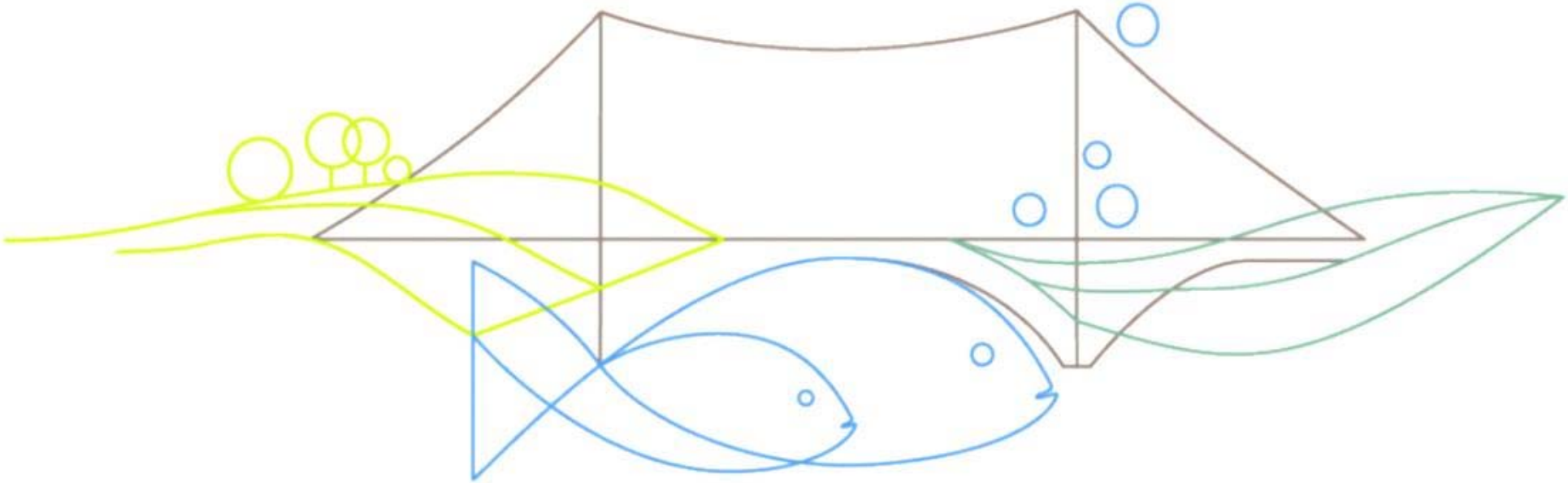
Session B4: Movement Patterns of Several Fish Species Approaching and Passing a Vertical Slot Fishway

Movement patterns of several fish species approaching and passing a vertical slot fishway



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Fish Passage 2015
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1. Research Questions

Successful upstream migration of fish through a fishway can be described as 3-step process

Attraction to entrance	Entry into fishway	Passage through fishway

The design of the fishway has to focus on:

Entrance location Attraction flow	Entrance design Hydraulics at/in the entrance	Design of pool / bypass Hydraulics in the pool/slot/bypass

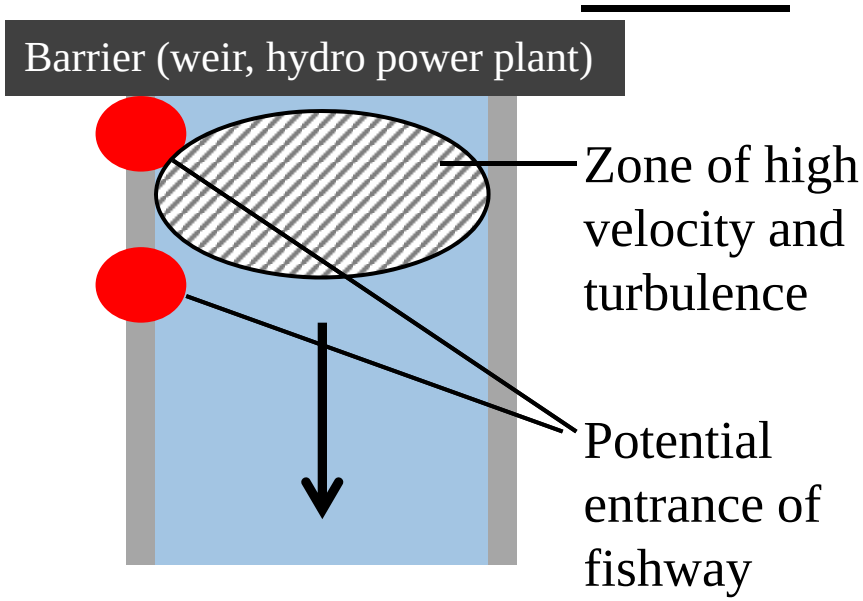
1. Research Questions

In fishway guidelines are some recommendations for the location and design of entrances. But uncertainties still exists.

Where is the best location for the fishway entrance?

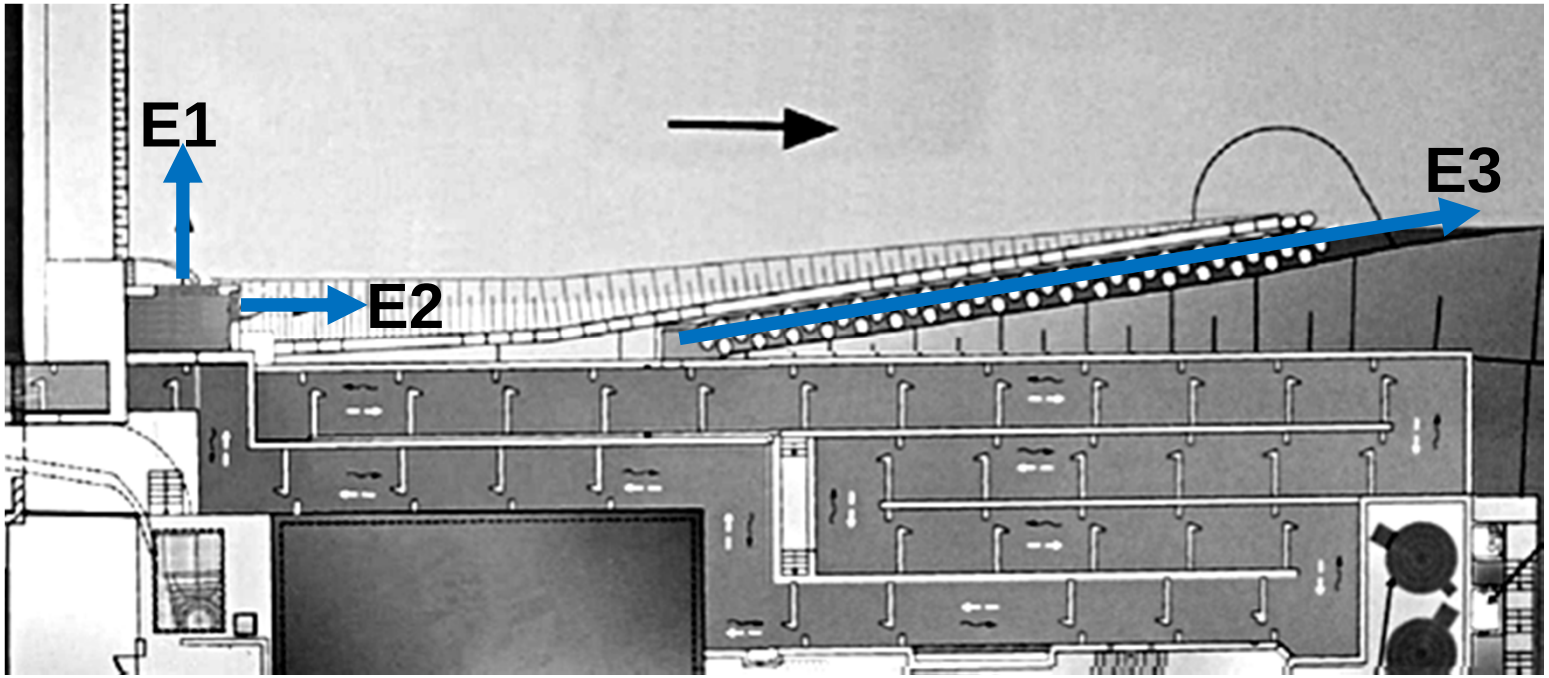
What kind of fish movements occur at the entrance?

How much does the entrance effect the passability compared to the rest of the fishway?



