Notitie / Memo

HaskoningDHV Nederland B.V.
Water

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Onderwerp: **IC memo adaptation fish metrics**

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1 Introduction

The original Dutch WFD classification method for fish in small rivers daters back to 2007 and has been successfully intercalibrated (JRC, 2011). This method has since been revised in accordance with the intercalibration requirements (Buijse en Beers 2012) and was last updated and published in Van der Molen et al (2016). This method has never been submitted for approval. After some years of experience with this method, a national group of fish experts from the Dutch water authorities concluded that a validation for the Dutch fist classification method was desirable. Reasons for this were the availability of better data, problems with the assessment of waters impacted by exotic (non-native) fish species and a more general idea that the metrics could be improved. Therefore, the Dutch dataset of fish and pressure data of streams (Buijse en Beers 2012) was updated. This new dataset was used to evaluate the existing system and to derive new metrics for fish in the small rivers (Dutch water types R4, R5, R6, R12, R13, R14, R15, R17, R18).

During the evaluation it became clear that the classification methods could be improved significantly, however this would mean that they should be considered “revised methods” in terms of the EU-intercalibration. This memo describes the procedure that has been followed to test the new WFD classification method for fish in streams in the Netherlands, against the requirements of the EU-intercalibration, as stated in guidance document no. 30 (EU, 2015).

2 Methods

The main approach for the study consisted of the following steps:

- Collecting a dataset for fish in Dutch streams and collecting a dataset with human pressures for these locations, including the creation of a Multi-pressure index;
- Analyzing the fish stocks in relation to pressures and evaluating the functioning of the current assessment methods;
- Proposal for adaptions of the species list and guild-classification (including ways to deal with exotic species);
- Selection of new indicators and class boundaries for the new assessment methods based on the relations to pressures and the requirements of the intercalibration;
- Compare the new EQR’s to the old EQR’s (2007 and 2012 methods) and expert-judgements of the fish experts from the regional water authorities.

The study was performed in 2018. An extensive description of the project, corresponding methods and results is reported in (Van Herpen, Jaarsma, en Koole 2018).

3 Selection of indicators

The selection of indicators was primarily based on their relationship with pressures. The definition of the corresponding threshold values (draft class boundaries) was also based on the relation with pressures. In many cases however, these needed quite some adaptation (become stricter) to meet with the requirements of the EU intercalibration. Finally, because of this iterative process, a new classification system was devised that consists of the following indicators:

- absolute number of native rheophilic species (n)
- absolute number of native migratory species (n)
- relative number of native phytophilic species (%)
- relative abundance of native rheophilic species (%)

For the relation with the pressures, both the individual pressures as well as a combined pressure-assessment method (a Multi-Pressure index) was used. As mentioned above, the first selection of indicators and class boundaries was based on Dutch data, but the final set of indicators and class boundaries was heavily determined by intercalibration requirements.

Table 1 – Final proposition with new indicators and threshold values for the sub-methods.

Class-boundaries	Absolute number of rheophilic species			Absolute number of migratory species			Relative number of phytophilic species	Relative abundance of rheophilic species		
	R4	R5, R6, R12	R13, R14, R15, R17, R18	R4	R5, R12, R13, R17	R6, R14, R15, R18	R4, R5, R6, R12, R13, R14, R15, R17, R18	R4, R5, R12	R6	R13, R14, R15, R17, R18
Reference (1)	5	6	8	5	6	10	≤ 5	90	68	95
Good – High (0.8)	4	5	7	4	5	9	10	80	60	90
Moderate - Good (0.6)	3	4	6	3	4	8	15	50	38	80
Poor – Moderate (0.4)	2	3	4	2	3	6	20	30	23	60
Bad – Poor (0.2)	1	2	2	1	2	4	25	20	15	40
Bad (0)	0	0	0	0	0	0	≥ 50	10	8	20

The classification system is based on the species guilds according to EFI+, with some adaptations for the species mentioned below (van Herpen, et. al., 2018). For the phytophilic species, the Dutch listwith phytophilic fish species for lakes is used:

- *Cobitis taenia*
- *Gobio gobio*
- *Squalius cephalus*
- *Carassius carassius*
- *Leuciscus leuciscus*
- *Rutilus rutilus*

- *Sander lucioperca*
- *Gasterosteus aculeatus*

In addition, based on a data-analysis, the decision has been made to exclude exotic species (ignore them both for with regards to species composition and abundance) from the metrics and base the metric on native species only.

