Jun 23rd, 11:50 AM - 12:05 PM

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

Matthias Pitsch  
*Federal Institute of Hydrology (BfG)*

Bernd Mockenhaupt  
*Federal Institute of Hydrology (BfG)*

Marcus Herbst  
*Federal Institute of Hydrology (BfG)*

David Nijssen  
*Federal Institute of Hydrology (BfG)*

Follow this and additional works at: [https://scholarworks.umass.edu/fishpassage_conference](https://scholarworks.umass.edu/fishpassage_conference)  
Part of the [Aquaculture and Fisheries Commons](https://scholarworks.umass.edu/aquaculture Fisher), and the [Hydraulic Engineering Commons](https://scholarworks.umass.edu/hydraulic engineering)

Pitsch, Matthias; Mockenhaupt, Bernd; Herbst, Marcus; and Nijssen, David, "Session B4: Movement Patterns of Several Fish Species Approaching and Passing a Vertical Slot Fishway" (2015). *International Conference on Engineering and Ecohydrology for Fish Passage*. 11.  
[https://scholarworks.umass.edu/fishpassage_conference/2015/June23/11](https://scholarworks.umass.edu/fishpassage_conference/2015/June23/11)

This Event is brought to you for free and open access by the Fish Passage Community at UMass Amherst at ScholarWorks@UMass Amherst. It has been accepted for inclusion in International Conference on Engineering and Ecohydrology for Fish Passage by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.
Movement patterns of several fish species approaching and passing a vertical slot fishway

Matthias Pitsch, Bernd Mockenhaupt, Marcus Herbst, David Nijssen
Federal Institute of Hydrology, Koblenz

Fish Passage 2015
23rd of June 2015 Groningen, The Netherlands
Successful upstream migration of fish through a fishway can be described as 3-step process:

1. **Attraction to entrance**
2. **Entry into fishway**
3. **Passage through fishway**

The design of the fishway has to focus on:

1. **Entrance location**
2. **Attraction flow**
3. **Entrance design**
4. **Hydraulics at/in the entrance**
5. **Design of pool / bypass**
6. **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 exist.

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*)

- 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

Fish Image altered after Friese (2005)
4. Results – Location of Entrance

Site of first appearance
- 48% of Roach at E3
- High amount of Nase (40%) and Chub (50%) at E1
4. Results – Location of Entrance

Site of first appearance
- 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.

![Graph showing movement types and locations](image_url)
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

Date

Location

Proportion of Fish

entry after several attempts
immediate entry

Roach  Nase  Chub  Trout

n= 159  85  19  4
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**
entry attempts

<table>
<thead>
<tr>
<th>Fish</th>
<th>No. of attempts per fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roach</td>
<td>1</td>
</tr>
<tr>
<td>Nase</td>
<td>5</td>
</tr>
<tr>
<td>Chub</td>
<td>4</td>
</tr>
<tr>
<td>Trout</td>
<td>2</td>
</tr>
</tbody>
</table>

**unsuccessful fish**
entry attempts

<table>
<thead>
<tr>
<th>Fish</th>
<th>No. of attempts per fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roach</td>
<td>4</td>
</tr>
<tr>
<td>Nase</td>
<td>5</td>
</tr>
<tr>
<td>Chub</td>
<td>3</td>
</tr>
<tr>
<td>Trout</td>
<td>2</td>
</tr>
</tbody>
</table>
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

**Delay at entrances**

- **Roach**: Time [min] range
- **Nase**: Time [min] range
- **Chub**: Time [min] range
- **Trout**: Time [min] range

**Passage through fishway**

- **Roach**: Time [min] range
- **Nase**: Time [min] range
- **Chub**: Time [min] range
- **Trout**: Time [min] range
4. Results – Comparison Entry ~ Passage

**first appearance at the fishway**

<table>
<thead>
<tr>
<th>Fish</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roach</td>
<td>85</td>
<td>49</td>
<td>38</td>
<td>159</td>
</tr>
<tr>
<td>Nase</td>
<td>18</td>
<td>13</td>
<td>12</td>
<td>45</td>
</tr>
<tr>
<td>Chub</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>Trout</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

**entrance into the fishway**

<table>
<thead>
<tr>
<th>Fish</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roach</td>
<td>27</td>
<td>10</td>
<td>7</td>
<td>44</td>
</tr>
<tr>
<td>Nase</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Chub</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Trout</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>
### 4. Results – Comparison Entry ~ Passage

#### Efficiency of the Fish pass

<table>
<thead>
<tr>
<th></th>
<th>Roach</th>
<th>Nase</th>
<th>Chub</th>
<th>Brown trout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance at Entrance</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Entry into fishway</td>
<td>72%</td>
<td>32%</td>
<td>53%</td>
<td>75%</td>
</tr>
<tr>
<td>Passage through fishway</td>
<td>99%</td>
<td>96%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

- **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.
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.

Example of Didson recording at E1 & E2
Thank you for your attention

This investigation was made as part of the Research & Development program:
Ecological continuity in German Waterways
of the Federal Institute of Hydrology and
the Federal Waterways Engineering and Research Institute
It was financially supported by the Federal Ministry of Transport and Digital Infrastructure.

Matthias Pitsch
Tel.: +49 261/1306-5956
E-Mail: pitsch@bafg.de; durchgaengigkeit@bafg.de
www.bafg.de/durchgaengigkeit