2. Experimental Setup

Study site: fishway at the River Mosel
- vertical slot typ
- 39 pools
- 3 entrances

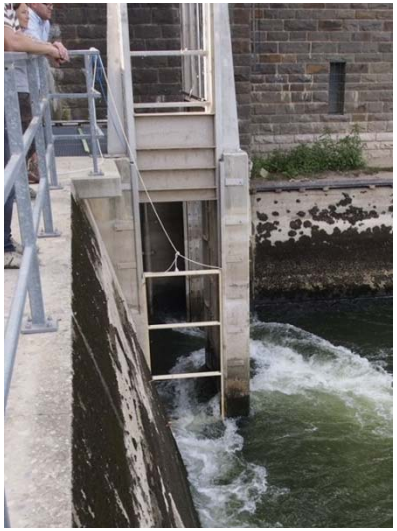


E1: close to HPP
90° to main flow
width 2m

E2: near the HPP
0° to main flow
width 1m

E3: 50m downstream
bypass channel

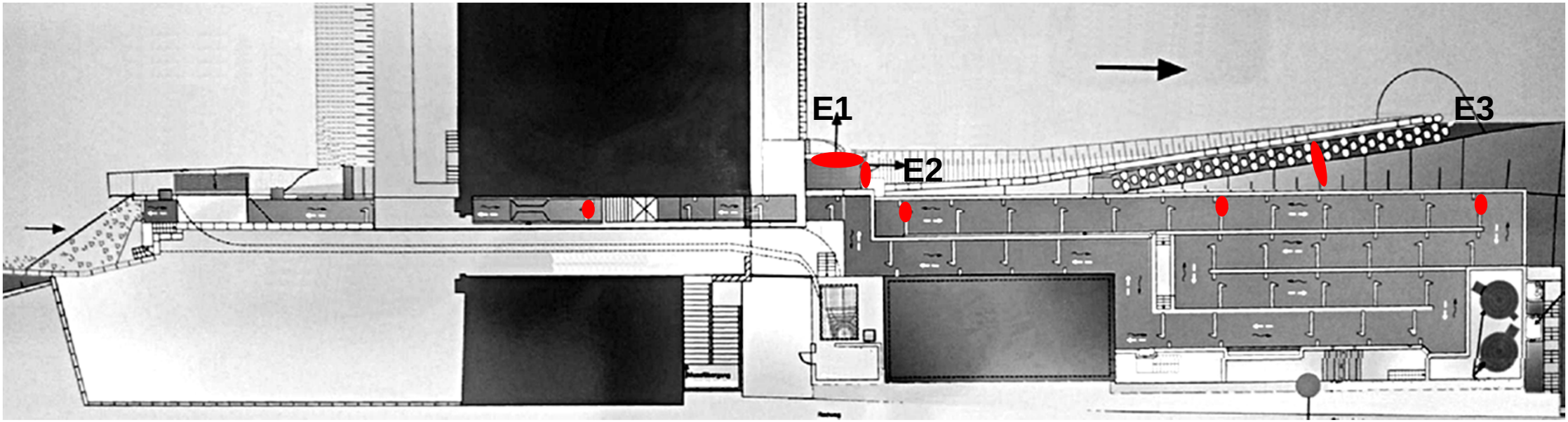
2. Experimental Setup



PIT antennae at entrances
at slots in the fishway

Since 04/2013 release of ~2500 tagged fish

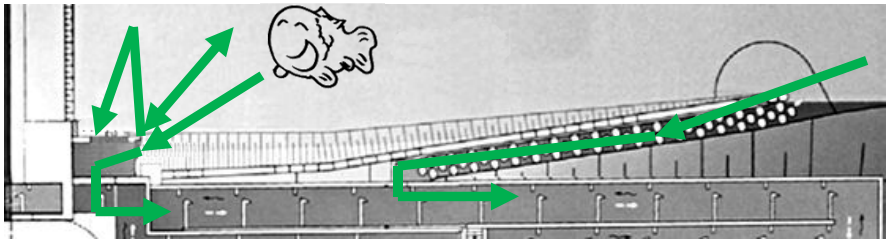
- potamodromous: roach, perch, chub, nase, barb…
- diadromous: brown trout*, river lamprey



3. Data Analysis

Detections 19.03. – 09.06.2015

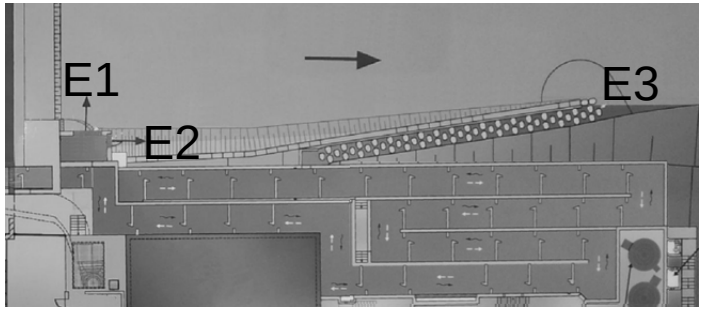
Fish species: Roach (*Rutilus rutilus*)
Nase (*Chondrostoma nasus*)
Chub (*Squalius cephalus*)
Brown Trout (*Salmo trutta*)

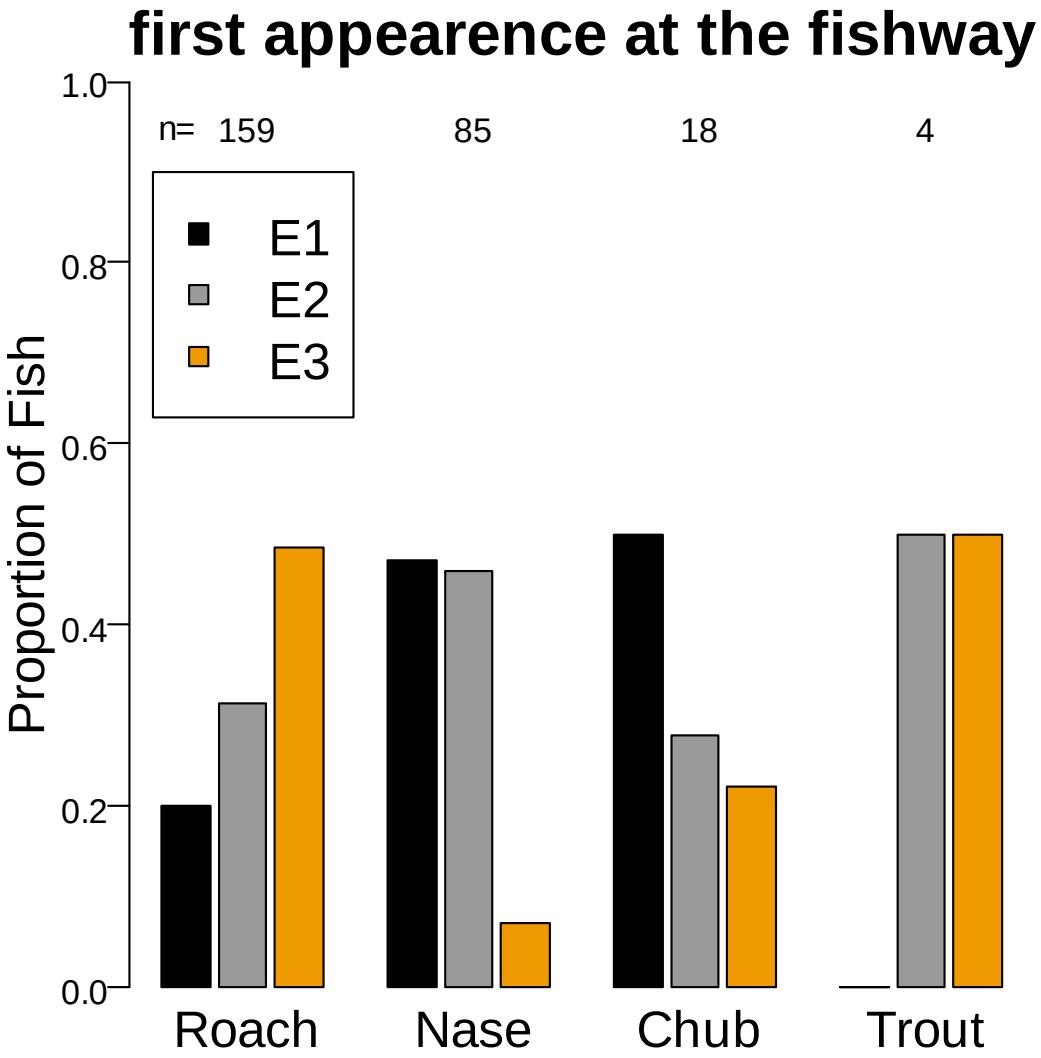


Fish Image altered after Friese (2005)

