UKTAG River Assessment Method

River continuity

Barrier to fish migration method (Scotland)

by

Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG)

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Health and safety statement

WARNING. Working in or around water is inherently dangerous; persons using this standard should be familiar with normal laboratory and field practice. This published monitoring system does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate health and safety practices and to ensure compliance with any national regulatory guidelines.

It is also the responsibility of the user if seeking to practise the method outlined here, to gain appropriate permissions for access to water courses and their biological sampling.

UKTAG Guide to River Continuity

Barrier to fish migration method

1. Introduction

This method statement describes a monitoring system for assessing and classifying rivers in accordance with the requirements of Article 8; section 1.3 of Annex II and Annex V of the Water Framework Directive (2000/60/EC). The assessment procedures work by first assessing whether the main migratory fish species in Scotland are likely to be able to pass a barrier. It then uses this information to assess the impact of each barrier in terms of the amount of habitat which would be available to migratory fish under reference conditions, but which has been rendered unusable by artificial barriers to migration.

1.1. Method summary
The water body classification is calculated based on the amount of habitat excluded to migratory fish due to artificial barriers. The length of suitable habitat upstream of each artificial barrier is used as a measure of the size of the impact. The influence of natural impassable barriers upstream and downstream of artificial barriers is taken into account in the calculation of the amount of available habitat.

1.2. Geographic application of the method
The method can be applied to rivers in Scotland.

1.3. Quality element assessed by the method
The method enables the assessment of the condition of the quality element "River continuity" listed in Table 1.2.1. of Annex V to the Water Framework Directive.

1.4. Environmental pressures to which the method is sensitive
The method has been designed to detect impacts on fish in rivers and lochs from hydromorphology pressures resulting in interruptions to river continuity.

2. Input data collection (Parameters used to assess the quality element)

Two methodologies can be used to assess impact of barriers on river continuity; fish population surveys and physical measurements of barriers. The two methods are not mutually exclusive. Fish population data may be useful both to identify potential barriers and to demonstrate the nature, scale and species range of barrier impacts.

2.1. Fish population survey method

2.1.1 Data needs and survey methods
The assessment requires information on the presence and abundance of all expected age classes of the main Scottish migratory fish species, i.e. Atlantic salmon, Brown trout (including sea trout), Lamprey (sea and river) and European eel. It is expected that this information will normally be collected by standard electric fishing surveys, following protocols produced by the Scottish Fisheries Coordination Centre (SFCC) [1], or similar.

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[1] SFCC electric fishing protocol. Available online at
http://www.scotland.gov.uk/Topics/marine/science/sfcc/Protocols

- Several sites should be surveyed both upstream and downstream of a potential migration barrier.
- Survey sites should be located close to the barrier.
- Survey sites should contain suitable habitat for the target species and habitat characteristics should as far as possible not differ significantly between sites upstream and downstream of a barrier.
- Timed (> 15 minutes) or area surveys (>50 m^2) are acceptable.
- Survey time/ area, date and National Grid References must be recorded for each survey site.
- For each survey site fish data should be presented as number of fish caught per minute or m^2.
- Data should be broken down by species and age class.

2.1.2. Assessment of fish survey data

The fish survey tool uses a comparison of abundance of fish species and age classes caught at sites upstream and downstream of a barrier to determine the impact of that barrier on fish migration. Where these data show that fish are absent from surveys sites upstream of a barrier when present downstream the barrier is likely to be considered impassable and having a severe impact. If the data show serious loss in fish abundance or failure of recruitment in most years then the barrier will also be considered to be having a severe impact.

2.2 WFD111 coarse-resolution barrier assessment method

2.2.1 Physical and hydrological description of potential barriers

The WFD111[2] method has been designed to provide a procedure for rapidly assessing at a coarse level the likely passability of a barrier. Field measurements of physical parameters such as length, height and water depth, combined with a subjective assessment of barrier porosity for target species and life history stage(s), are used to assess passability of natural and artificial barriers for the main migratory fish species.

The parameters required for each barrier type and target fish species are described in the WFD111 manual.

For salmon and brown trout (including sea trout) a streamlined approach to using the full WFD111 approach is possible for some type of barriers, i.e. weirs, dams and long culverts. In cases where the physical dimensions alone would be sufficient to put a barrier into the impassable or high impact category for upstream migration (Table 1), then a detailed assessment of water depth and velocity across the barrier would not be needed to show evidence of "severe impairment".

Where physical dimensions do not provide evidence of causing severe loss, a full survey as outlined in the WFD111 manual will be required to show whether the barrier is likely to be passable or not.

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[2] WFD111 methodology manual. Available online at http://www.sniffer.org.uk/knowledge-hubs/resilient-catchments/water-framework-directive-and-uktag-co-ordination/fish-obstacles-porosity/

Table 1: Critical physical limits for barriers to the main species as specified in the WFD111 manual. If dimensions of a barrier are greater than any of these limits, it should be considered to be a "severe impairment" to the species.