4 Intercalibration requirements

A modified assessment method, as proposed in this report, has to be tested against the intercalibration-requirements following EU-rules in the guidance (European Union, 2015). This guidance applies to two specific situations:

a) completely new methods which have not previously been subject to intercalibration but for which an exercise has already been completed for the BQE and GIG in question, and
b) methods which were part of a completed exercise but have since been revised in some way.

The latter applies (the Dutch method was revised), in this case the requirements are in short:

- check correlation between “old” and “new” method. If r^2 >= 0.8 check boundaries (next step), if r^2 < 0.8 then carry out feasibility check:
    - to qualify for intercalibration the revised method should have a correlation (r) with the common metric >= 0.5 (r^2 >= 0.25);
    - the slope of the regression (revised method vs common metric) should be between 0.5 and 1.5.
- check if the boundaries H-G and G-M of the revised method are higher (i.e. more precautionary) than the old method. If this is true, the intercalibration “fitting procedure” is accomplished. If not, follow the procedure for fitting new classification methods.

In our case the correlation of the revised method with the old method was not high enough (r^2 < 0.8), the feasibility check however was successful (see Figure 1). The next step was to check the class boundaries, for this we used an R-script developed by CEMAGREF, that allows to intercalibrate a modified version of the Dutch index and to explore the response of alternative metrics. This was carried out according to “Case A1”: IC Option 1 or 2 using reference/benchmark sites.

4.1 Class boundaries

The most important step in the intercalibration procedure is the harmonization of class-boundaries. For fish in streams, this can be done by applying a procedure (R-script) that has been created for the purpose of intercalibration. The application of the R-script shows whether the proposed class-boundaries of the new assessment methods fit within the determined range of boundary values on the common metric. The proposed class boundaries for the individual indicators (e.g. number of rheophilic species) have been adjusted to fit the resulting EQR within the ranges for the H-G and G-M boundaries as part of an iterative processes. For practical reasons, we adjusted the class boundaries of the indicators rather than the EQR’s for the H-G and G-M boundaries. In the Netherlands, at all times these boundaries are at EQR = 0.8 and 0.6 respectively. Several options have been tested to select the best set of class boundaries.

Group	Method_country	Type	H_G_raw	G_M_raw	H_G_fit	H_G_lwr	H_G_upr	G_M_fit	G_M_lwr	G_M_up
Lowland-Midland	NL4_srt_RMprcP_ab_R_IC1_index	no	0.8	0.6	0.745	0.695	0.795	0.544	0.494	0.594
Lowland-Midland	NL4_srt_RMprcP_ab_R_IC3_index	no	0.8	0.6	0.957	0.9	1.013	0.732	0.675	0.788
Lowland-Midland	NL4_srt_RMprcP_ab_R_IC4_index	no	0.8	0.6	0.97	0.912	1.028	0.738	0.679	0.796
					0.984	0.984	0.984	0.781	0.781	0.781