- first appearance
- Number of attempts to enter the fishway
  attempt = detection at different entrances or absence for >60 sek
- Entry: immediate / during first attempt or after several attempts
- delay: time between first appearance and successful entry

4. Results – Location of Entrance

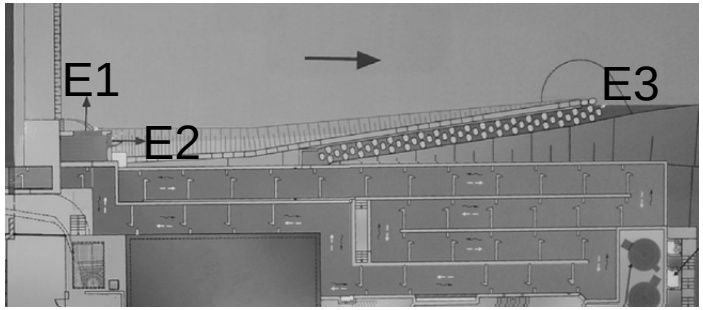


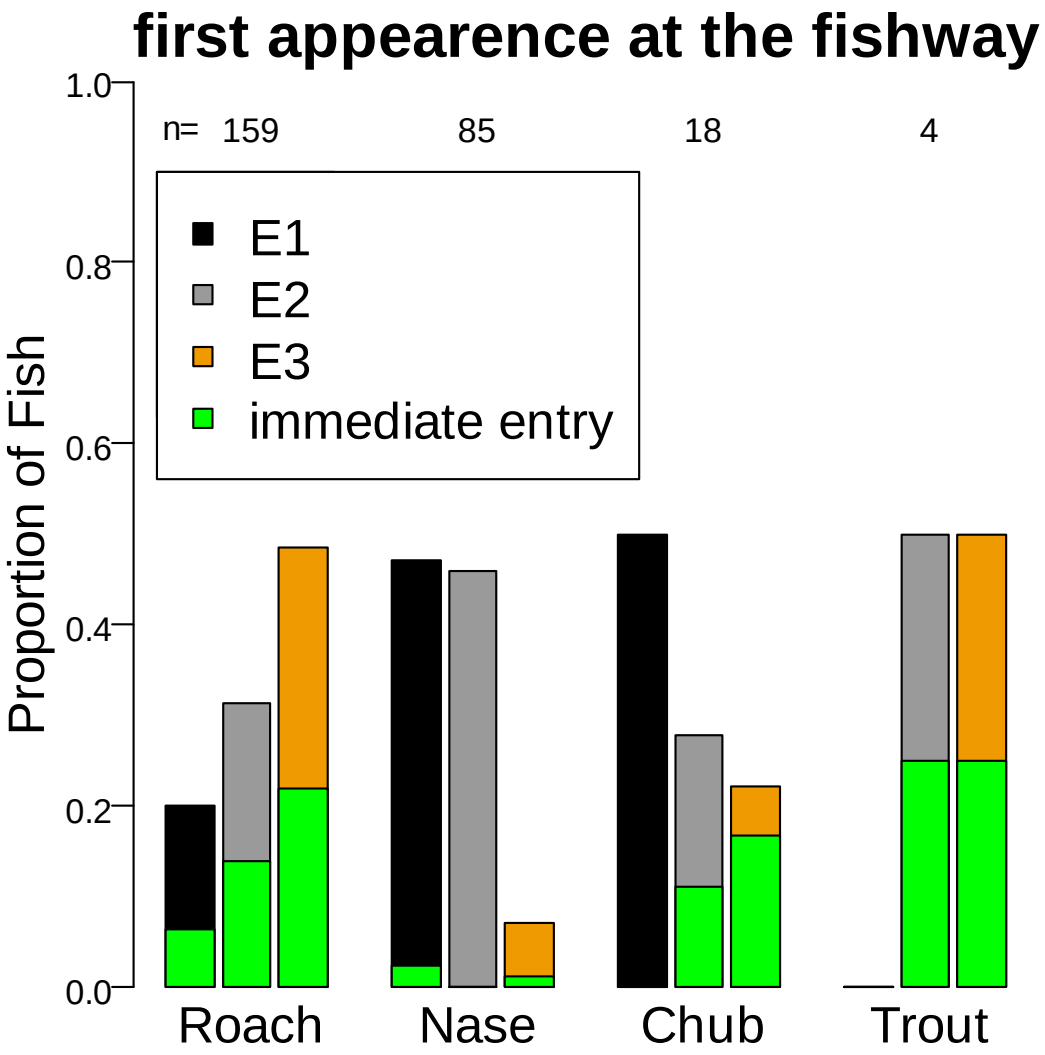


Site of first appearence

- 48% of Roach at E 3
- High amount of Nase (40%) and Chub (50%) at E 1

4. Results – Location of Entrance





Site of first appearence

- 48% of Roach at E 3
- High amount of Nase (40%) and Chub (50%) at E 1

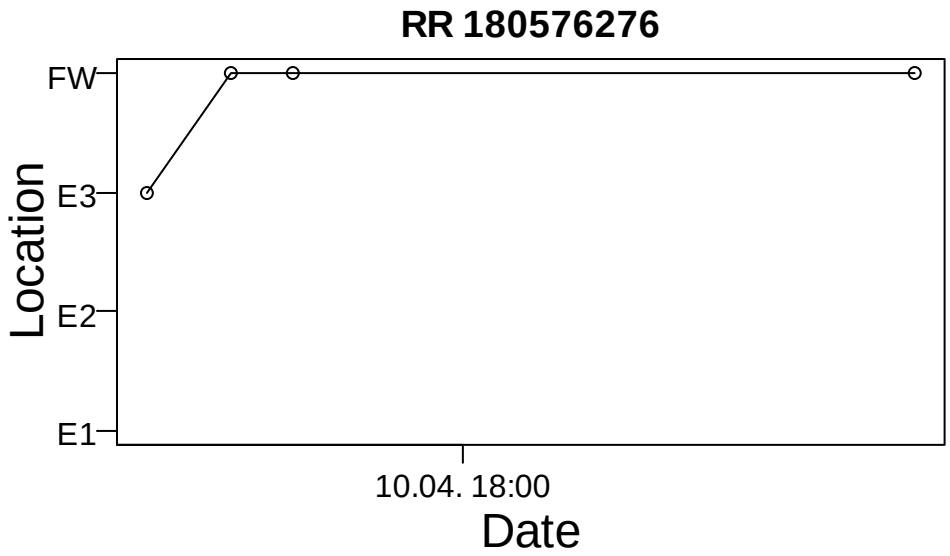
- E1 : few fish entered immediately
- E3: highest proportion of immediate entries

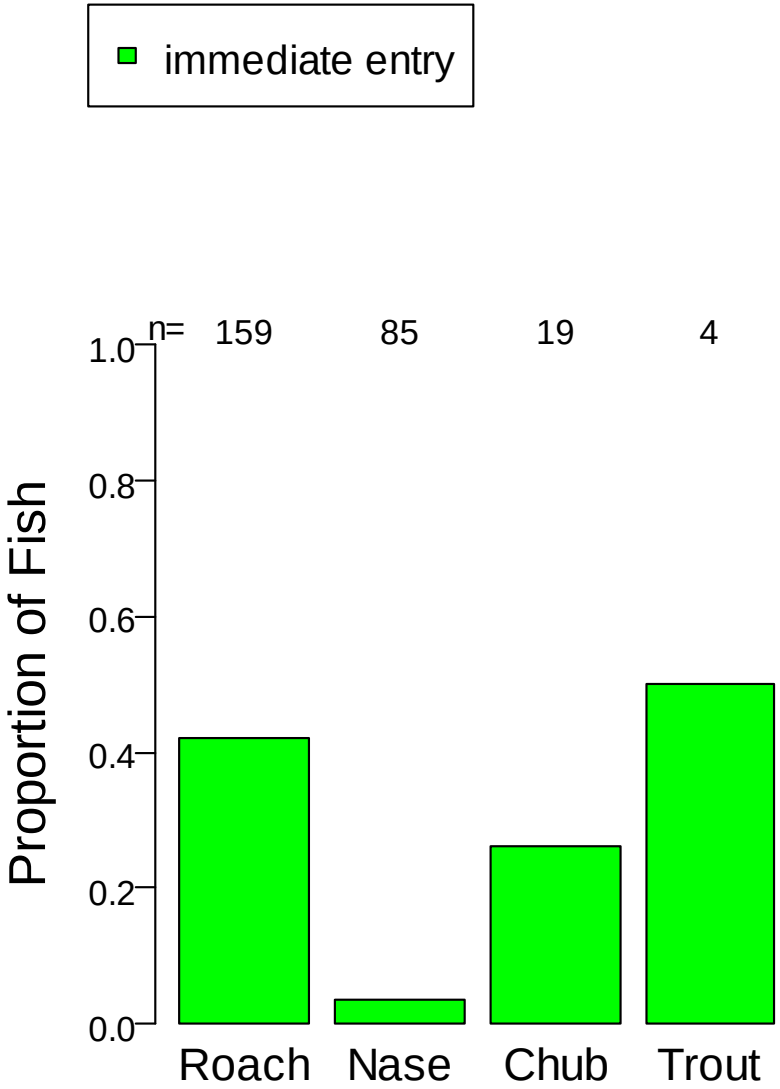
What happened to the fish that did not enter?