Barrier type	Criteria	Atlantic salmon	Sea trout and brown trout
Barrier presenting a vertical drop	Vertical hydraulic head	≥ 1.4m	≥ 1.0m
Barrier presenting a slope, including culverts	**% Slope of structure** • Structure effective length ≤ 3m • Structures effective length 4-9m • Structures effective length ≥ 10m	≥ 60 % ≥ 40 % ≥ 15 %	≥ 60% ≥ 40% ≥ 15%
	Effective length of barrier (the distance which would have to swum by a fish to pass the barrier)	≥ 100 m	≥ 100 m

2.2.2 WFD111 assessment of barrier data

Based on the assessments carried out to determine barrier passability a passability score is generated for each fish species and life stage assessed (Table 2). It is considered that the barrier will have a severe impact on fish populations when the WFD111 assessment results in the barrier being classified as either "impassable" (passability score 0) or "passable high impact" (passability score 0.3).

Table 2: Barrier passability assessment scoring system

Description	Passability score
Complete barrier	0
Partial barrier with high impact	0.3
Partial barrier with low impact	0.6
No barrier	1.0

The output from the WFD111 method has not yet been "ground-truthed", although projects are underway to test it. Until this is completed, it is recommended that only medium confidence is given to resulting classification results. High confidence should only be used where additional electric fishing data support the conclusion that the barrier is preventing migratory species from occurring at sites where they would otherwise be expected.

The ability of lamprey and eels to pass barriers is particularly difficult to predict with confidence. Figures for lamprey in particular suggest that many relatively small barriers may prevent migration and cause many waterbodies to be downgraded. Errors in interpreting the effects of barriers on lamprey therefore carry the potential risk of wrongly downgrading large numbers of waterbodies. It is proposed to reduce this risk by only downgrading for eels and lamprey when there is supporting evidence to show that the species is absent from areas where it would normally be expected to be present. This will be achieved by incorporating an additional rule in the fish ecology classification tool to downgrade to less than good if either species is absent from areas where they would otherwise be expected to be present.

Species specific electrofishing surveys, particularly for lamprey, will be required to provide sufficient evidence for this rule to be applied. The WFD111 methodology will therefore only be used to directly classify on the basis of salmonid barriers. It will be used as a risk assessment procedure for lamprey and eel.

3. Applying class boundaries to generate a classification

3.1. GIS based classification method

A GIS-based barrier assessment method which classifies water bodies based on the proportion of suitable habitat which migratory fish are prevented from entering due to artificial barriers has been developed by SEPA. Areas which are naturally inaccessible due to natural barriers such as waterfalls are taken into account. SEPA uses the Network Analyst extension for ESRIs ArcGIS software to implement the method.

Points to consider:
- Stream size - no limit on size of watercourse. SEPA uses the CEH river network dataset which was captured at a scale of 1:50,000. The same method could be applied to a higher resolution river network dataset, e.g. the Ordnance Survey Master Map Water Network Layer.
- Three types of barriers are included in the classification methodology: impassable artificial, impassable natural and natural limit to migration. The latter two have the same impact on classification, but have a different form. An impassable natural barrier is usually a waterfall, whereas a natural limit to migration could be a steep section of river with no single impassable waterfall but which has a cumulative impact with the same outcome.
- The catchment areas of rivers known to be naturally inaccessible to the fish species shall be disregarded when applying the river continuity condition limits. Any artificial barriers upstream of a naturally impassable barrier are excluded from the dataset prior to calculating the classification.
- Those barriers for which there is a working mitigation measure in place (e.g. a fish pass) are not used in the classification process.
- These criteria are applied to all baseline water bodies, i.e. all those rivers with catchments greater than 10 km^2 as well as all lochs over 0.5 km^2 in area.
- The results from downstream water bodies will be extrapolated upstream to hydrologically connected water bodies:
  - if a downstream barrier is natural, all upstream water bodies which are hydrologically connected will not be classified (i.e. will be treated as unaffected by any man-made barriers that are present)
- Water bodies where 95% or more of the upstream river length is naturally inaccessible are excluded from this classification – i.e. they are not downgraded if the remaining 5% of accessible river length is inaccessible to fish due to man-made barriers. If these water bodies were included in the assessment, SEPA's classification would discourage man-made barriers from being sited as close as possible to natural barriers, discouraging stakeholders from minimising the length of inaccessible river.

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3.2 Classification limits

The limits for classifying impact of barriers on river continuity have been set by UKTAG and are outlined in Table 3.

Table 3: Classification limits for River Continuity assessment

High status	Good status	Moderate status	Poor status
Severe impairment of fish movement to, or from, rivers draining 1 % of the upstream river length or part thereof.	Severe impairment of fish movement to, or from, rivers draining 5 % of the upstream river length or part thereof.	Severe impairment of fish movement to, or from, rivers draining 20 % of the upstream river length or part thereof.	Severe impairment of fish movement to, or from, rivers draining greater than 20 % of the upstream river length or part thereof.

"A severe impairment of fish movement" is defined in the SG Classification Direction as being "more than 80 % of fish that would otherwise be able to move upstream to, or downstream from, the river or part concerned are, in SEPA's judgement, unable to do so because of man-made barriers to their movement." Man-made barriers are classified as either "passable high impact" or "impassable" for salmon and trout using the WFD111 methodology.