Irish Standard
I.S. EN 17233:2021

Water quality - Guidance for assessing the efficiency and related metrics of fish passage solutions using telemetry

I.S. EN 17233:2021

Incorporating amendments/corrigenda/National Annexes issued since publication:

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National Foreword

I.S. EN 17233:2021 is the adopted Irish version of the European Document EN 17233:2021, Water quality - Guidance for assessing the efficiency and related metrics of fish passage solutions using telemetry

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 17233

April 2021

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English Version

Water quality - Guidance for assessing the efficiency and related metrics of fish passage solutions using telemetry

Qualité de l'eau - Recommandations pour l'évaluation par télémétrie de l'efficacité des dispositifs de franchissement piscicole et d'indicateurs associés

Wasserbeschaffenheit - Anleitung zur Beurteilung der Wirksamkeit und zugehöriger Kennwerte von Fischaufstiegshilfen mittels Fernmessung

This European Standard was approved by CEN on 18 January 2021.

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European foreword

This document (EN 17233:2021) has been prepared by Technical Committee CEN/TC 230 “Water analysis”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2021, and conflicting national standards shall be withdrawn at the latest by October 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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Introduction

Fish passage solutions (FPS) are measures to help fish pass a cross-river obstacle or impediment in upstream and/or downstream directions. The ideal solution, from a global-ecological perspective, would be to re-establish natural river connectivity by decommissioning or removing the obstacle which would at the same time eliminate or reduce any impounded section and allow unimpeded sediment transport. In the last two decades or so, the number of constructed upstream FPS has increased significantly at least in some parts of the world, and the range of proposed FPS designs has also increased. However, despite careful control of FPS design both pre-and post-construction, the performance of FPS needs comprehensive field monitoring for the following reasons: FPS designs globally rely on laboratory experiments that need validating *in situ*; the efficiency of initially well-designed FPS may be modified by changes to the environment (e.g. discharge, river morphology) and require improvement; and the efficiency for new target species or life stages that were not considered during the initial design process could be necessary. In addition, whilst the design of FPS for some species and life stages is well advanced (e.g. adult migratory salmonids), the requirements of other species and for downstream migration are not fully understood. Only systematic, reproducible monitoring studies assessing the performance of FPS will enable us to improve and develop current fish pass designs.

In general terms, FPS monitoring is the activity of assessing by appropriate means the degree of success (or failure) of fish overcoming an impediment and dealing with the conditions of an implemented FPS.

FPS monitoring can serve several purposes:

— It can help to determine the appropriateness of the chosen design of a FPS by providing data about the effectiveness (assessment or count of the number and type of fish successfully negotiating the FPS in relation to the fish community present) and/or the efficiency (percentage of available fish attempting to pass an impediment(s) that find, enter and successfully negotiate, the FPS) for fish that have to cross the impediment. As a result, a documented well-functioning solution can serve as an example for a solution in a similar river type with a similar fish community. Any reduction in performance should be carefully analysed, and the reasons for failures identified and addressed through adjustments, i.e. by structural changes (e.g. modifications of the design of [different parts of] the pass) or by operational solutions (e.g. by optimizing the attraction to the entrance, by adapting the discharge through the pass or by adapting the operation of the turbines).

— Technical information which is indispensable for the design development or optimization of future FPS can be gathered along with the observations of fish behaviour.

— Provided that appropriate methods are used, FPS monitoring can support informed management of fish populations upstream or downstream of the impediment, e.g. supporting EU eel regulations, Directive 2000/60/EC (Water Framework Directive) or direct management of freshwater fishery resources, and the general biodiversity in the river.

FPS monitoring studies can provide several layers of information. Methods for assessing FPS effectiveness are not covered by this document. These include; trapping, video, acoustic cameras, direct observation/online surveillance, physiological telemetry (e.g. EMG (electromyogram), accelerometry and heart rate), eDNA (environmental Deoxyribonucleic Acid), Catch Per Unit Effort (CPUE) and flume studies (see [10] and [11] for further information about these methods). These methods do not provide information on the numbers of fish approaching the impediment that are available to pass, therefore the failure rate cannot be assessed.