4. Results – Movement types

immediate entry:

Example: Roach, detected at one entrance (E 3) with immediate entry into the fishway.



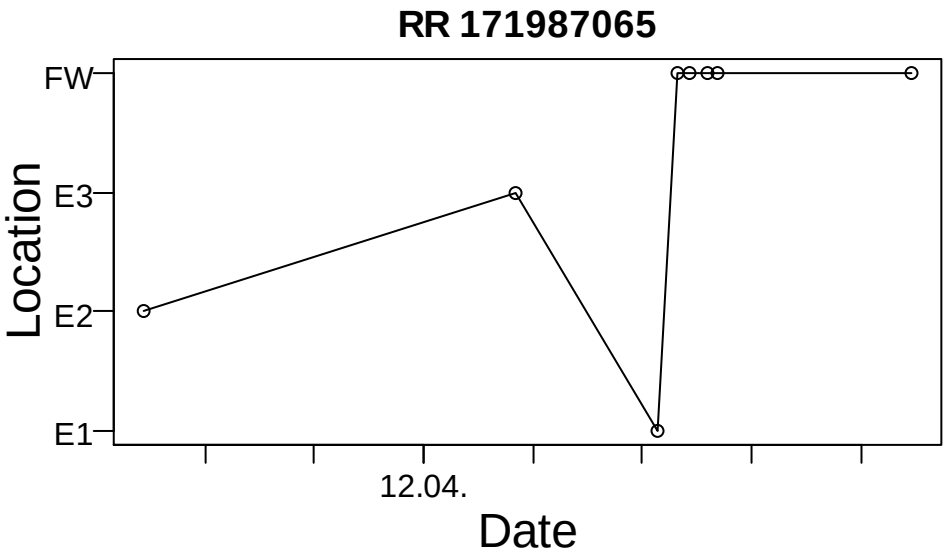


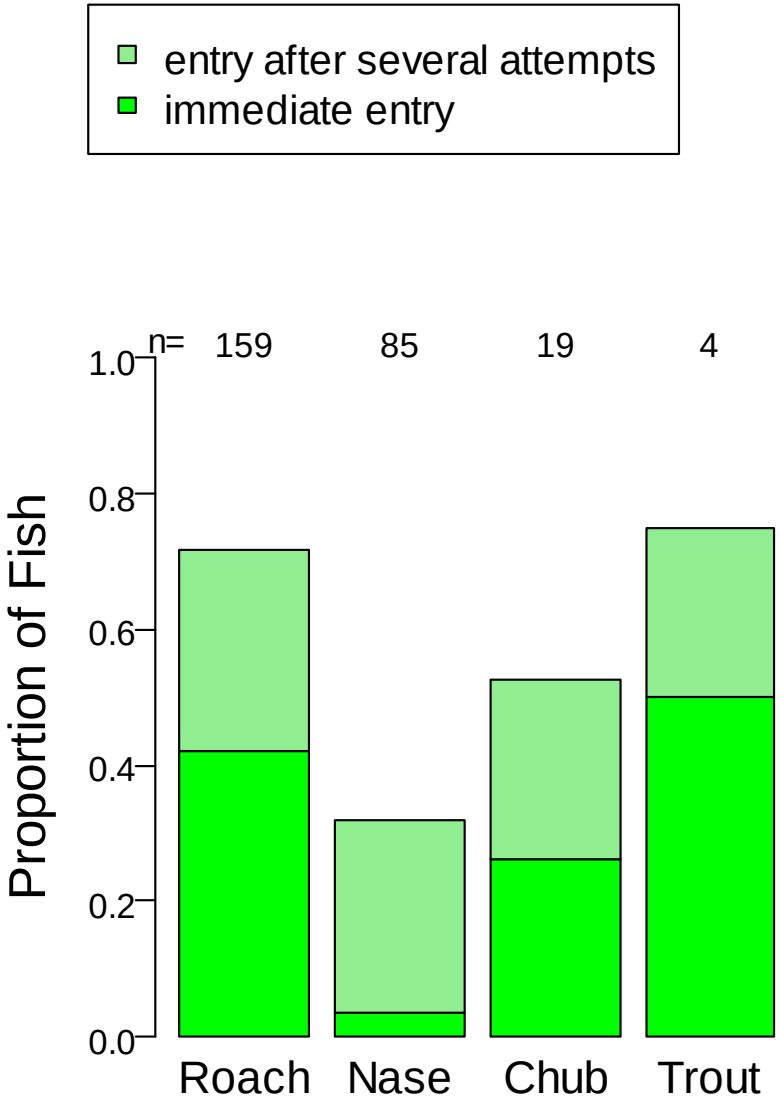
4. Results – Movement types

delayed entry:

-repeated attempts at one antenna
-attempts at different antenna

Example: Roach, detected at all 3 entrances before entering the fishway



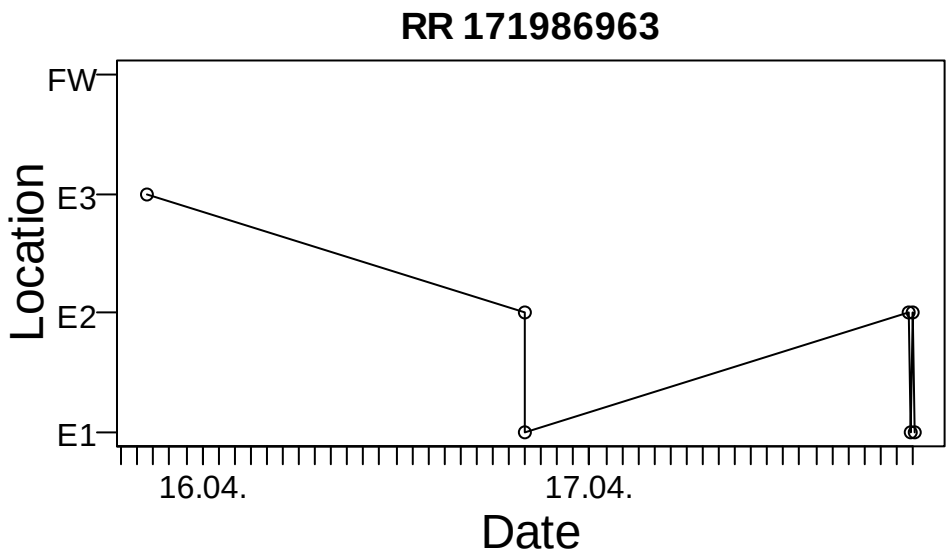


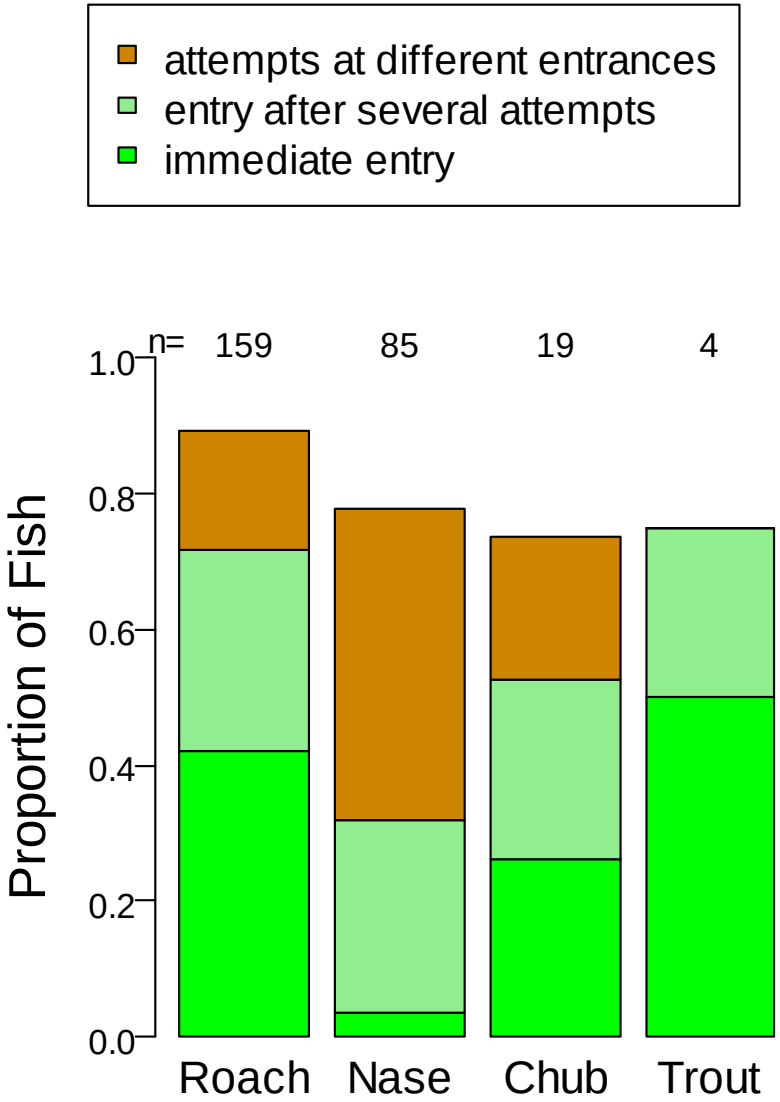
4. Results – Movement types

failure to enter:

-attempts at different entrances

Example: Roach, detected at all 3 entrances but no entry into fishway



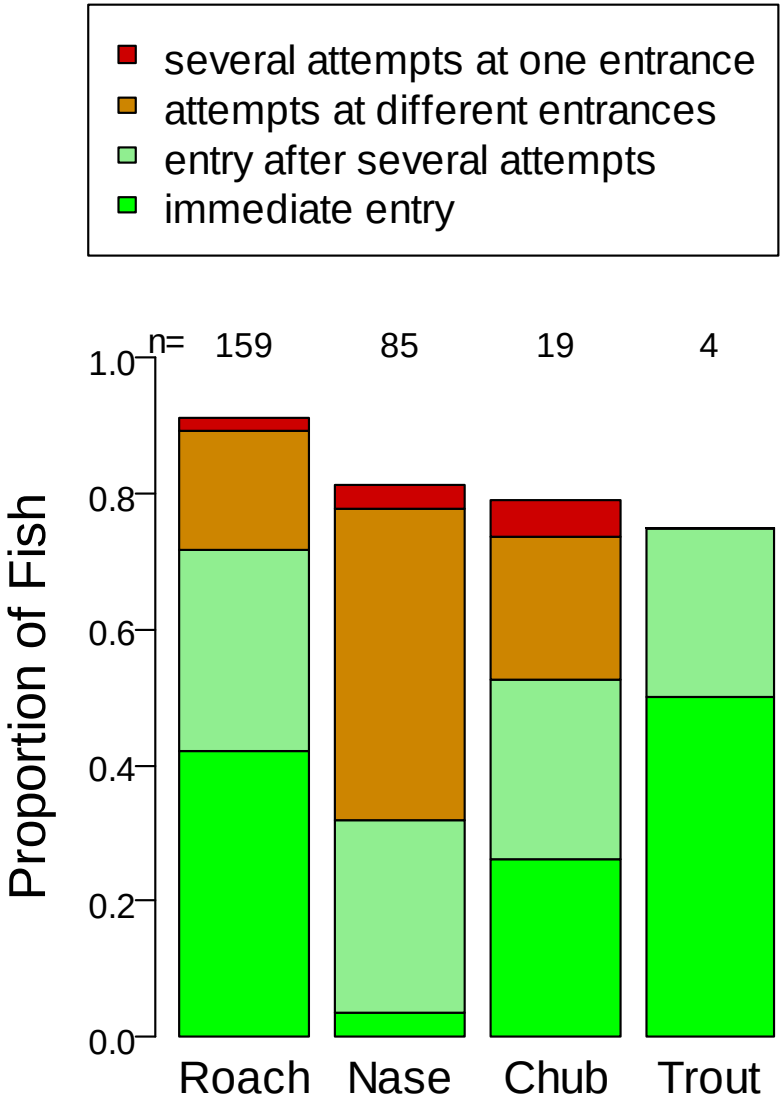


4. Results – Movement types

failure to enter:

-attempts at different entrances

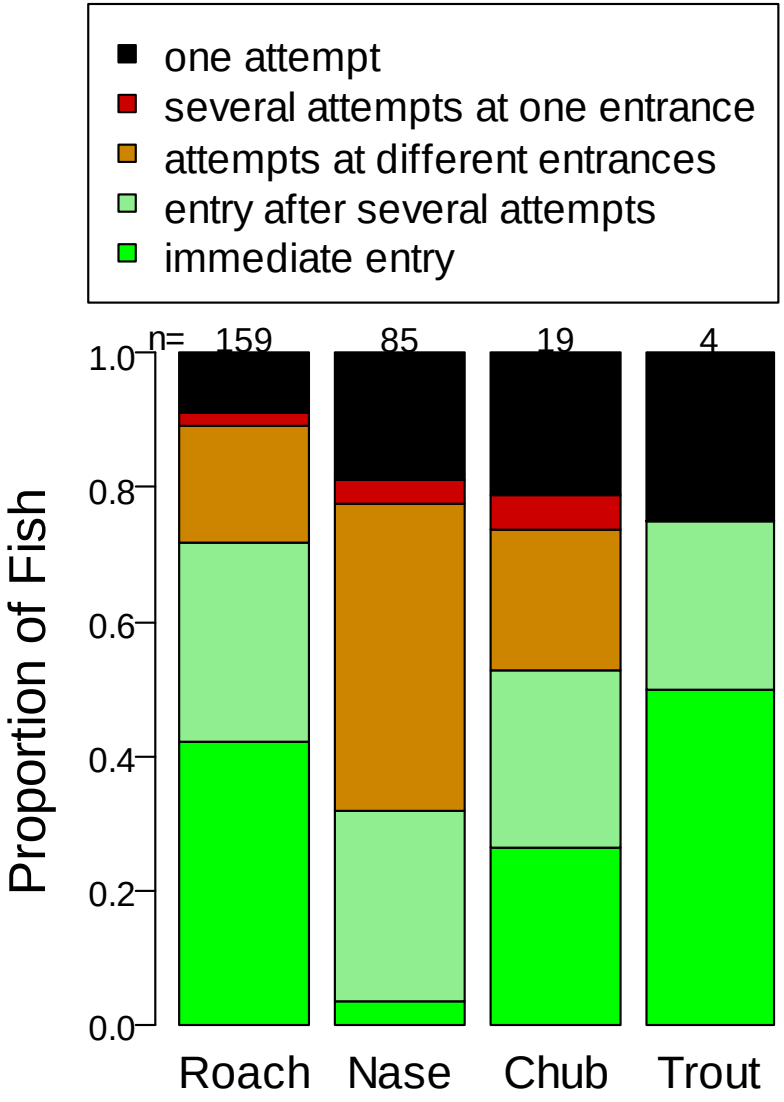
-repeated attempts at one entrance



4. Results – Movement types

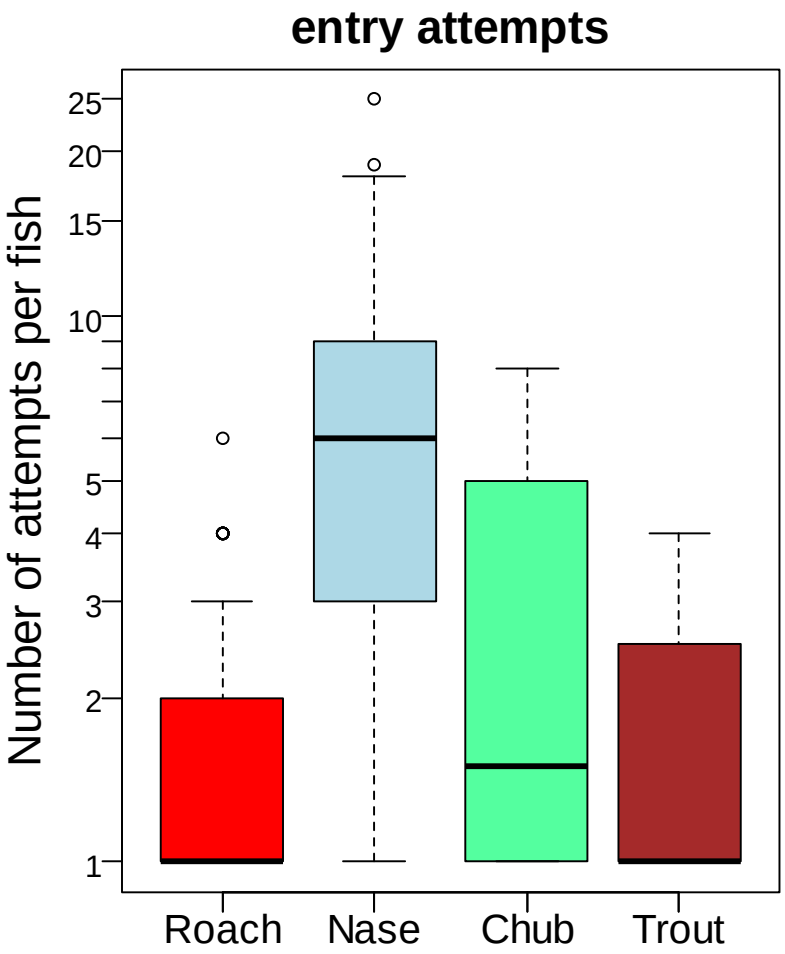
failure to enter:

-attempts at different entrances
-repeated attempts at one entrance
-only one attempt

