

A new coarse resolution, rapid-assessment methodology to estimate the passability of obstacles to fish migration



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1. Introduction

- i. The passability of artificial and natural obstacles to fish migration would ideally be assessed using fish data.
- ii. These data are frequently unavailable at the correct spatial and temporal scales.
- iii. A new method has thus been developed to rapidly and indirectly estimate obstacle passability based on obstacle and approach-to-obstacle geometry and hydraulics and published data describing the swimming abilities of different migratory species.

3. Transversal Sections



- i. Hydraulically complex obstacles are broken down into discrete 'Transversal Sections' (TS), each with roughly similar hydraulic characteristics.
- ii. Red arrows denote possible TS.
- iii. For each TS, the data described in sections 4 & 5 are collected.

5. Other geometric & hydraulic characteristics



- i. Other factors scored are pools for fish to jump out of; resting areas; degree of turbulence; debris blocking possible passage routes; structures damaging to downstream migrants; length and slope of a surface; step characteristics; gap dimensions.

Criteria	1.0	0.5	0.3	0.0
Effective length of structure	< 10m	11 - 30m	31 - 50m	> 50m
Pool for structures	≤ 20%	21 - 40%	41 - 50%	≥ 60%
Structure effective length ≥ 3m	≤ 5%	6 - 20%	21 - 30%	≥ 40%
Structure effective length < 3m	≤ 5%	6 - 10%	11 - 14%	≥ 15%
Structure effective length < 3m	Pool depth < 1.0 x hydraulic head	Pool depth < 2 x hydraulic head	Pool depth < 3 x hydraulic head	Pool depth < 3.5 x hydraulic head
Only score for structures	0.0	0.5	1.0	1.5
Water turbulence associated with structure	Present		Absent	
For all structures	May be present but does not restrict fish passage		May be present and may locally restrict fish passage	
Water turbulence associated with structure	Low	Moderate	High	
For all structures	May be present but does not restrict fish passage		Present and may locally restrict fish passage	
Gap width	≥ 0.50m	0.25 - 0.49m	0.16 - 0.24m	≤ 0.15m

- ii. Passability scores allocated based on available sources of data. The quality of these data varies and will need to be updated through time.

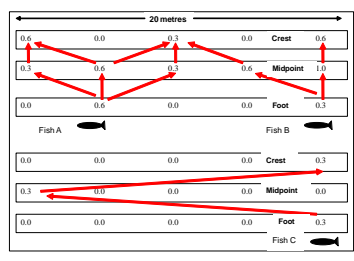
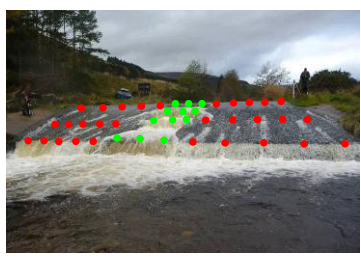
Structure	4.2 FOR BARRIERS PRESENTING A SLOPE, WEIRS, CULVERTS, FORDS BRIDGE FOOTINGS, RAPIDS ETC		Lip (Y, N)		Standing wave (Y, N)	
	Total hydraulic head (inlet-outlet, m)	% Slope	BF, pool depth (m)	Y	N	N
AS	1.0	0.3	NA	1.0	1.0	1.0
AT	1.0	0.3	NA	1.0	1.0	1.0
AD	0.6	0.6	NA	1.0	1.0	1.0
C	0.3	0.6	1.0	1.0	1.0	1.0
LS	NA	0.6	1.0	1.0	1.0	1.0
JS	0.6	0.6	NA	1.0	1.0	1.0

2. Passability

Passability:
The proportion of fish that encounter an impediment and then successfully pass it (during either an upstream or downstream migration) without undue delay (i.e. the probability of reaching the final destination, e.g. spawning or feeding grounds, is not comprised due to increased energetic expense or predation risk).

Score	Description
0.0	Complete barrier
0.3	Partial high impact
0.6	Partial low impact
1.0	No barrier

4. Obstacle hydraulics



- i. Flow depth & velocity (at bed and 0.6 x depth) measured at multiple points along foot, mid-point and crest transects.
- iii.and possible routes are identified and evaluated.

6. Completing the assessment

Transversal Section	UPSTREAM MIGRATION					DOWNSTREAM MIGRATION				
	Non-Weir	Partial barrier	Partial barrier	Complete barrier	Degree of restriction	Non-Weir	Partial barrier	Partial barrier	Complete barrier	Degree of restriction
AS	1.0	0.5	0.3	0.0	1.0	0.5	0.3	0.0	1.0	0.5
AT	1.0	0.5	0.3	0.0	1.0	0.5	0.3	0.0	1.0	0.5
AD	1.0	0.5	0.3	0.0	1.0	0.5	0.3	0.0	1.0	0.5
C	1.0	0.5	0.3	0.0	1.0	0.5	0.3	0.0	1.0	0.5
LS	1.0	0.5	0.3	0.0	1.0	0.5	0.3	0.0	1.0	0.5
JS	1.0	0.5	0.3	0.0	1.0	0.5	0.3	0.0	1.0	0.5

Structure No.	Structure Name	Structure Type	Structure Length (m)	Structure Width (m)	Structure Height (m)	Structure Slope (%)	Structure Material	Structure Condition	Structure Location	Structure Date	Structure Status
AS	AS	AS	10	10	1.0	0.3	Concrete	Good	AS	2020	Active
AT	AT	AT	10	10	1.0	0.3	Concrete	Good	AT	2020	Active
AD	AD	AD	10	10	1.0	0.3	Concrete	Good	AD	2020	Active
C	C	C	10	10	1.0	0.3	Concrete	Good	C	2020	Active
LS	LS	LS	10	10	1.0	0.3	Concrete	Good	LS	2020	Active
JS	JS	JS	10	10	1.0	0.3	Concrete	Good	JS	2020	Active

- ii. Passability scores allocated based on published swimming performance data....

7. Discussion

- i. Method designed to be quick and easy to use, transparent and easily auditable. Virtually eliminates need for expert judgment so should increase consistency between surveyors.
- ii. Obstacle scores and data from which they are derived to be entered into central database along with supporting habitat quality data - latter used to refine passability scores if necessary.
- iii. Scores for multiple barriers in a catchment can be combined to identify 'bottleneck' barriers to be targeted for remedial action. Procedure for doing so still to be worked out.
- iv. Passability scores need validating with fish data.
- v. Ongoing research into fish passage science required, particularly for non-salmonid species, in order to incrementally improve the method.
- vi. Staff from the Northern Ireland Environment Agency, the Scottish Environment Protection Agency and Scottish Fisheries Boards and Trusts currently being trained: three-day training course and looking to develop an accreditation.

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