

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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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](https://scholarworks.umass.edu/fishpassage_conference/2015/June22/92)

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## Introduction

### Background

## Protocol

### 1. Field test approach

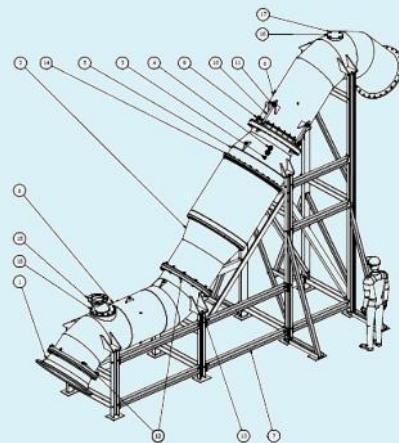
- Fish Species
- Legislation
- Qualification
- Sensor Fish

### 2. Survivability score

## Alternative

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

By  
**Jan H. Kemper**



### **Author's:**

Hendry Vis (VisAdvies),  
Frank Cooper (Bedford pumps Ltd)  
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Jan H. Kemper (VisAdvies)

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### 1. Field test approach

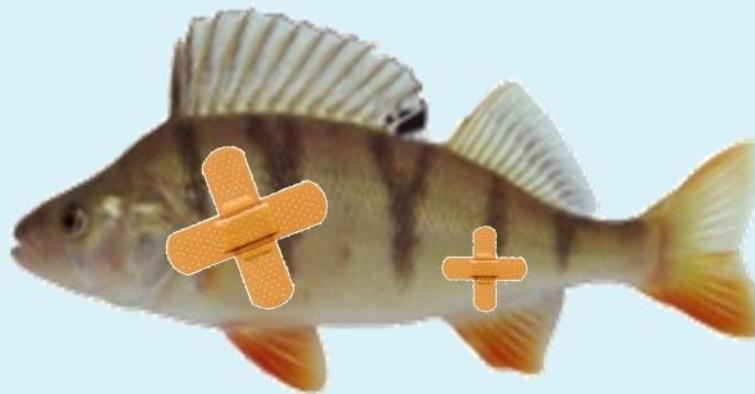
- Fish Species
- Legislation
- Qualification
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### 2. Survivability score

## Alternative

### Background

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



**With all consequences for fish!!**

Actueel Hoogtebestand Nederland (AHN)  
Boven/beneden 0 meter NAP kaart



Legenda  
Actueel Hoogtebestand Nederland  
met relief-schaduwering

- Beneden 0 meter NAP
- Boven 0 meter NAP
- Woonkernen
- Rivieren

Schaal 1: 1.500.000

Adviescent Gro-informatie en ICT  
Rijkswaterstaat

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**Extend of the problem (???)**

Monitoring of 26 pumping stations *in situ*



Actueel Hoogtebestand Nederland (AHN)  
Boven/beneden 0 meter NAP kaart



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**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)

Actueel Hoogtebestand Nederland (AHN)  
Boven/beneden 0 meter NAP kaart



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Adviesbureau Geo-informatie en ICT  
Rijkswaterstaat

## Protocol

### Protocol

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

Established with support of ecological technical specialists from many water authorities

  
**VisAdvies protocol for testing and evaluating fish survivability in pumping station pumps**

Document: VA2011\_38

April 2013

Authors:

Vis H. Q.A.A. de Bruijn & J.H. Kemper

#### Bibliographical reference

Vis H. Q.A.A. de Bruijn & J.H. Kemper, 2013. VisAdvies protocol for testing and evaluating fish survivability in pumping station pumps. VisAdvies BV, Nieuwegein, the Netherlands. Project number VA2011\_38, 23 pages.

