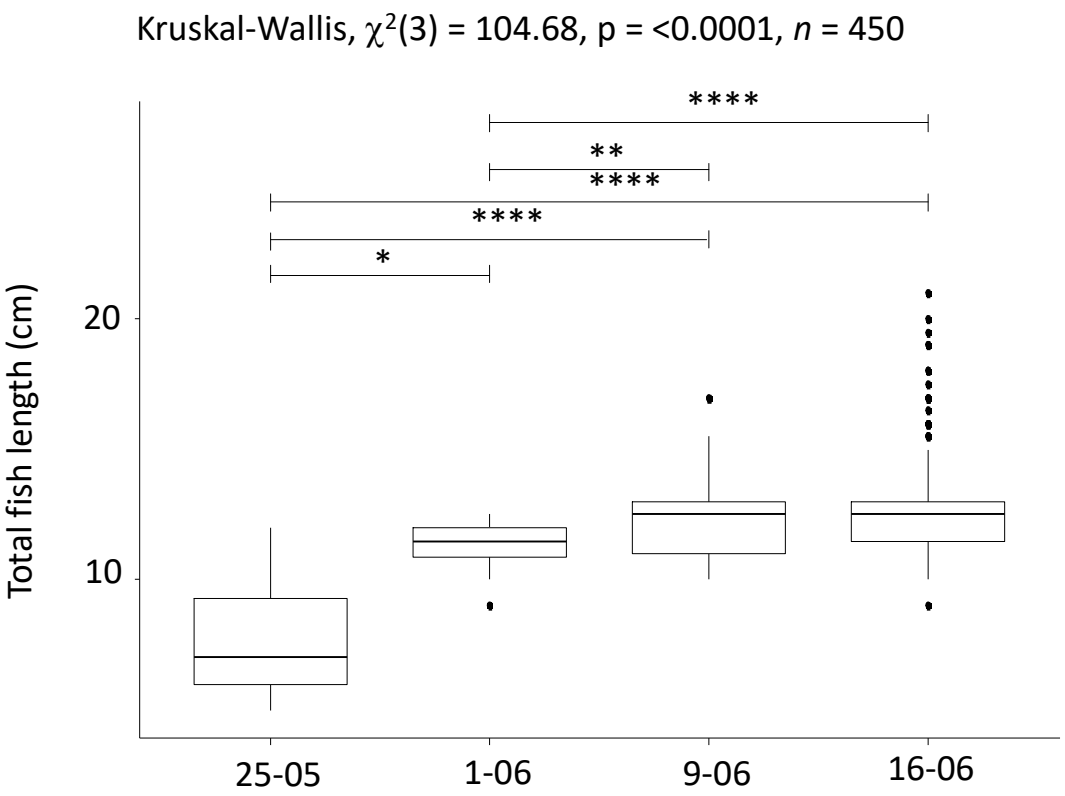
Kruskal-Wallis, $\chi^2(3) = 2.75$, p = 0.43, *n* = 48