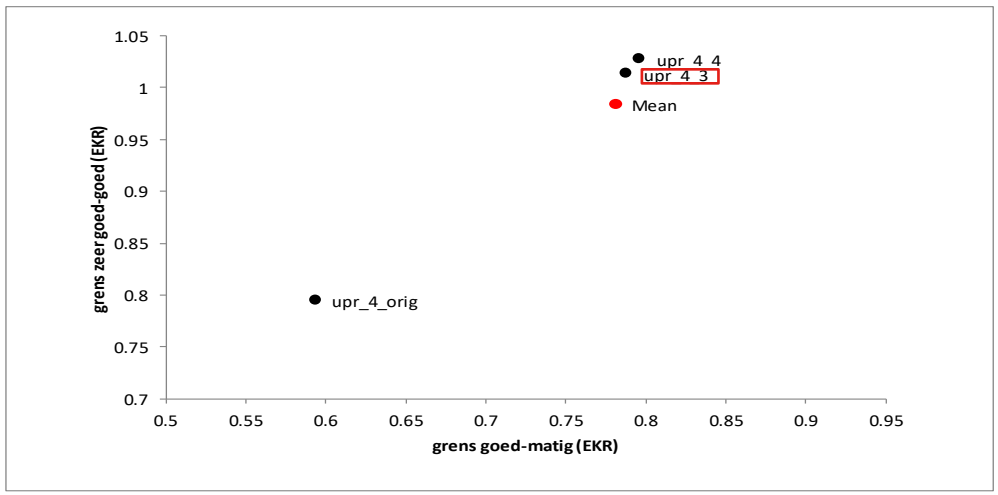

Figure 1: result of the intercalibration of the class boundaries, red box is selected metric. graphical representation of the G-M boundary (x-axis) to the H-G boundary (y-axis) compared to the mean of the intercalibrated methods, expressed in an EFI+-score. NL4_srt_RMprcP_ab_R_IC3_index is the proposed new metric.

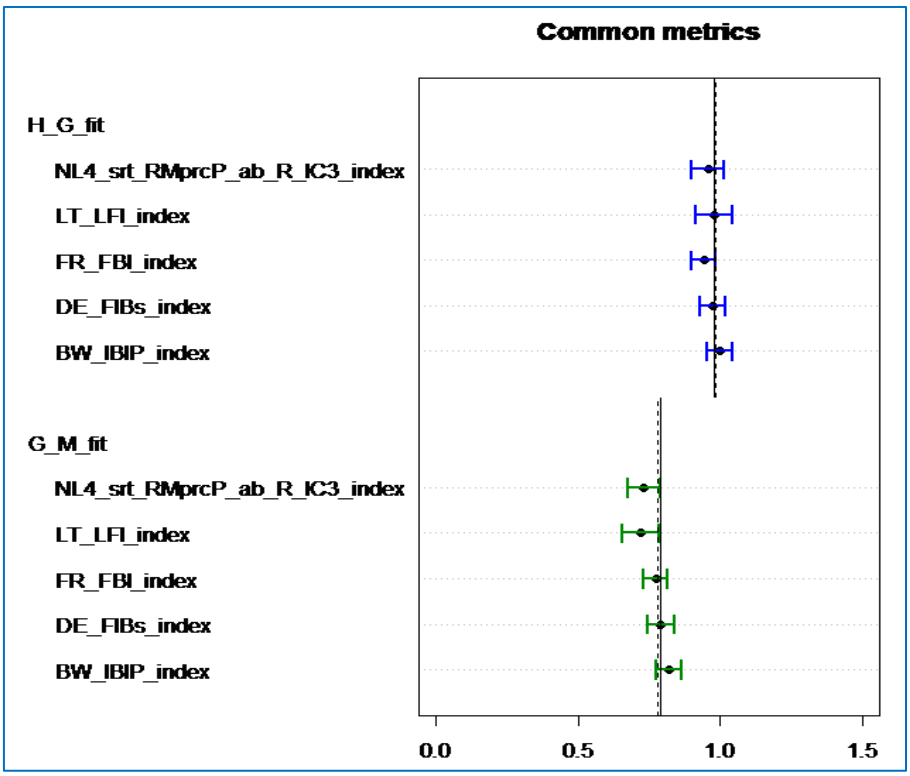

Figure 2: results from the R-script for testing of the H-G and G-M boundaries compared to metrics from other countries. NL4_srt_RMprcP_ab_R_IC3_index is the proposed new metric.

4.2 Relation with EU fish index

Figure 3 shows the relation between the new fish metric and the EU-fish index (EFI+). This shows that both display a very good correlation, more than necessary for intercalibration (r≥ 0.5, or $r^2 \geq 0.25$).