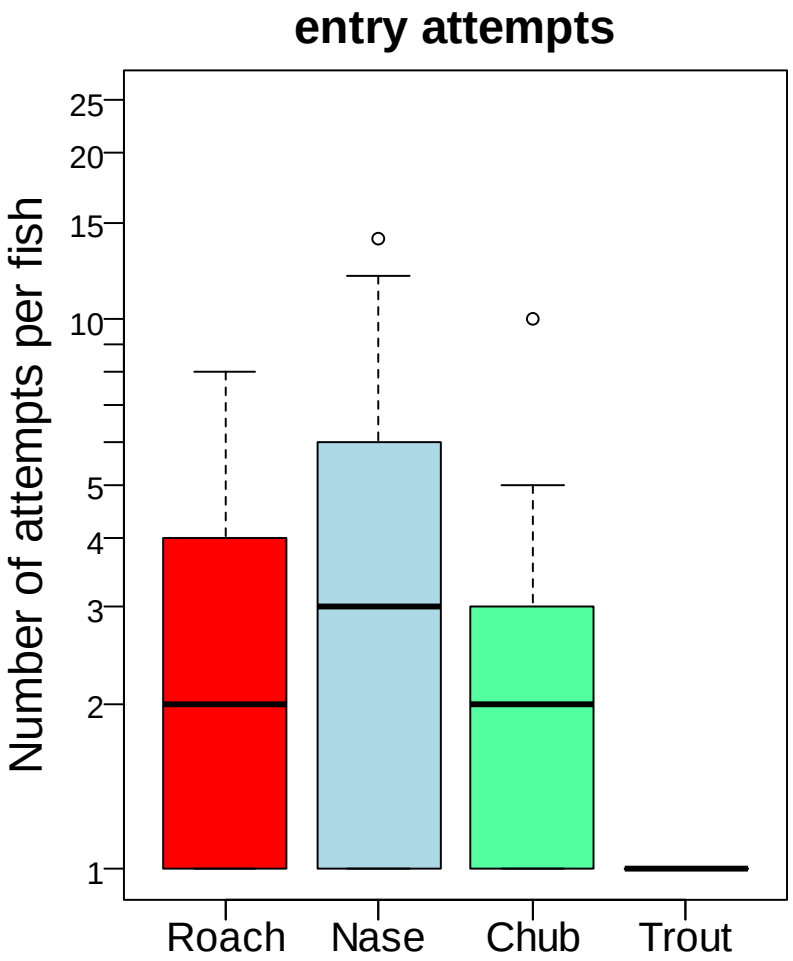


4. Results – Movement types

successful fish



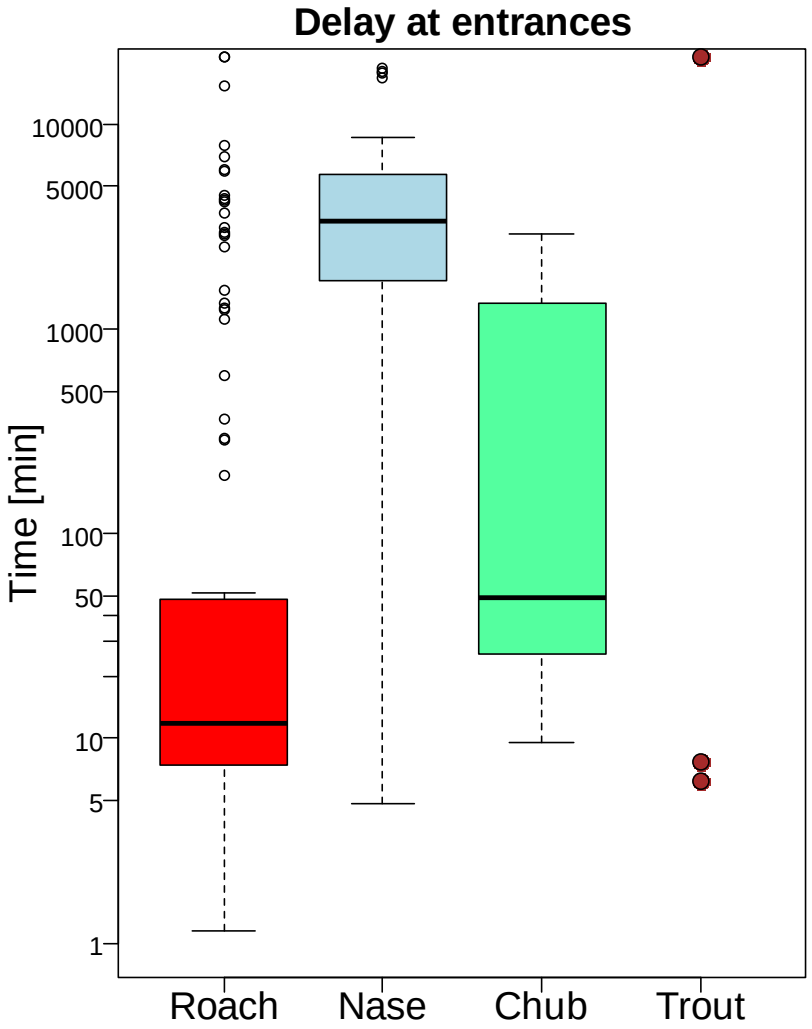
unsuccessful fish



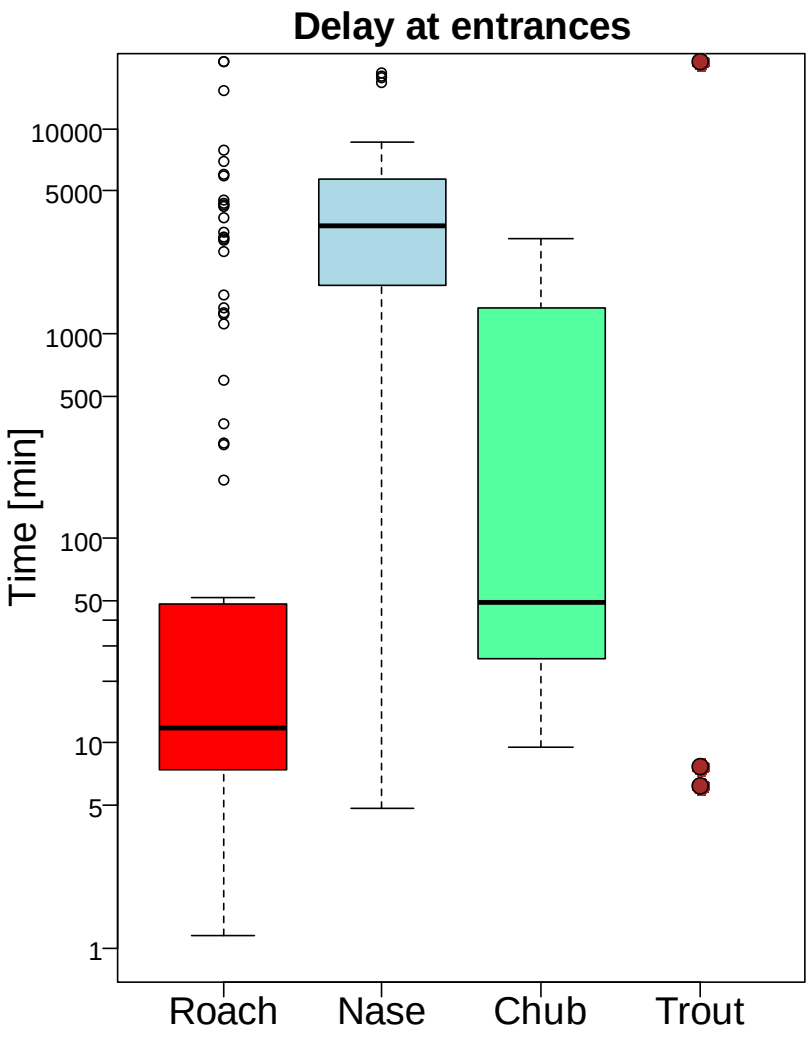
4. Results – Movement types

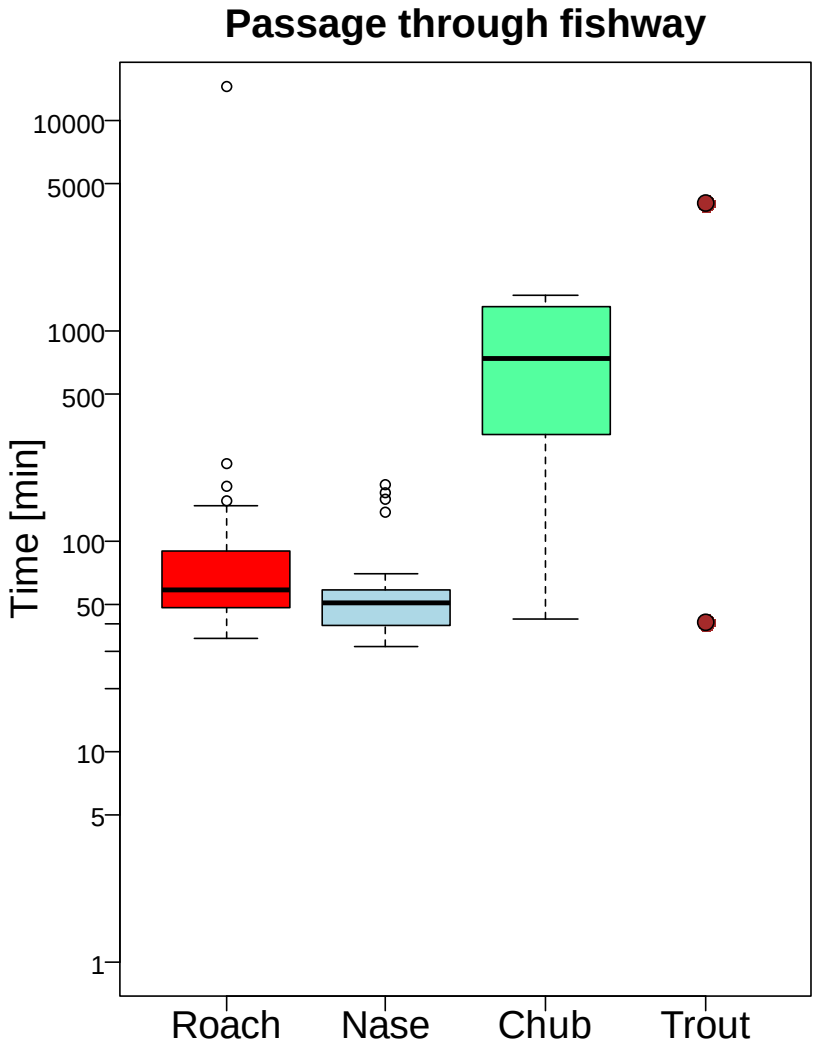
Delay at the entrances:

Low for roach (12 min) and trout (8 min)
Medium for Chub (49 min)
High for Nase (3413 min)



4. Results – Comparison Entry ~ Passage





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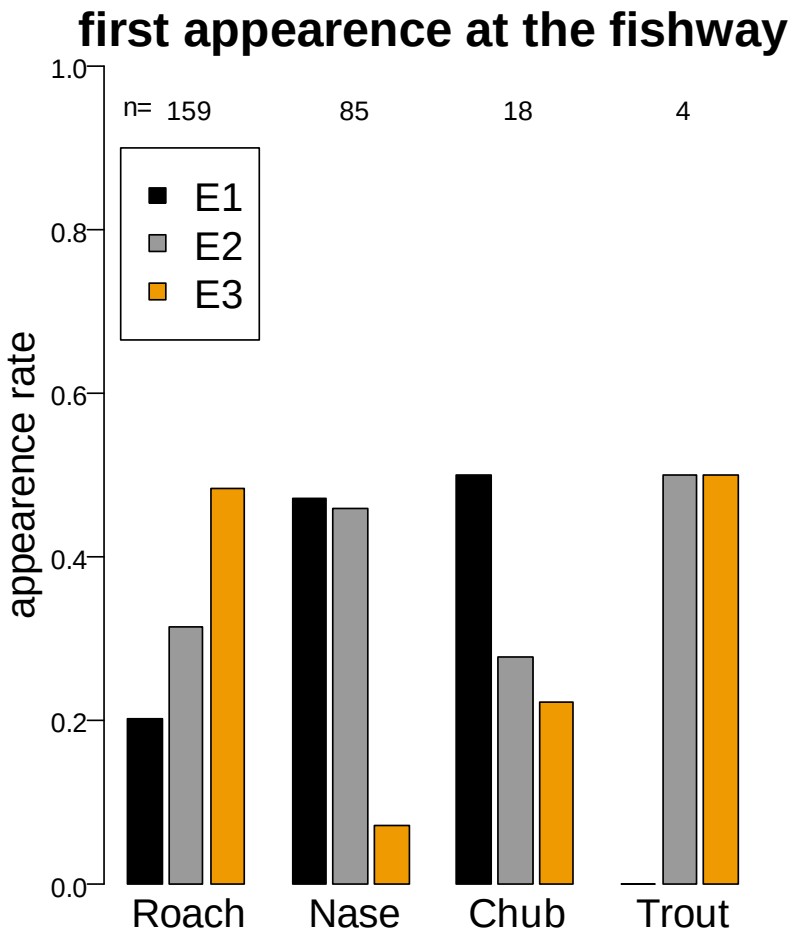
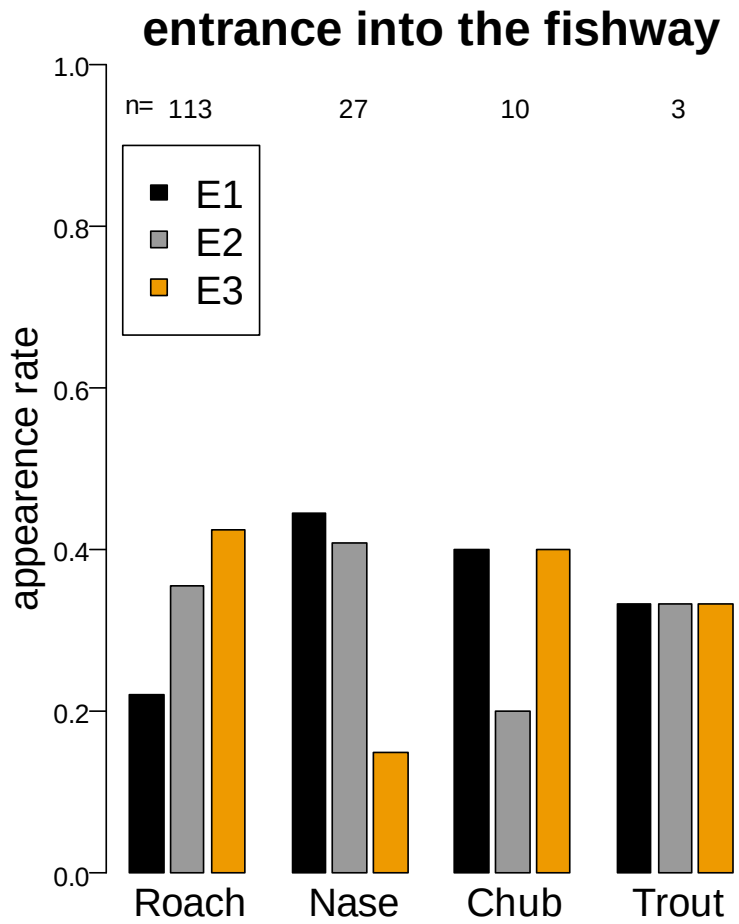




4. Results – Comparison Entry ~ Passage

Efficiency of the Fish pass

	Roach	Nase	Chub	Brown trout
Appearance at Entrance	*100%*	*100%*	*100%*	*100%*
Entry into fishway	72%	32%	53%	75%
Passage through fishway	99%	96%	100%	100%

Attraction to entrance ?

