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

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

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

By
Jan H. Kemper

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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>
Introduction
Background
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**

   - Anguillidae (eel-like): $\leq 45$ cm
     - $> 45$ cm (silvereel)
   
   - Cyprinidae (carp-like): $\leq 15$ cm
     - $> 15$ cm
   
   - Percidae (perch-like): $\leq 15$ cm
     - $> 15$ cm
Statistical justification

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

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

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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)
Introduction

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1. Field test approach
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2. Survivability score

Alternative

Qualification of fish injuries

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

$$\text{Final score (0 – 1)} = \frac{1}{6} \sum_{n=1}^{6} (\text{Group}\_\text{survival(n)percentage} \times \text{weighting factor})$$

<table>
<thead>
<tr>
<th>Group</th>
<th>Length class (cm)</th>
<th>Weighing factor</th>
</tr>
</thead>
<tbody>
<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>0-15</td>
<td>0.1</td>
</tr>
<tr>
<td>4</td>
<td>&gt;15</td>
<td>0.2</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>
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Survivability score

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Rating | Score
---|---
Outstanding | 1
Excellent | 0.75-0.99
Good | 0.50-0.75
Insufficient | 0.25-0.50
Bad | 0.00-0.25
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)
Introduction

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   - Sensor Fish

2. Survivability score

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

Thank you for your attention.

Questions?

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