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**Protocol**

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➤ Fish Species

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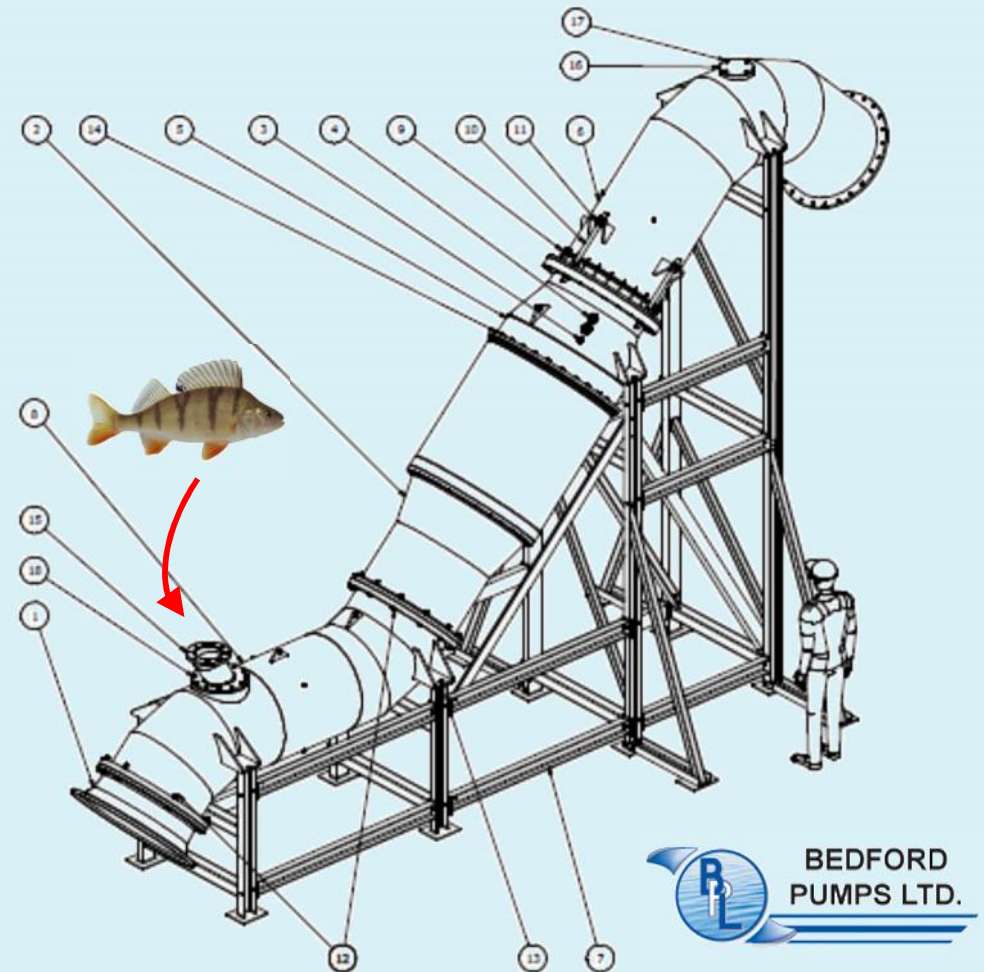
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## Test protocol in lab setting

Test with the Bedford SAF.90.05.12 (2012)

Aspect	value
Running speed	330 rpm
Water elevating height	2.9 m
Discharge	1.3 m <sup>3</sup> /s



- > Fish Species
- > Legislation
- > Qualification
- > Sensor Fish



## Test protocol in lab setting



**Dry dock**

**Pump and test rig**



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## Law on Animal Experiments

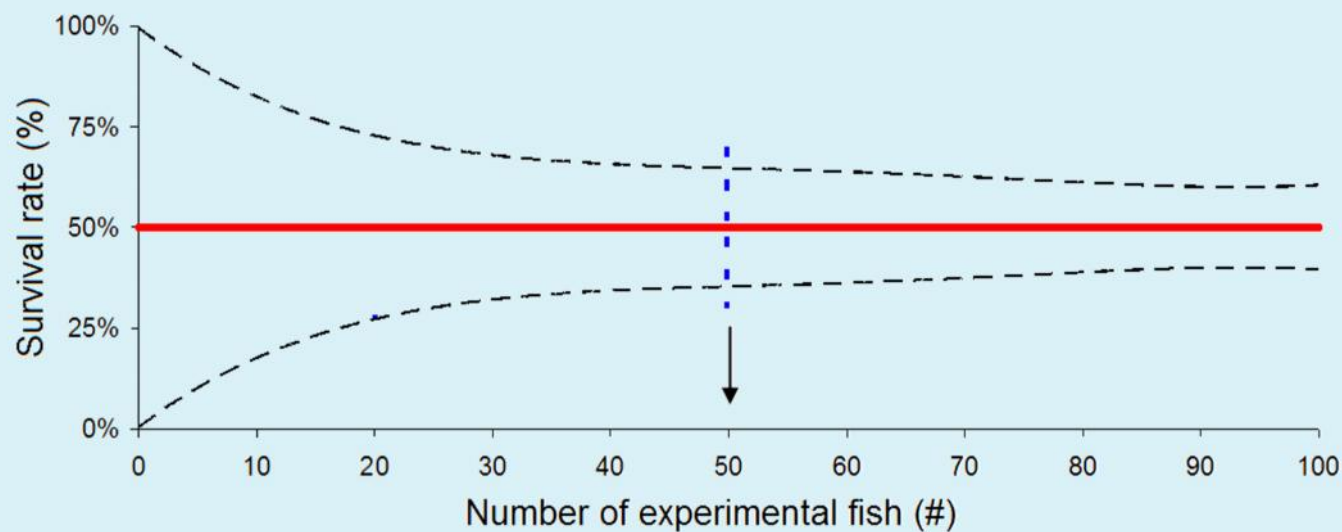
### Statistical justification

$$CI = 1,96 * \sqrt{\frac{p * (100 - p)}{(n - 1)}} + \text{survivability} (\%) - 1,96 * \sqrt{\frac{p * (100 - p)}{(n - 1)}}$$

*CI* = Confidence interval

*p* = the estimated probability of survivability (%)