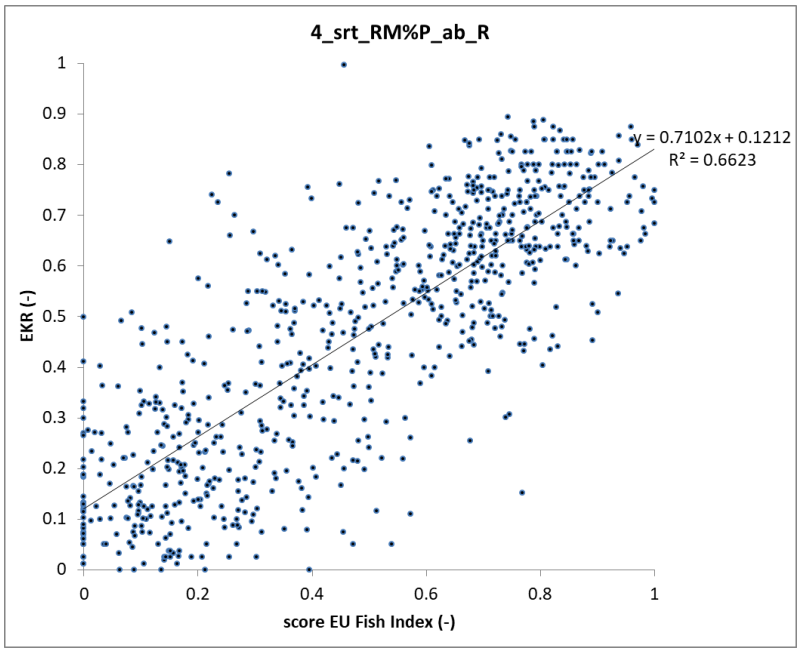

Figure 1- Scores new fish metrics in relation to the EFI-index (on X-axis).

4.3 Relation with pressures

Below are boxplots per indicator compared to the pressure gradient from the Intercalibration dataset for the Dutch water types R4, R5, R6, R14 and R15 (slow and fast flowing streams on a sandy soil). This pressure gradient is based on a range of pressured and is derived with the assistance of multivariate techniques (RIVER_FISH_IC_Milestone_6_2012-07-16).