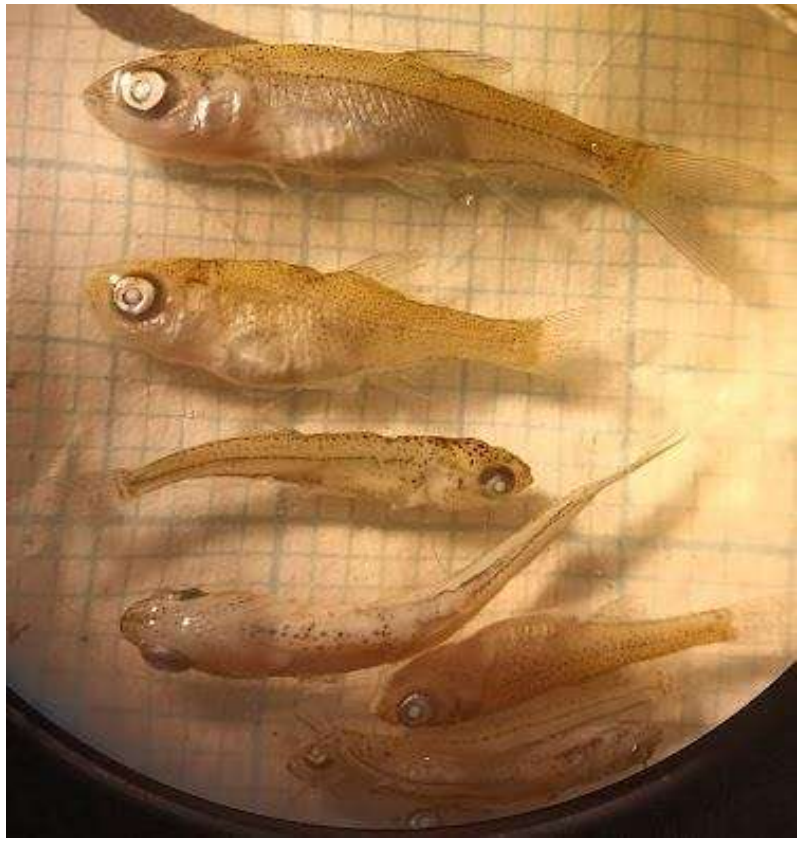


Kruskal-Wallis, $\chi 2\ (3) = 0.97$, p = 0.81, *n* = 16



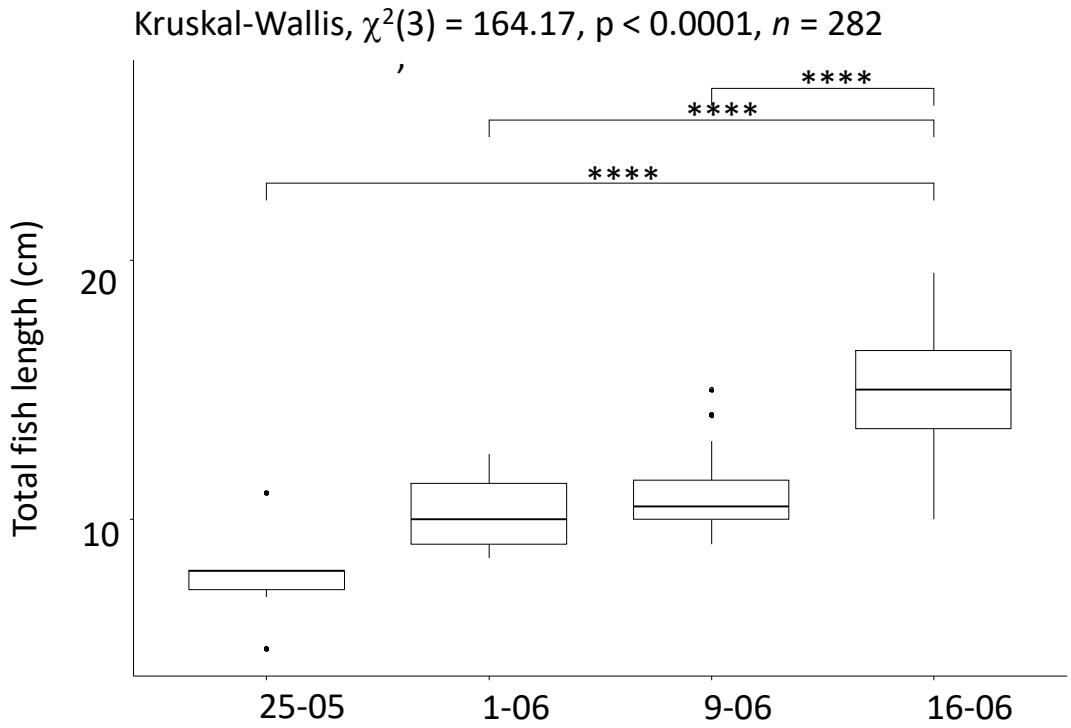
Results: *Fish length R. amarus*



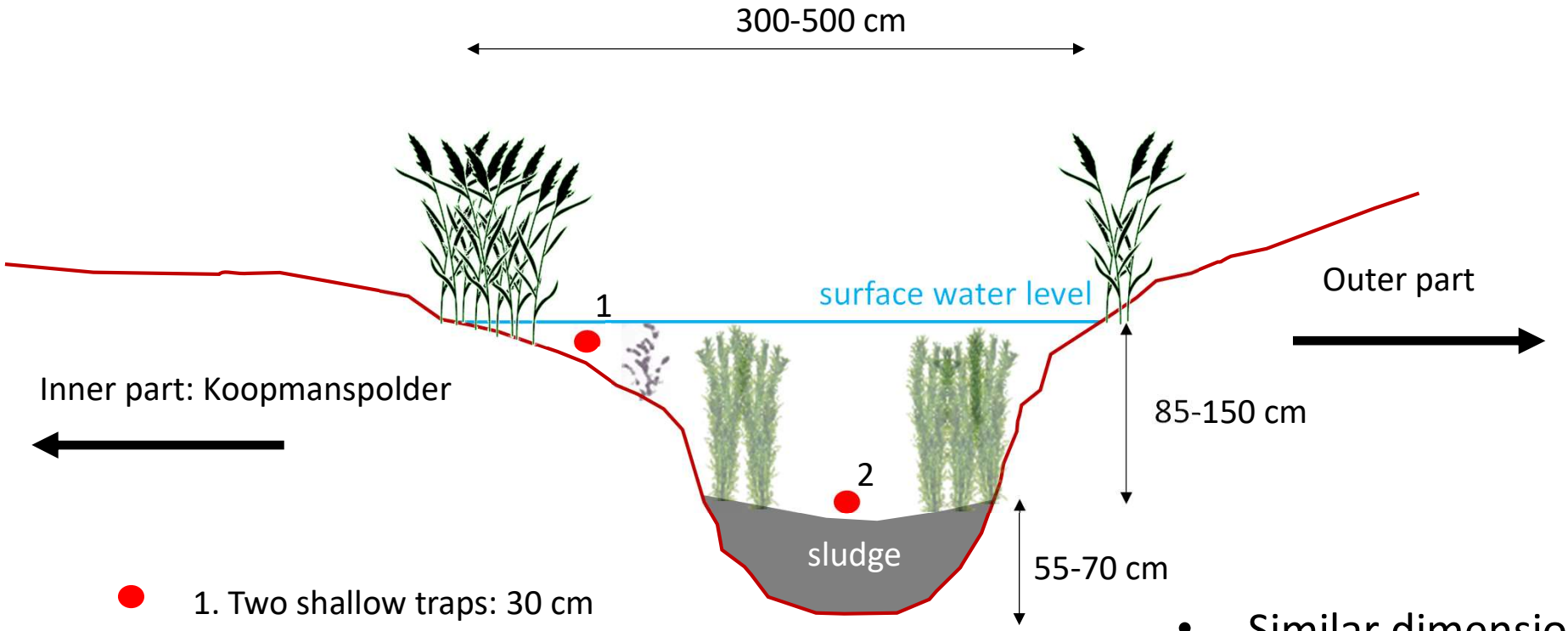


June 16

Results: *Fish length K. caucasica*



June 16

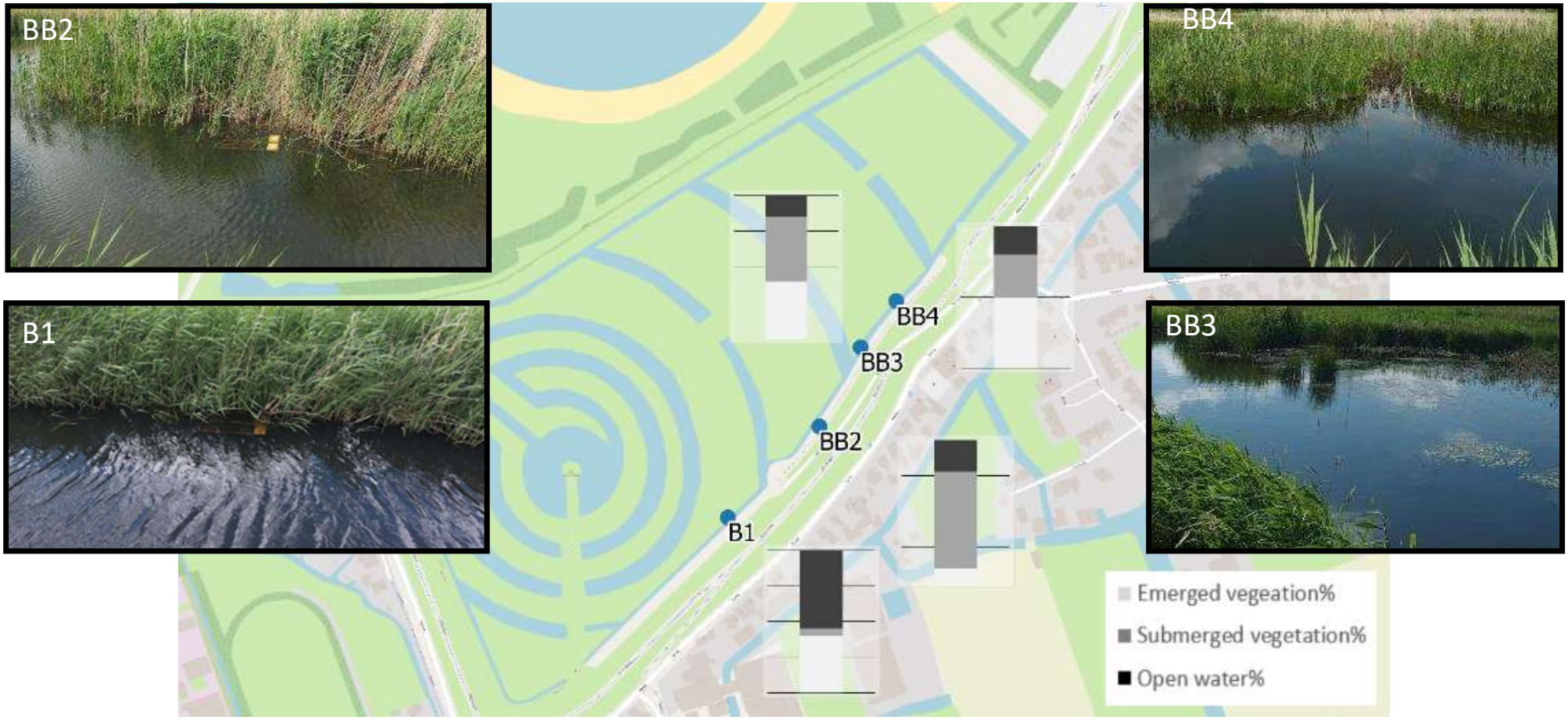


- Similar dimensions
- Similar substrate
- Vegetation coverage slightly different

Results: *Habitat*

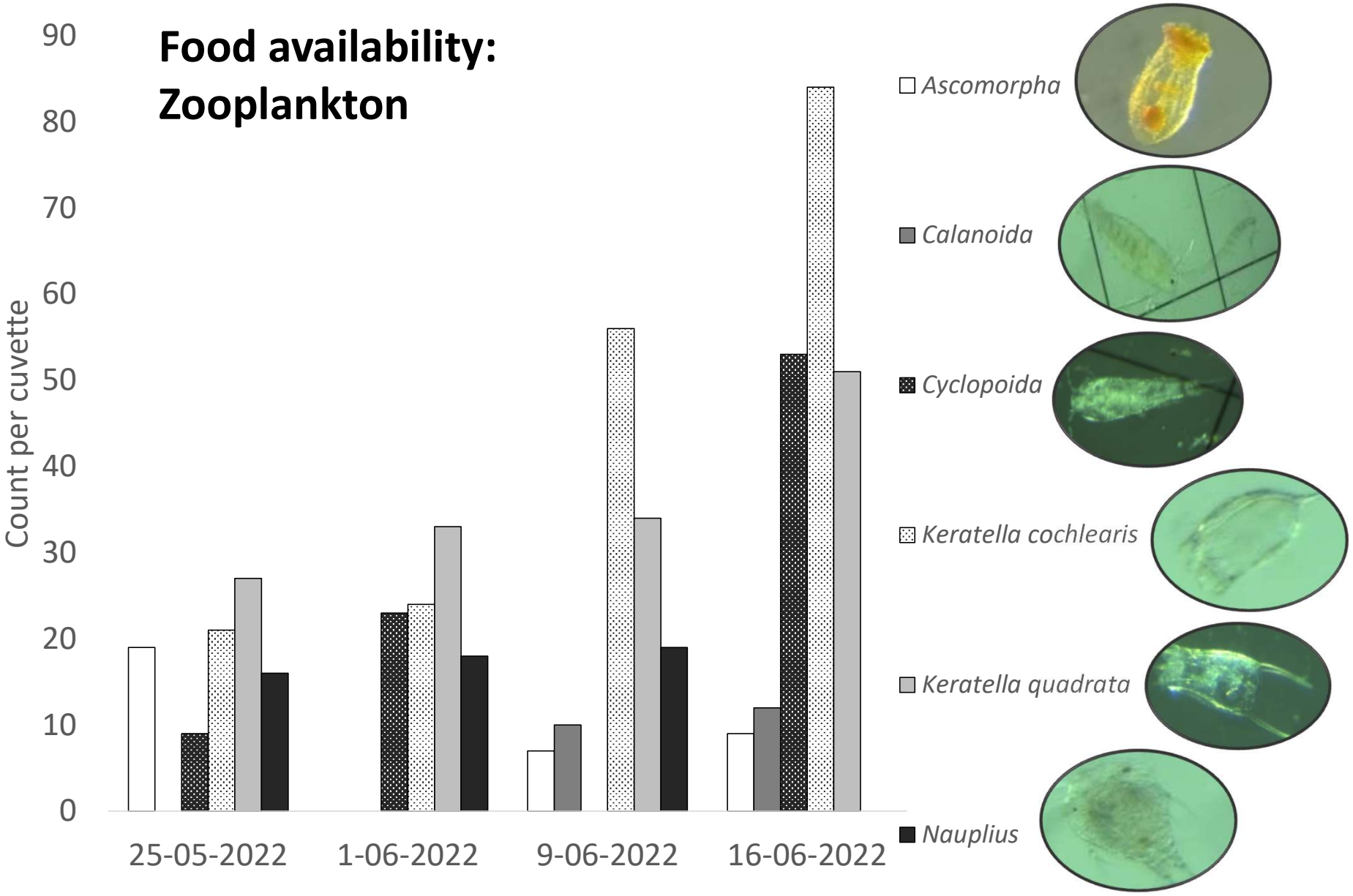
Results: *Vegetation coverage*

Similar but B1 slightly different from the others!



Results: *Substrate coverage*

Food availability: Zooplankton



Discussion: *fish – habitat and time*

+++  

Mussels, invasion, substrates

< species than ATKB

locations, habitat, sampling effort, season

Fish - time/location (NS)

Similar locations, schooling behaviour

