Jun 22nd, 3:00 PM - 3:15 PM

Session B2: VisAdvies Protocol for Testing and Evaluating Pumping Station Pumps on Fish Survivability

Hendry Vis
Project leader

Frank Cooper
Bedford Pumps Ltd.

Quincy de Bruijn
VisAdvies BV

Jan H. Kemper
VisAdvies BV

Follow this and additional works at: https://scholarworks.umass.edu/fishpassage_conference
Part of the Aquaculture and Fisheries Commons, and the Hydraulic Engineering Commons

Vis, Hendry; Cooper, Frank; de Bruijn, Quincy; and Kemper, Jan H., "Session B2: VisAdvies Protocol for Testing and Evaluating Pumping Station Pumps on Fish Survivability" (2015). International Conference on Engineering and Ecohydrology for Fish Passage. 92.
https://scholarworks.umass.edu/fishpassage_conference/2015/June22/92

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.
“VisAdvies protocol” for testing and evaluating pumping station pumps on fish survivability.

By
Jan H. Kemper

Authors:
Hendry Vis (VisAdvies),
Frank Cooper (Bedford pumps Ltd)
Quincy de Bruijn (VisAdvies)
Jan H. Kemper (VisAdvies)
Background

- Much land below sea level
- All water must be drained by pumping stations.

With all consequences for fish!!
Extend of the problem (???)

Monitoring of 26 pumping stations *in situ*
Results and conclusions

Results
- 11% for fish <15 cm
- 35% for fish >15 cm.
- 10 – 50% for eel (under-represented)

Conclusion:
- Pumping stations pumps must be fish friendly
- Supply of natural stock insufficient (silvereel)
  Alternative: Forced exposure of fish
- Need for universal approach (protocol)
Protocol

1. **Guideline for the field test**
2. **Survivability score**

Established with support of ecological technical specialists from many water authorities
Test protocol in lab setting

Test with the Bedford SAF.90.05.12 (2012)

<table>
<thead>
<tr>
<th>Aspect</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running speed</td>
<td>330 rpm</td>
</tr>
<tr>
<td>Water elevating height</td>
<td>2.9 m</td>
</tr>
<tr>
<td>Discharge</td>
<td>1.3 m³/s</td>
</tr>
</tbody>
</table>
Protocol

1. Field test approach
   - Fish Species
   - Legislation
   - Qualification
   - Sensor Fish

2. Survivability score

Alternative

Test protocol in lab setting

Dry dock

Pump and test rig
1. Field test approach
   - Fish Species
   - Legislation
   - Qualification
   - Sensor Fish

2. Survivability score

Fish species (room for other compositions)

- **Anguillidae (eel-like)**
  - \( \leq 45 \text{ cm} \)
  - \( > 45 \text{ cm (silvereel)} \)

- **Cyprinidae (carp-like):**
  - \( \leq 15 \text{ cm} \)
  - \( > 15 \text{ cm} \)

- **Percidae (perch-like):**
  - \( \leq 15 \text{ cm} \)
  - \( > 15 \text{ cm} \)
Law on Animal Experiments

Statistical justification

\[
CI = 1.96 \times \sqrt{\frac{p \times (100 - p)}{(n - 1)}} + survivability(\%) - 1.96 \times \sqrt{\frac{p \times (100 - p)}{(n - 1)}}
\]

- \(CI\) = Confidence interval
- \(p\) = the estimated probability of survivability (%)
- \(n\) = Sample size

![Graph showing survival rate vs. number of experimental fish (in %)]
Introduction

Background

Protocol

1. Field test approach
   - Fish Species
   - Legislation
   - Qualification
   - Sensor Fish

2. Survivability score

Alternative

Exposure / Qualification

Qualification of fish injuries
Qualification of fish injuries

1. No injury or mortality
2. Deviant swimming behaviour
3. External injuries
Qualification of fish injuries

1. No injury or mortality
2. Deviant swimming behaviour
3. External injuries
4. Delayed mortality
Qualification of fish injuries

1. No injury or mortality

2. Deviant swimming behaviour

3. External injuries

4. Delayed mortality

5. Internal injuries (swimm bladder, broken spines)
Qualification of fish injuries

5. Internal injuries (swim bladder, broken spines)
## Survivability score

\[
\text{Final score } (0 - 1) = \sum_{n=1}^{6} \left( \text{Group} \times \text{up survival(n)percentage} \times \text{weighting factor} \right)
\]

<table>
<thead>
<tr>
<th>Group</th>
<th>Length class (cm)</th>
<th>Weighing factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eel</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0-45</td>
<td>0.15</td>
</tr>
<tr>
<td>2</td>
<td>&gt;45</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>Cyprinids</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0-15</td>
<td>0.1</td>
</tr>
<tr>
<td>5</td>
<td>&gt;15</td>
<td>0.2</td>
</tr>
<tr>
<td>6</td>
<td>Percids</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0-15</td>
<td>0.1</td>
</tr>
<tr>
<td>6</td>
<td>&gt;15</td>
<td>0.2</td>
</tr>
</tbody>
</table>
Survivability score

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running speed</td>
<td>330 rpm</td>
</tr>
<tr>
<td>Water elevation height</td>
<td>2.9 m</td>
</tr>
<tr>
<td>Discharge</td>
<td>1.3 m3/s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rating</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outstanding</td>
<td>1</td>
</tr>
<tr>
<td>Excellent</td>
<td>0.75-0.99</td>
</tr>
<tr>
<td>Good</td>
<td>0.50-0.75</td>
</tr>
<tr>
<td>Insufficient</td>
<td>0.25-0.50</td>
</tr>
<tr>
<td>Bad</td>
<td>0.00-0.25</td>
</tr>
</tbody>
</table>
Alternative approach

Theoretical approach (Jacob van Berkel)

- Unique guidelines to the design of fish friendly pumps and turbines
- However: “The proof of the pudding is in the eating”. (methods complementary)
“VisAdvies protocol” for testing and evaluating pumping station pumps on fish survivability.

Thank you for your attention.

Questions?

Author’s:
Hendry Vis (VisAdvies),
Frank Cooper (Bedford pumps Ltd)
Quincy de Bruijn (VisAdvies)
Jan H. Kemper (VisAdvies)