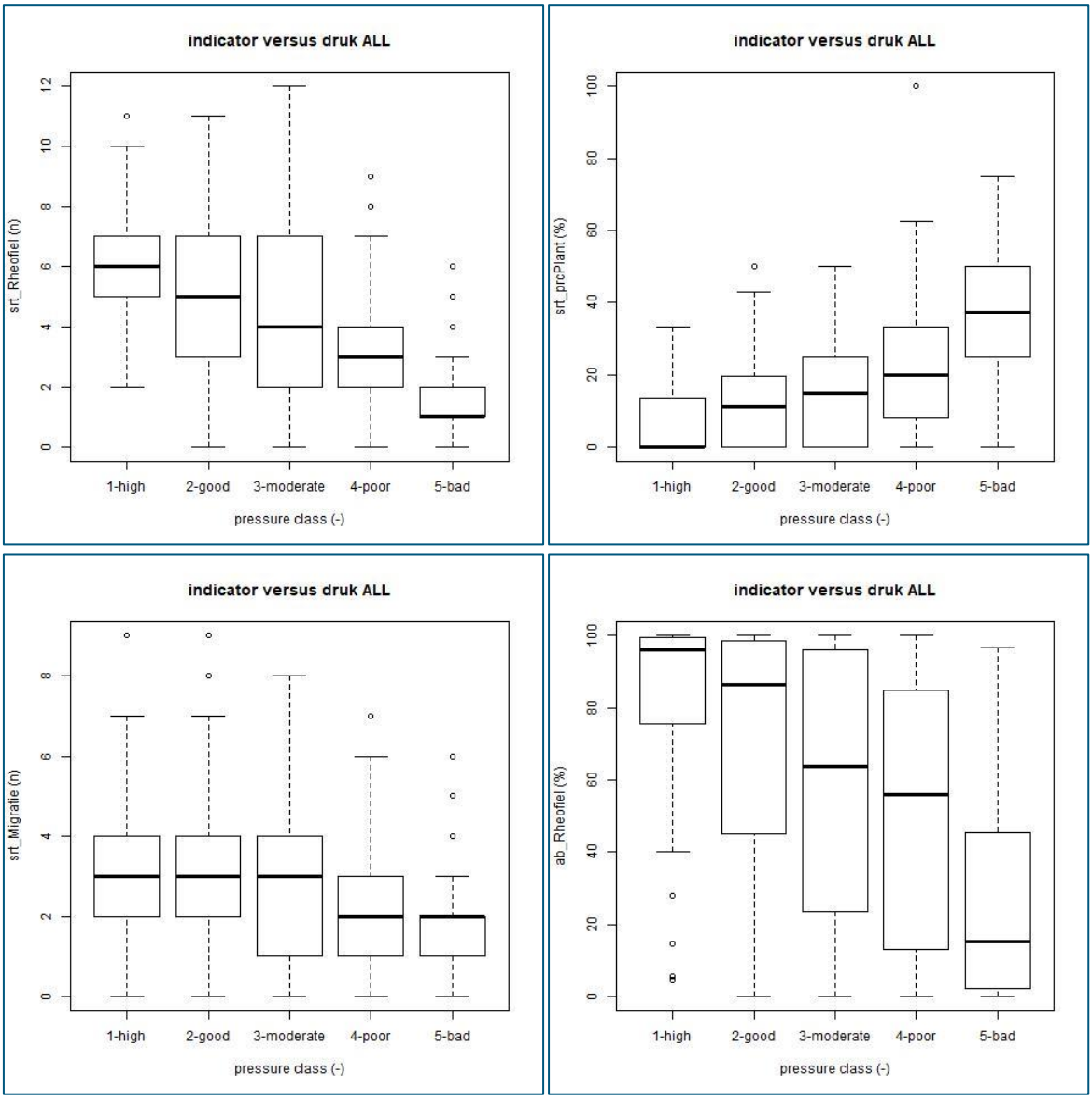

Figure 4: boxplots for the indicators compared to pressure gradient from the intercalibration absolute number of native rheophilic species (top left), absolute number of native migratory species (bottom left), relative number of native phytophilic species (%) (top right), relative abundance of native rheophilic species (%) (bottom right)

5 Results

The new assessment method for fish in small rivers results in some cases in drastic EQR-changes on trajectory level, but on average the method is approximately as strict as the current assessment method (2012, see figure 5) and the original method which has been submitted and approved for the intercalibration (2007, see figure 6). This is a logical consequence of the EU-intercalibration requirements. To comply with the EU-intercalibration rules, the class-boundaries of good-very good and moderate-good had to be adjusted, leading to EQR's that are sometimes regarded as too strict by the Dutch regional water authorities. This is especially the case for the trajectories with very low slopes and hence low flow velocities.

The EQR for the Dutch dataset has on average increased with about 0.01. The individual changes in EQR are mostly considered logical by the fish experts of the regional water authorities. Streams in which the most important pressures for fish (channelised streams with lots of weirs and lower reach migration-obstacles and a low flow velocity) are present, already received low EQR-scores with the current assessment methods and have decreased even further. Qualitatively better trajectories, which instinctively scored too low with the current assessment methods, now receive higher EQR's. Table 2 shows the number of waterbodies that will be scored in lower classes with the new assessment methods (with the boundaries for natural waters) as well as the number of waterbodies that will be scored in higher classes.

Although the new assessment method is considered an improvement, the impression is that it is sometimes very (too) strict. Especially for slow-flowing lowland streams in areas with slight slopes, the EQR-scores are quite low, even when there is little or no pressure.