Fish length

Time, Waterdepth (LATER!)

Discussion: *fish – habitat (food availibity)*

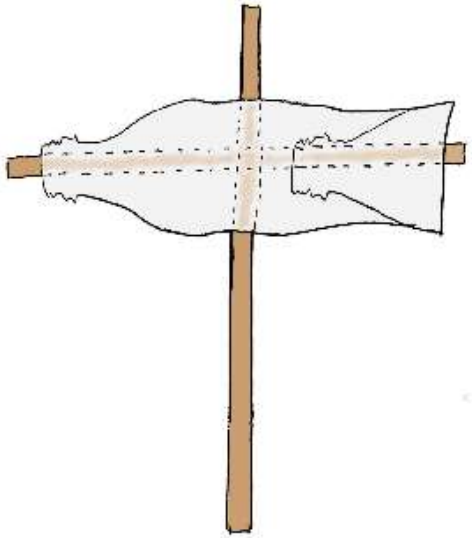
Zooplankton	Larvae diet	Source
*A. alburnus**	*Calanoida, Cyclopoida (nauplii, adult), Rotifera*	(Nunn et al., 2012)
*Leucaspius delineatus**	*Protozoan, Rotifera, Copepoda*	(Pinder et al., 2005)
*Rhodeus amarus**	*Phytophage*	
*Knipowitschia caucasica**	*?*	
Esox Lucius	*Cyclopoida, Calanoida*	(Salonen & Engström-Öst, 2010)
Cobitis taenia	*?*	
Perca fluviatilis	*Copepoda (nauplii, adults), Keratella cochlearis, Rotifera (order Ploima)*	(Mikheev & Wanzenböck, 2010)
Proterorhinus semilunaris	*Cyclopoida*	
Rutilus rutilus	*Calanoida* *Nauplius (Cyclopoida)*	(Nunn et al., 2012)
Gasterosteus aculeatus	*Calanoida* *Nauplius (Cyclopoida)*	(Nunn et al., 2012)
Pungitius pungitius	*?*	

