Fishway effectiveness

Definitions

- Passage efficiency (%)
- Entrance efficiency (%)
- Attraction efficiency (%)

FLOW
Fishway effectiveness definitions:

- Turbine entrainment (% mortality)
- Pressure
- Fluid shear
- Blade strike

Efficiencies:
- Passage efficiency (%)
- Entrance efficiency (%)
- Guidance efficiency (%)

Attraction efficiency (%)
Studies and evidence included in review (n=46, e=76)

Full-text articles assessed for eligibility (n=72, e=121)

Evidence items excluded (e=45)

Records screened (n=630)

Records excluded (n=558)

Disqualified or ambiguous species (e=9)

Study limitation (e=11)

Insufficient reporting (e=25)

Records after duplicates removed (n=630)

Other (n=18)

UMass (n=502)

WoS (n=173)
Wilkes et al. (in revision) Rev.

Systematic evidence review

Fishing Biology and Fisheries

(c) Downstream movement

Support

0 10 20 30 40 50 60 70

Refute

0 5 10 15 20 25

Refute

Passage

Support

0 10 20 30 40 50 60 70

0 5 10 15 20 25 30 40 50

Other taxa
Galliformes and Anseriformes
Anguilliformes
All taxonomic groups

Entrance & attraction

Support

0 10 20 30 40 50 60 70
Key findings:

- Not enough empirical evidence
- Attraction of fish and downstream movement neglected
- Incomplete monitoring data and insufficient reporting
- Need to combine little evidence with expert knowledge and numerical modelling

Systematic evidence review
Wilkes et al. (in review)

Bayesian networks: Upstream passage

Fish & Fisheries

Attraction flow (%)

0 5 10 15 20
0.0 0.4 0.8

Attraction efficiency

●

Best estimate

50% intervals

95% intervals

Head loss = 20 - 100 mm

Head loss = 150 - 230 mm

Distance from migration limit (m)

0 20 40 60 80 100
0.0 0.4 0.8

Entrance efficiency

Probability density

Fishway length (pools)

0 10 20 30 40 50
0.0 0.4 0.8

Passage efficiency

●

L = 0 m

L = 100 m

Q_{att} = 5%

Q_{att} = 15%

W = 50 mm

V = small

\Delta h = 60-90 mm

W = 50 mm

V = small

\Delta h = 130-200 mm

W = 250 mm

V = small

\Delta h = 60-90 mm

W = 250 mm

V = large

\Delta h = 130-200 mm

W = 250 mm

V = large

\Delta h = 60-90 mm

Wilkes et al. (in review)
Bayesian networks: Upstream passage

Wilkes et al. (in review)

Fish & Fisheries

Wilkes et al. (in review)
Upstream fishway design criteria

Wilkes et al. (in review)
Mortality during downstream passage

Fish body length (mm TL)

Overall 72h mortality

No swim bladder
Physostomous
Physosclitous

Wilkes et al. (in review)

Fish & Fisheries
Key findings:

- North Hemisphere criteria an order of magnitude too high
- Attraction flow, turbine design and pressure most sensitive design parameters
- Solutions could be near 0% or near 100% effective, depending on design
- Local extinction, decline in fisheries and ecosystem services expected without sensitive planning and design

Bayesian networks
Applications to hydropower planning, design, and monitoring
Applications

• Predict impact of barrier for planning and EIA
• Design fishways for any target species or group
• Set targets for fish screens and bypasses
• Prior probabilities for basic fish passage research
• Trade-offs between cost, hydraulic & biological performance
• Design fishways for any target species or group
• Predict impact of barrier for planning and EIA