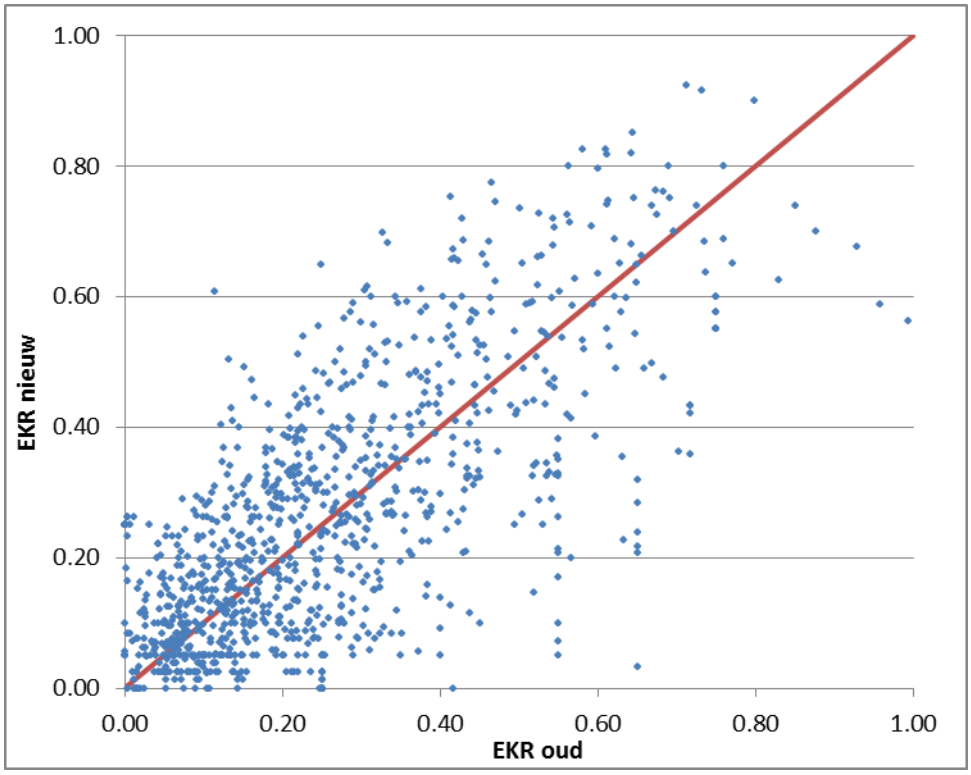

Figure 5 – EQR's for the current metrics (EKR oud, x-axis) and the new metrics (EKR nieuw, y-axis). The red line is the 1:1 line, above the line the new method yields higher EQR's, while EQR's are lower below the line. The graph is based on the dataset consisting of measurements of the water boards that participated in the research.