Green = evidence potential food resources

Orange = no evidence

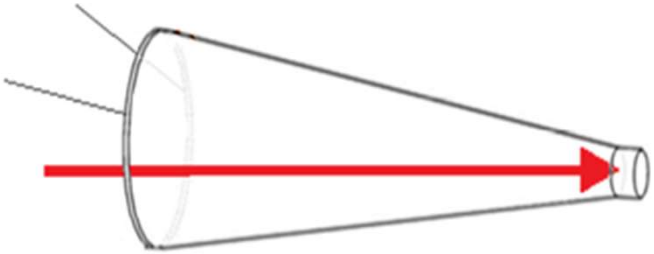
White = no zooplankton

Discussion: *methods*



- Ineffective
- Small and only 12 traps
- No mesh

- NS but more fish larvae
- 4 traps
+ bigger > bottles



+ Significantly more fish larvae
+ 795 L water per location
- Net too big for (micro)habitat at one location?

Conclusions

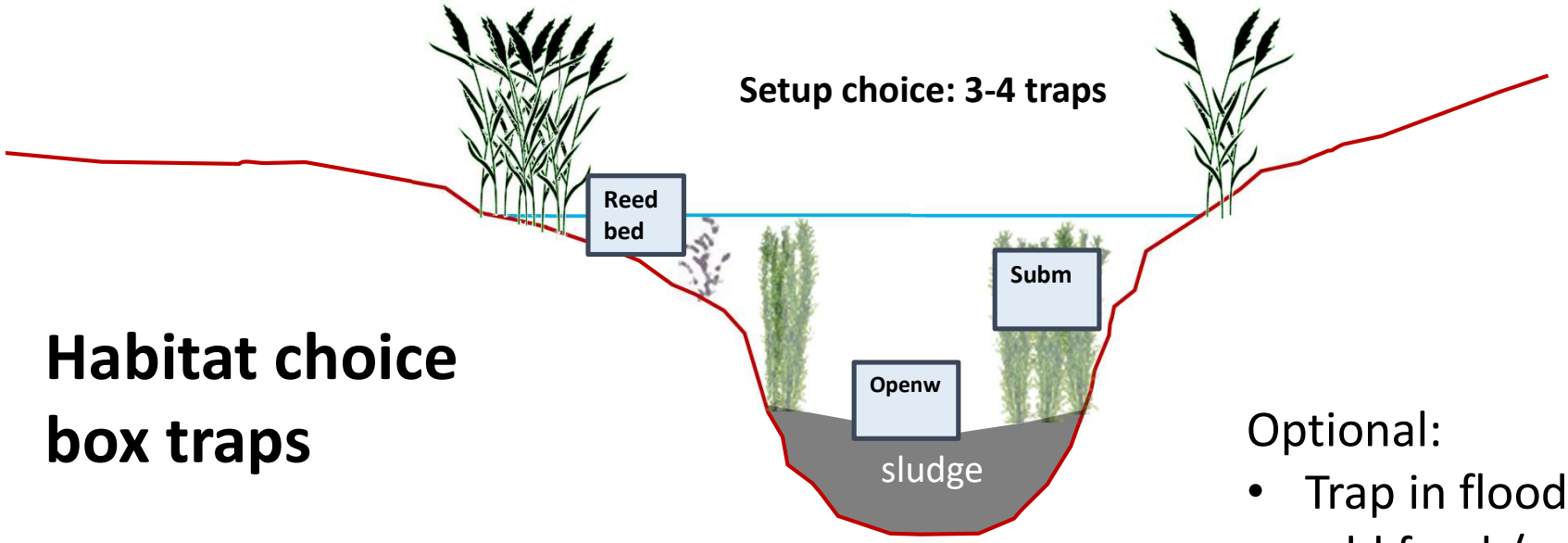
Response variable	Q1: How effective are the sampling methods?	Q2: What are the differences in fish among locations?	Q3: What are the differences in fish among sampling times?
Total fish count	Net > Box trap* Net > Bottle trap*	ns	ns
Fish count *R. amarus*		ns	ns
Fish count *K. caucasica*		ns	May 25 – June 16*
Fish length *R. amarus*		ns	All except June 9 – June 16
Fish length *K. caucasica*		ns	May 25 – June 16 June 1 – June 16 June 9 – June 16

Q4: What are the differences in habitats between locations?

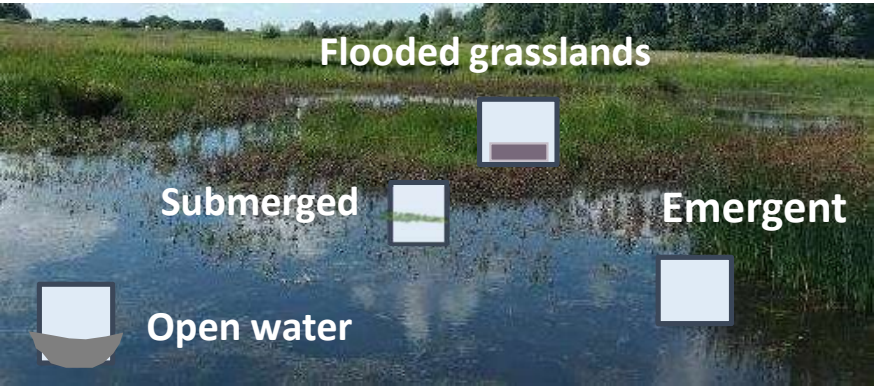
→ Similar!