Entry into fishway ✗

Passage through fishway ✓

5. Summary

-Fish species tend to have preferences for different entrances

-High proportion of fish did not enter immediately into the fishway.

-The number of attempts to enter differ between species.

-Time of delay at the entrances is different for species and can exceed the time of the passage through the fishway (e.g. Nase).

-High amounts of fish failed to enter the fishway. Only few fish failed to pass within the fishway.

5. Outlook

Verify the findings / problems at the entrances

further time period

other species

What kind of problems?

Characterise the fish behaviour (via Didson)

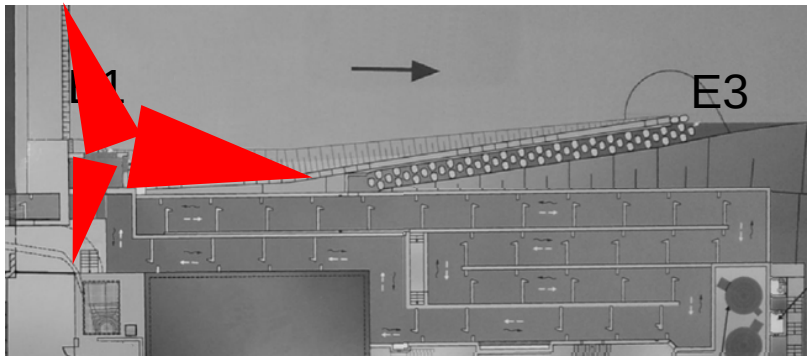
at the entrance

in the entrance facility

Why do these problems occur?

Connect the fish behaviour with hydraulics at the entrance. This will be done in close cooperation with colleagues at the Federal Waterways Engineering and Research Institute.

Potential observation areas of Didson sonar



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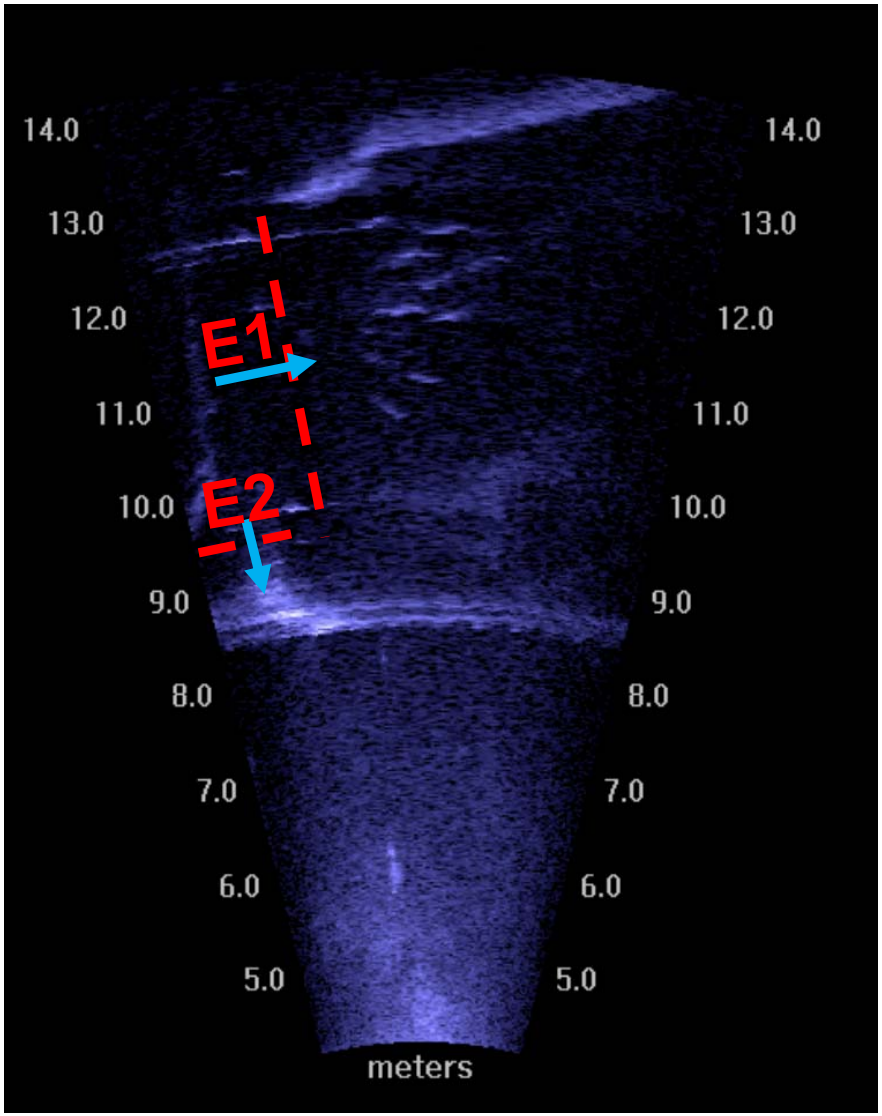
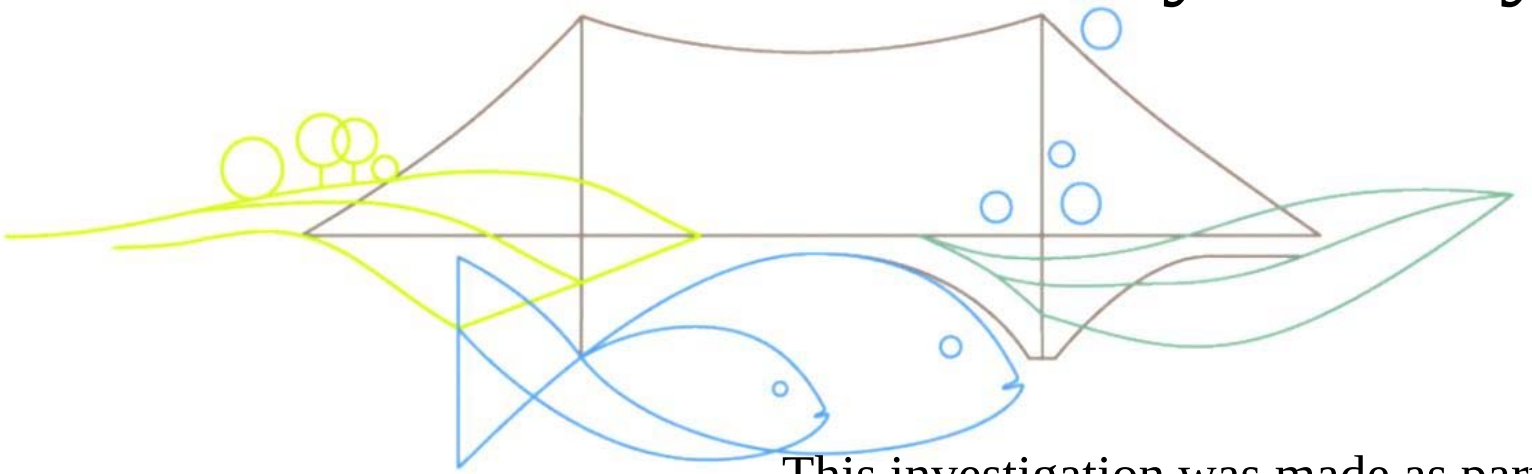


Example of Didson recording at E1 & E2

Thank you for your attention



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Ecological continuity in German Waterways

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