*n* = Sample size



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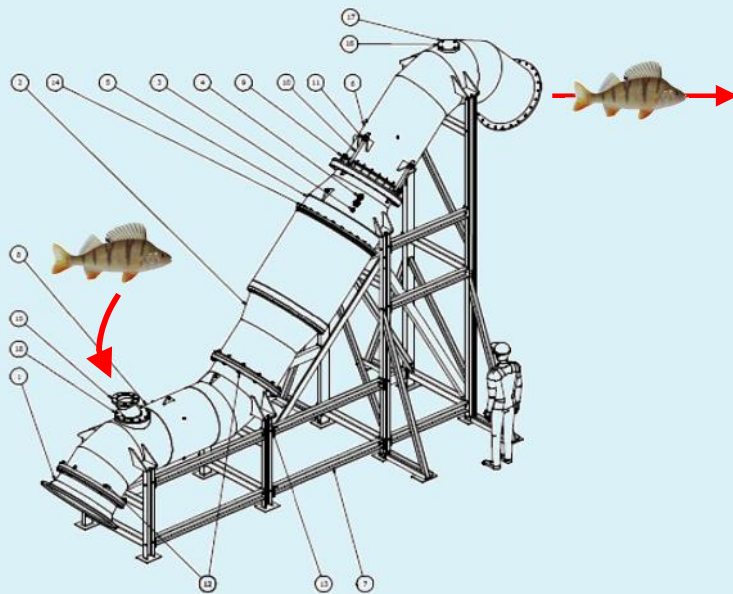
> Qualification

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## Exposure / Qualification



**Qualification of fish injuries**

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## Qualification of fish injuries

1. No injury or mortality
2. Deviant swimming behaviour
3. External injuries →



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## Qualification of fish injuries

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



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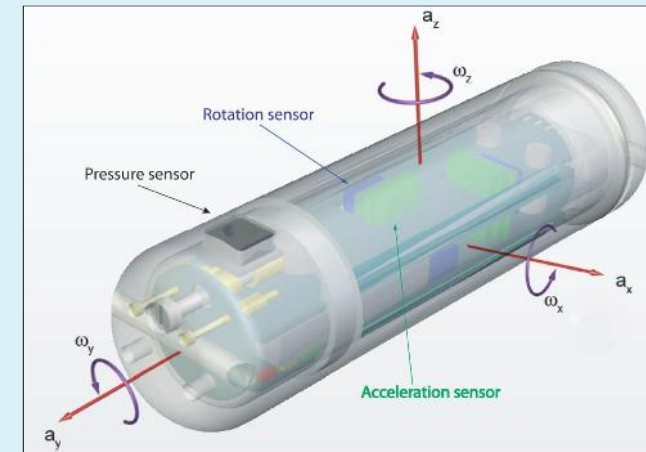
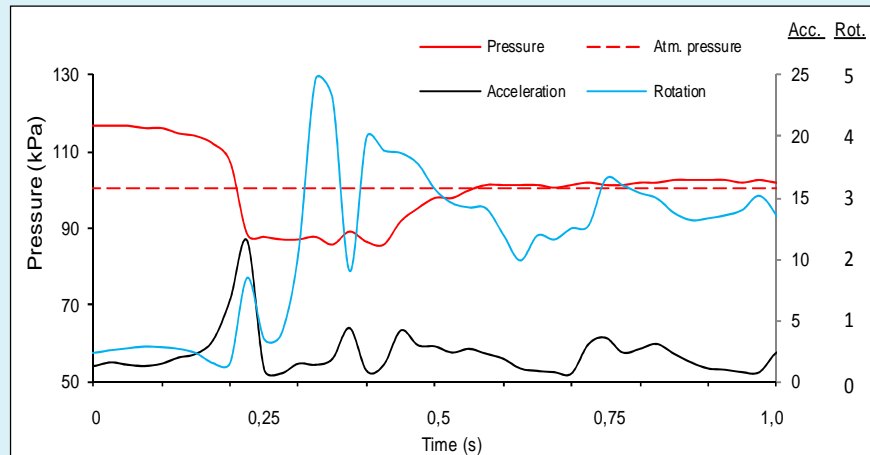
## Qualification of fish injuries

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 (swimm bladder, broken spines)



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## Survivability score

$$\text{Final score (0 - 1)} = \sum_{n=1}^6 (\text{Group } n \text{ survival percentage} * \text{weighting factor})$$

	Group	Length class (cm)	Weighting factor
1	Eel	0-45	0.15
2		>45	0.25
3	Cyprinids	0-15	0.1
4		>15	0.2
5	Percids	0-15	0.1
6		>15	0.2



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## Survivability score

Aspect	value
Running speed	330 rpm
Water elevating height	2.9 m
Discharge	1.3 m <sup>3</sup> /s




Rating	Score
Outstanding	1
Excellent	0.75-0.99
Good	0.50-0.75
Insufficiënt	0.25-0.50
Bad	0.00-0.25

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## 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)

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

*Thank you for your attention.*

*Questions?*

### **Author's:**

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