*P-value < 0.05 statistical significance
ns = not statistically significant

Recommendations: *What are effective sampling methods for monitoring young fish (juvenile, larvae) in the Koopmanspolder?*



Habitat choice box traps



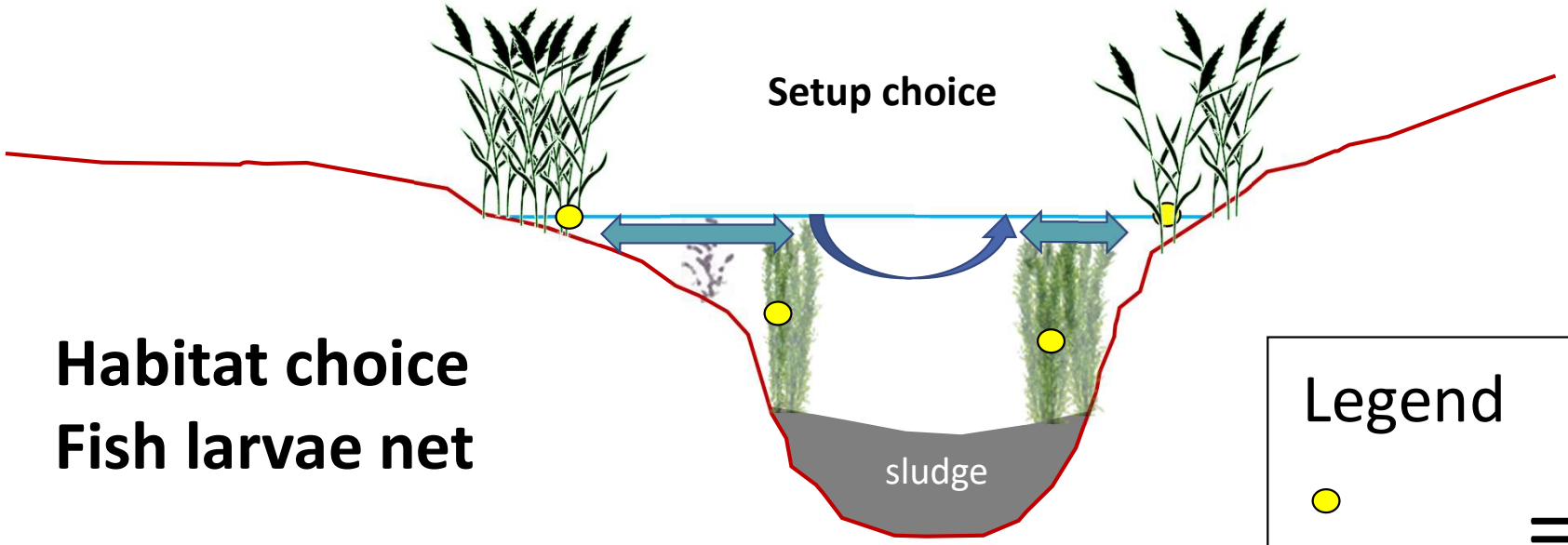
Optional:

- Trap in flooded grassland
- add food / substrate in trap

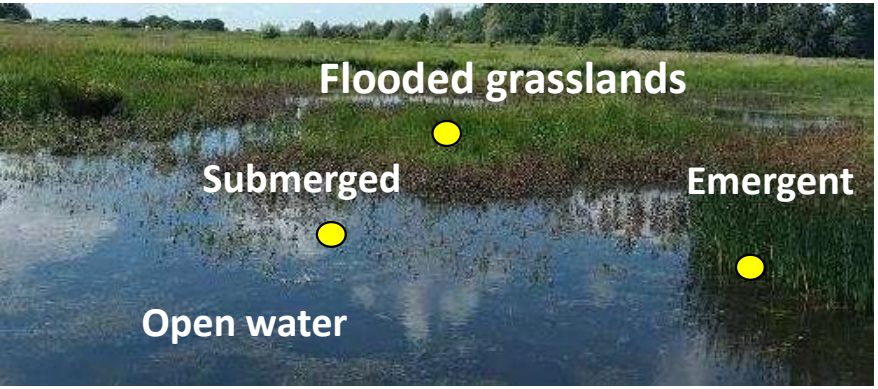
Requires frequent checking!

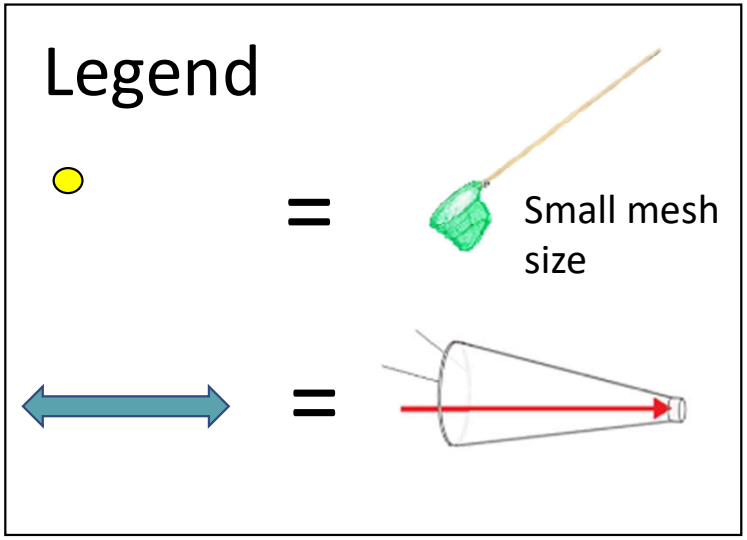
Risk: trap damage

Recommendations: *What are effective sampling methods for monitoring young fish (juvenile, larvae) in the Koopmanspolder?*