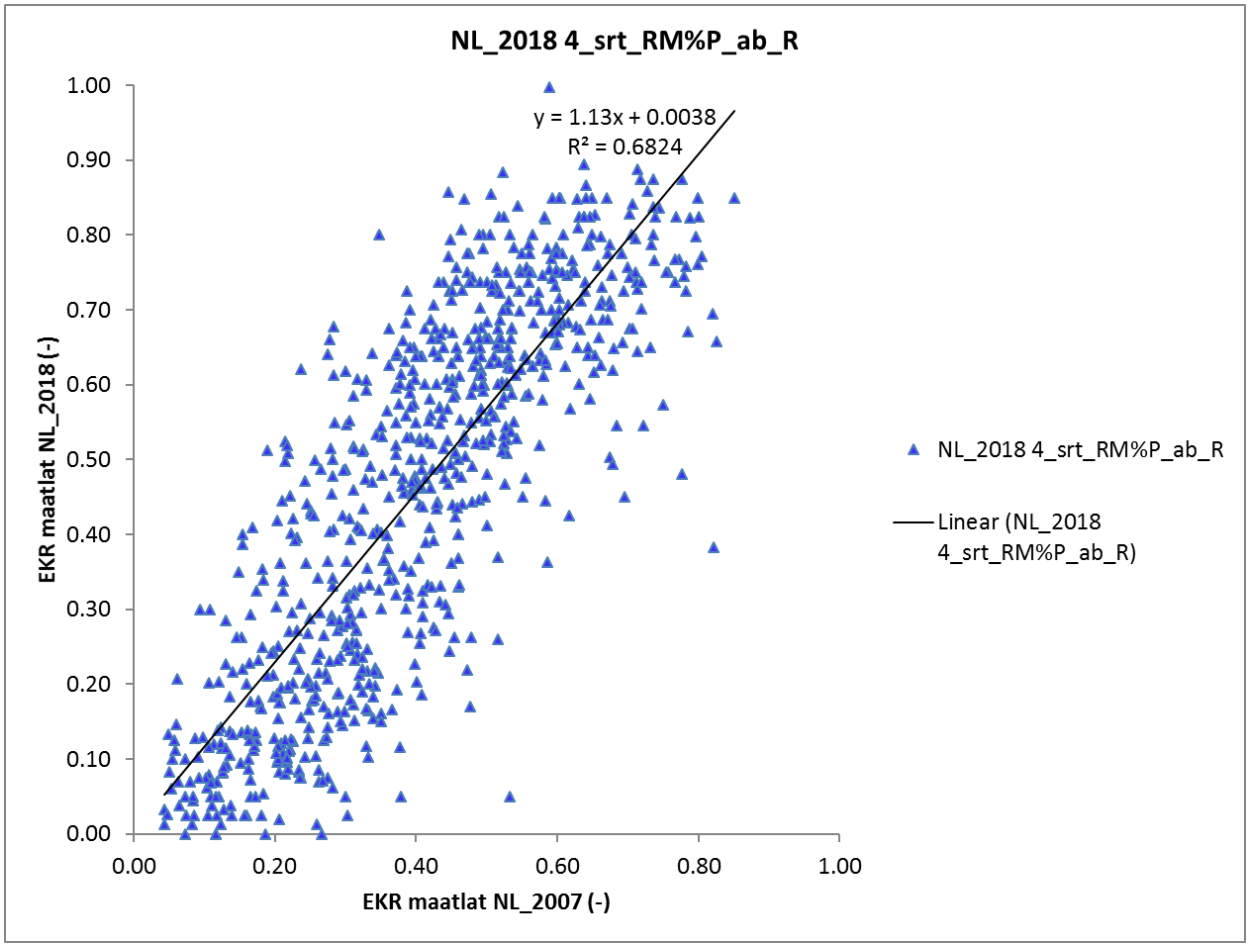

Figure 6 – EQR's for the original metrics (EKR maatlat NL_2007, x-axis) and the new metrics (EKR maatlat NL_2018, y-axis). The red line is the 1:1 line, above the line the new method yields higher EQR's, while EQR's are lower below the line. The graph is based on the dataset consisting of measurements of the water boards that participated in the research.

6 Points of attention and recommendations

The analysis raises the question whether the European intercalibration dataset for the Lowland-Midland group is suitable for the very slow-flowing Dutch streams (R4, R5, R6 and R12). During the intercalibration process, the Lowland group was later expanded to a Lowland-Midland group. With this, the reference- and benchmark-trajectories that were used for the determination of the class-boundaries, are possibly quite different from the slow-flowing streams of the Netherlands. It is recommended to investigate what foreign rivers are included in the intercalibration dataset and to what extent they match or deviate from the Dutch rivers. It is possible that this could give rise to the need for an adjusted intercalibration(dataset). This cannot be done on short notice, and thus requires an effort from the Netherlands towards the other member states that have similar very slow-flowing streams and rivers in the next WFD period.

Finally, we advise to investigate the applicability of other types of sampling methods than those currently used (electrofishing) for the assessment of large streams like R6 (now impossible because of the EU-intercalibration rules), because, particularly in large streams, the fish stock in open water and the species that live there are sampled less effectively with electro fishing and are thus less prevalent in the samples and consequently in the final score.

7 References

Bijkerk, R. (2014). Handboek Hydrobiologie. Biologisch onderzoek voor de ecologische beoordeling van Nederlandse zoete en brakke oppervlaktewateren. Deels aangepaste versie. (Amersfoort: STOWA).

Buijse, T., en M. Beers. 2012. “Verbetervoorstellen voor de KRW maatlatten voor visgemeenschappen in rivieren en beken”. 1205891-000-ZWS-0005-tk.

Europese Unie. 2015. *Procedure to fit new or updated classification methods to the results of a completed intercalibration exercise. Guidance Document No. 30*. Technical Report 2015–085.

JRC (2011). WFD Intercalibration Phase 2: Milestone 6 report – RIVER FISH – ALL GIGs, October 2011.

Van der Molen, D.T., R. Pot, C.H.M. Evers, F.C.J. Van Herpen, en L.L.J. Van Nieuwerburgh. 2016. “Referenties en maatlatten voor natuurlijke watertypen voor de kaderrichtlijn water 2015-2021”. rapportnummer 2012-31. Amersfoort: STOWA.

Van Herpen, F.C.J., N. Jaarsma, en M. Koole. 2018. “Aanpassingen maatlat vissen in beken”. BF7612WATRP1807161104. Royal HaskoningDHV.

R-script used for testing Intercalibration Requirements

```
# ======================================================================
# Description: data preparation for options 2 and 3 from annex V
#              EQR computation from raw data
# Authors:
#   Olivier Delaigue <olivier.delaigue@cemagref.fr>
#   Didier Pont <didier.pont@cemagref.fr>
# Creation date: 2009-10-10 08:43:21
# Last modified: 2011-05-02 09:57:32
# Comments: No computation for ET, EW
# Copyright (C) 2009-2011 DELAIGUE & PONT / Cemagref-HBAN
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