If efficiency needs to be addressed, measures of the proportion of fishes passing successfully, relative to those attempting, is crucial, together with evidence concerning passage-related delay, mortality or other health impacts [2]. For this purpose, telemetry (acoustic, radio and Passive Integrated Transponder [PIT] tagging) techniques that enable estimation of a percentage of fish that passed the impediment in relation to the number of fish approaching the impediment to pass, have major advantages over other methods. Acoustic and radio telemetry methods are typically applied in medium to large sized river systems. For smaller sized rivers with lower depths PIT telemetry is often a more suitable approach. Telemetry methods can be costly procedures for fish-pass monitoring and are inherently associated with implantation, surgery and therefore animal welfare and always require an animal testing approval. Some aspects of efficiency (FPS passage efficiency) can be also gathered by other methods (capture–mark-recapture [CMR], traps in combination with electric-fishing) in certain situations, mainly in smaller rivers. However, these other methods are not covered in this document.

It should be noted that telemetry methods used in isolation usually look only at a single species and/or fish of a limited size range (e.g. adults, sub-adults) and are therefore unsuitable to judge the overall FPS performance for the whole fish community and age classes present. In addition, other highly relevant aspects of fish passage related to FPS performance (number of species, size classes etc.) cannot be assessed by telemetry methods and can be much better assessed by using other methods in combination. A fully comprehensive monitoring programme should ideally target the whole range of species and fish sizes present, therefore requiring a multi-method approach.

Telemetry techniques involve the tagging of individual fish and subsequent tracking of these individuals as they approach an impediment and either pass or fail to pass. The proportion of fish that successfully negotiate the FPS can be calculated and further information about the point of failure derived from the tracking information e.g. a high attraction efficiency but low passage efficiency can highlight possible problems concerning the hydraulic conditions within the FPS. This detailed information has the potential to be used to improve current fish pass designs if enough comparable monitoring information can be collected to allow detailed assessments of the performance of fish passes for different species or of different fish pass designs. Currently, however, due to non-standardized monitoring methods, definitions and protocols, data from fish pass efficiency monitoring studies using telemetry across Europe are not directly comparable.

This document on assessing the efficiency and related metrics of FPS deals exclusively with telemetry as an agreed method for the judgement of the efficiency (attraction efficiency, entrance efficiency, passage efficiency, and overall FPS efficiency) of a FPS to achieve highly standardized and comparable results for selected species and age classes.

1 Scope

This document specifies standardized methods for assessing the efficiency and related metrics of fish passage solutions using telemetry techniques that allow individual fish approaching an impediment to be monitored.

It covers studies using fish that have been electronically tagged with acoustic, passive integrated transponder or radio tags in order to provide a variety of defined passage efficiency metrics and includes both upstream and downstream passage of fish.

It provides recommendations and requirements for equipment, study design, data analysis and reporting. Selected literature with references in support of this document is given in the Bibliography.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

NOTE 1 Not all definitions listed below are necessarily applicable to all studies. Only those which are relevant to the aims and objectives of the study in question are required.

NOTE 2 This document defines efficiency metrics in the following terms.

3.1
fish passage solution
FPS
any device, structure or mechanism which is designed or managed to facilitate the safe movement of fish in an upstream and/or downstream direction when overcoming one or several impediments

3.2
FPS performance
overall capability of the FPS to meet its design objective

Note 1 to entry: The design objective will include objectives related to the target fish community, target species, attraction and passage efficiencies and effectiveness.

3.3
available fish
f_a
number of tagged fish approaching the impediment

Note 1 to entry: The point at which fish are considered to be approaching the impediment will be site specific. Once past this point, fish are assumed to be motivated to pass.