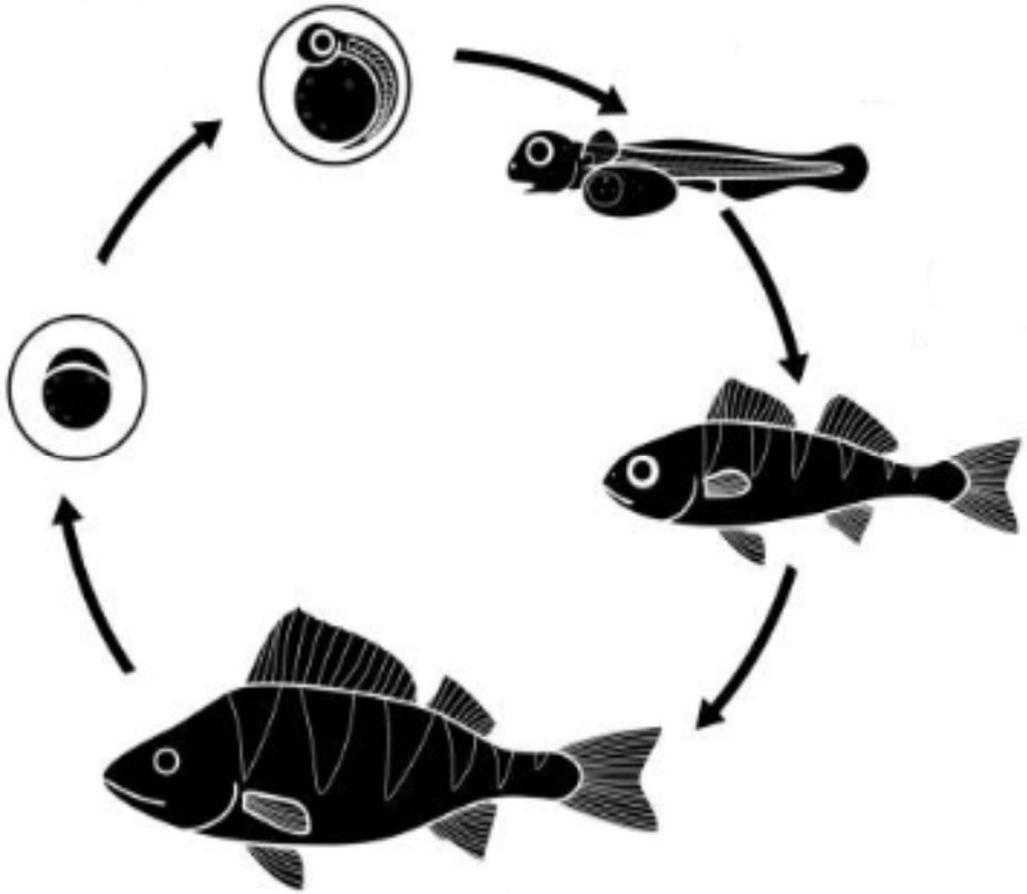


Habitat choice
Fish larvae net

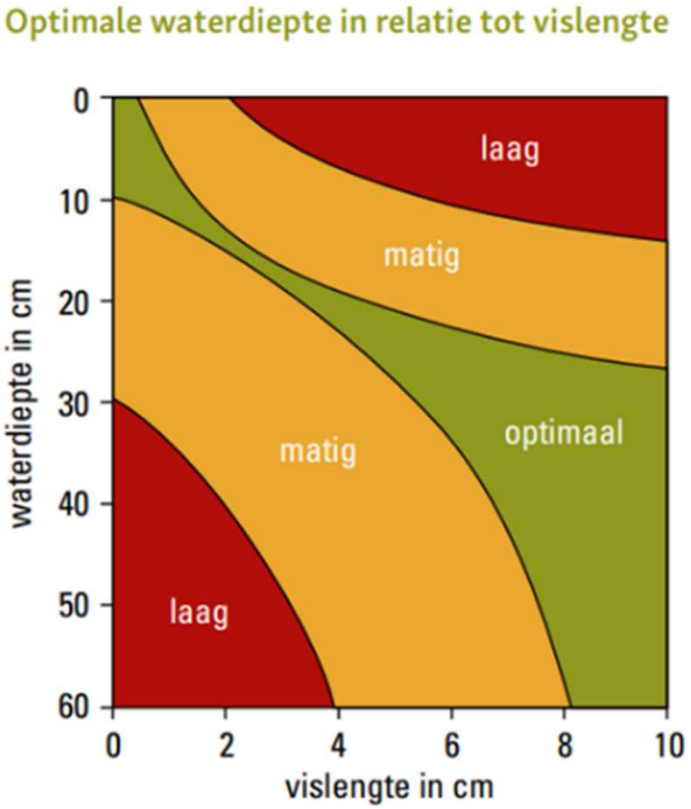




Recommendations: *Which sampling efforts are needed for effectively monitoring juvenile fish in the Koopmanspolder?*



Sampling location choice: spread and/or systematically chosen with habitat / water depth



Future

- Increase predation of exotic species and diversity native species
- Substrates and vegetation
- Water level and vegetation management
- Monitoring young fish and natural dynamics

Any questions?

Special thanks:

Supervisors: Jeroen Veraart (WENR), Remco van Ek (W&B), Jaap Quak (Sportvisserij Nederland)

Assistance in the field: SVN, Ilse and Connie (WUR), Mees (UvA)

Additional slides

Methods: statistical analysis

All data = non-normal

Response variable	Method	Location	Time
Fish count	X	X	X
Fish count *R. amarus*		X	X
Fish count *K. caucasica*		X	X
Fish length *R. amarus*			X
Fish length *K. caucasica*			X

Kruskal Wallis test, pairwise comparisons of the Dunn test were performed with Bonferroni p-value adjustments.

Kruskal-Wallis Formula

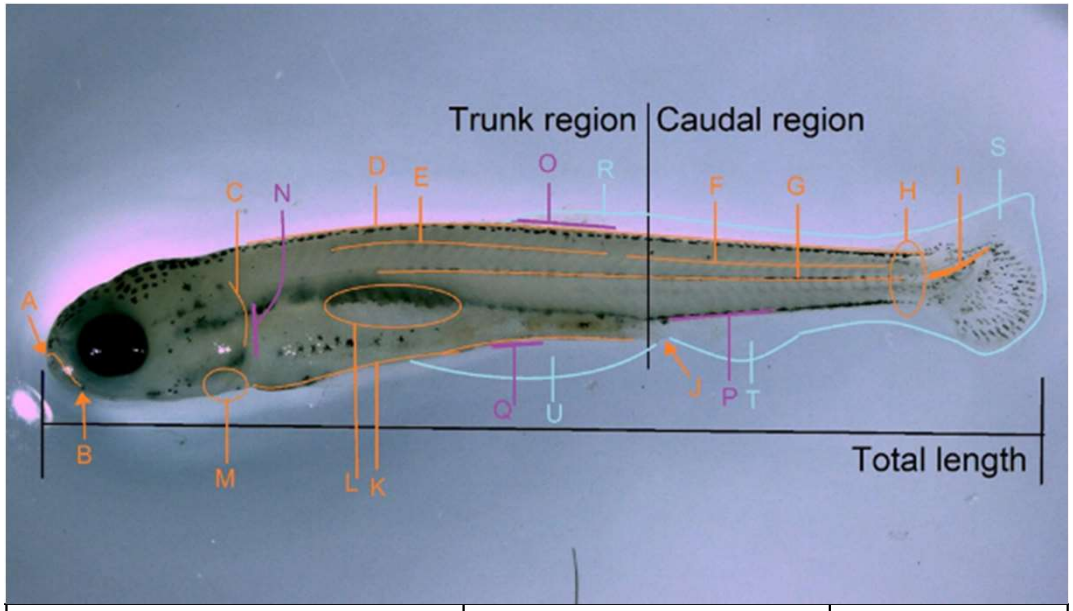
$$H = \frac{12}{n(n+1)} \sum \frac{R_i^2}{n_i} - 3(n+1)$$

n_i = the total number of points in the ith sample

R_i = the rank sums of the i^{th} sample

N = total number of sample points

Fish larvae determination



Legend		
A Opening mouth	H Caudal Peduncle	O Base dorsal fin
B Maxilla	I Urostyle	P Base anal fin
C Gill	J Anus	Q Base pelvic fin
D Dorsal line	K Pre-anal Medio-ventral line	R Dorsal fin-fold
E Notochord (pigmentation)	L Swim bladder	S Caudal fin-fold
F Horizontal myosept (Pigmentation)	M Heart-region	T Anal fin-fold
G Lateral line	N Base pectoral fin	U Pelvic fin-fold

Figure 3.1. Common Nase (stage 2), indicated are terms used in the identification guide.

Source: report student
The key to identifying fish larvae
An identification guide to fish larvae in the Rhine

Author: Krista Jonkers
Supervisors Wageningen University and research: Twan Stoffers & Leo Nagelkerke
Supervisor HAS University of Applied Sciences: Tom Brink

Results: juvenile - adult

Esox Lucius (juvenile, .. cm)

Proterorhinus semilunaris (adult, .. cm)

Sampling method: Shallow dark bottle trap

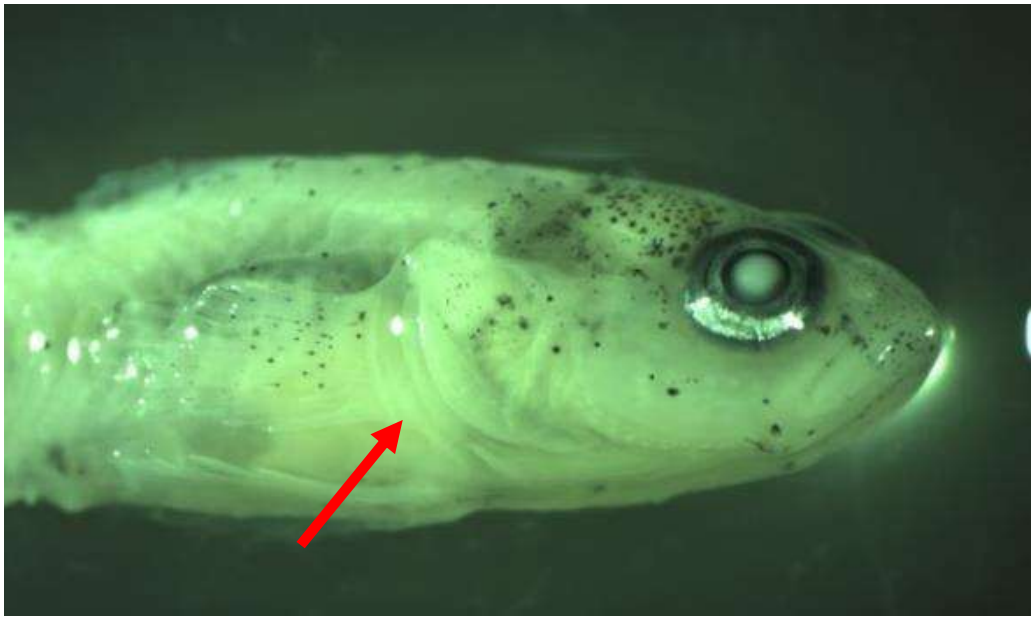
Cobitis taenia (adult, .. cm)

Results: *fish identification*

Juvenile

Fish larvae

Knipowitschia caucasica



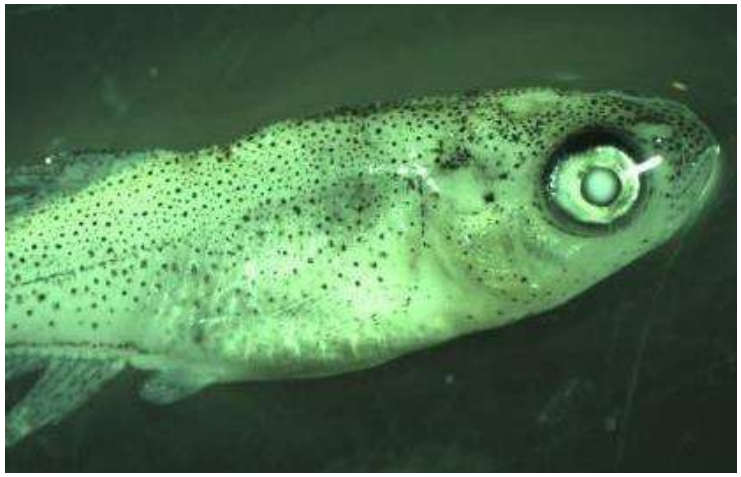
Sampling method: fish larvae net

Results: *fish identification*

Juvenile

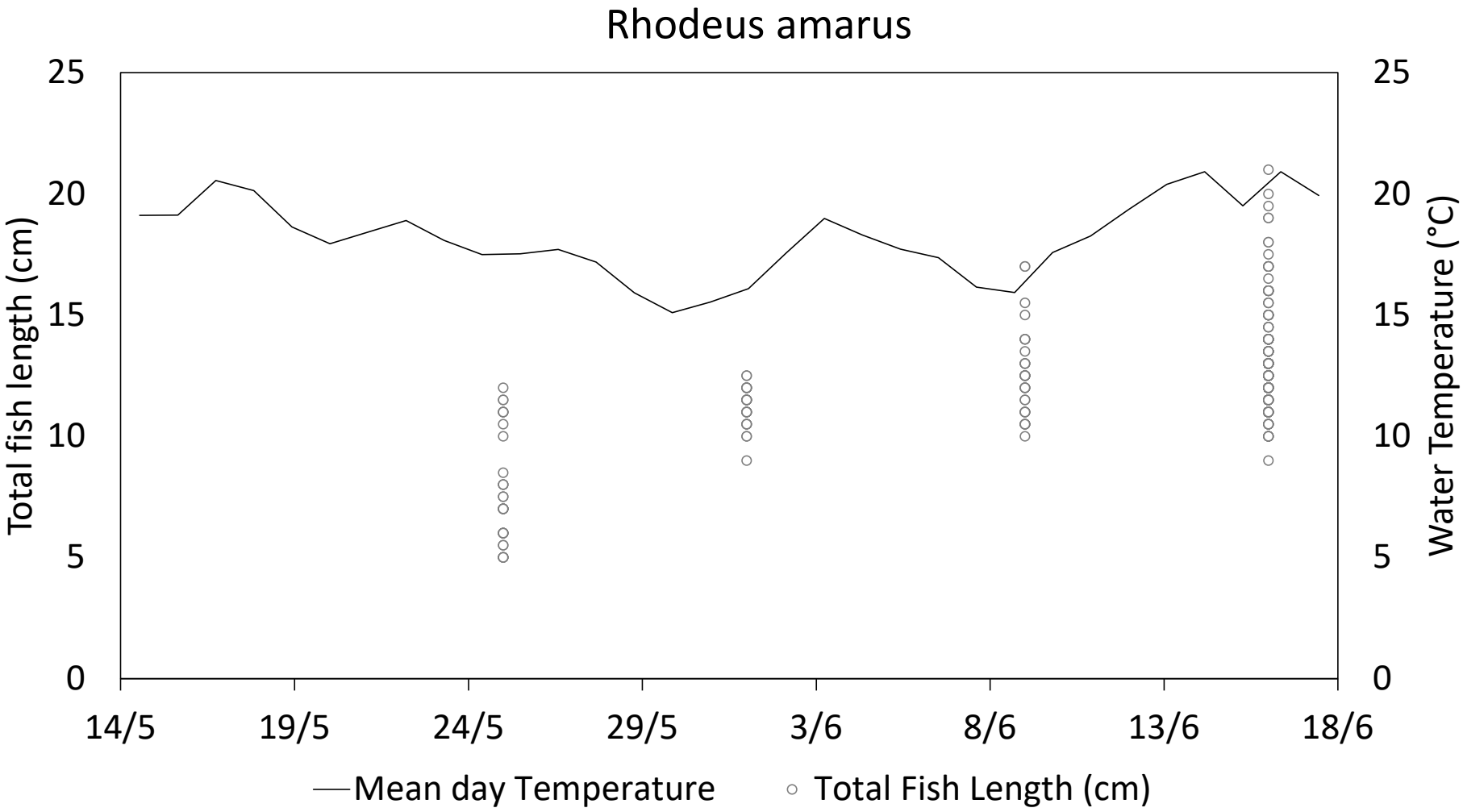
Fish larvae

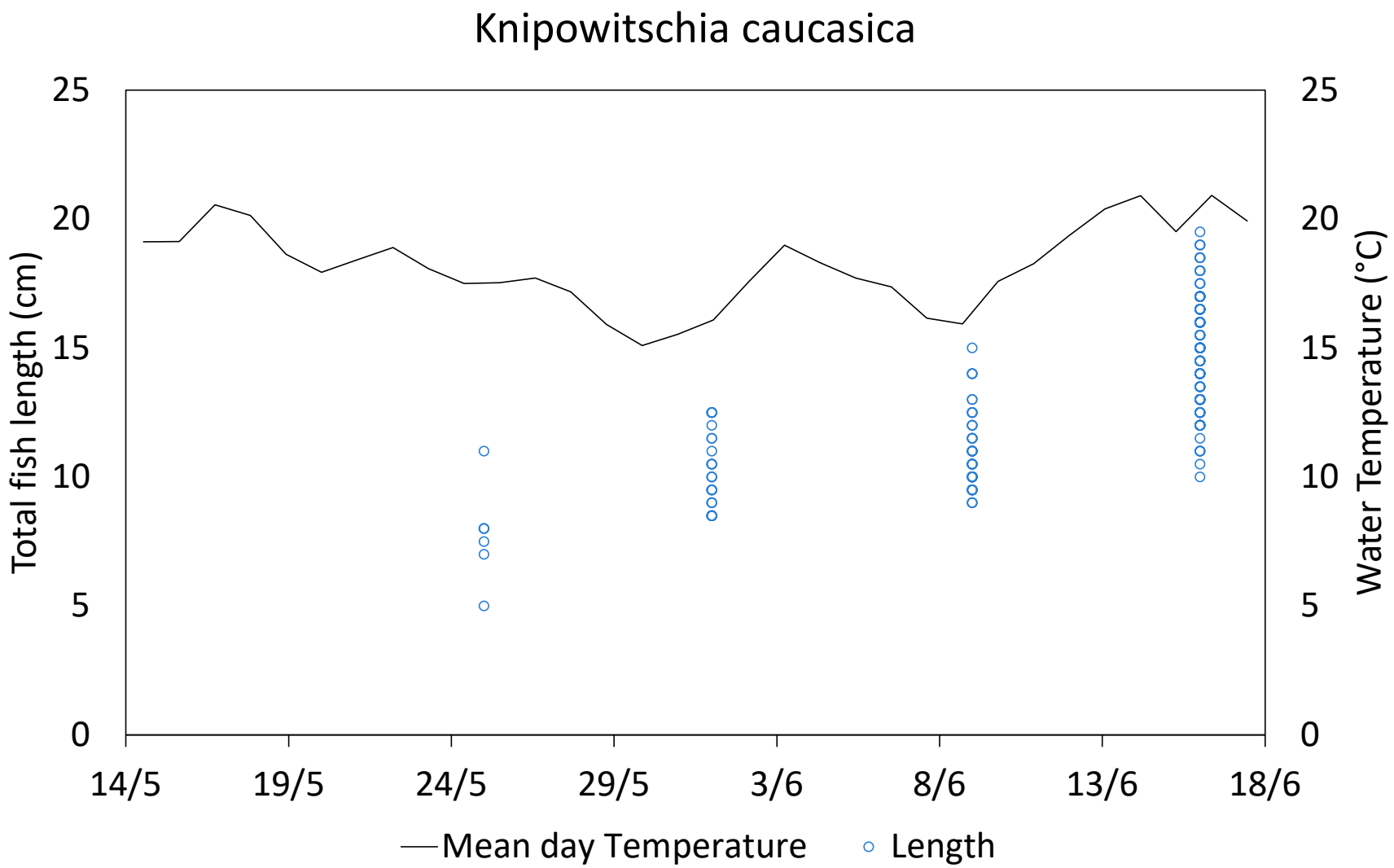
Rhodeus amarus



Pungitius pungitius

Sampling location		Emerged vegetation	Submerged vegetation
B1		**Phragmites australis**	**Elodea nuttallii**
BB2		**Phragmites australis**	**Elodea nuttallii, Persicaria amphibia, Ceratophyllum demsum,**
BB3		**Phragmites australis, Mentha aquatica, Bolboschoenus maritimus,**	**Persicaria amphibia, Characeae, Potamogeton trichoides, Stuckenia pectinata**
BB4		**Phragmites australis, Schoenoplectus tabernaemontani, Polytrichum, Mentha aquatica**	**Mentha aquatica, Characeae, floating algae**


Rhodeus amarus
Total fish length (cm)
Water Temperature (°C)
0
5
10
15
20
25
14/5
19/5
24/5
29/5
3/6
8/6
13/6
18/6
Mean day Temperature
Total Fish Length (cm)


Knipowitschia caucasica
Total fish length (cm)
Water Temperature (°C)
25
20
15
10
5
0
14/5
19/5
24/5
29/5
3/6
8/6
13/6
18/6
Mean day Temperature
Length