Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Intercalibration of the Lake Acidification Macroinvertebrate Metric (LAMM) in Ireland

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- Office of Radiation Protection and Environmental Monitoring
- Office of Communications and Corporate Services

The EPA is assisted by advisory committees who meet regularly to discuss issues of concern and provide advice to the Board.

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October 2020

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Acknowledgements

We acknowledge the following EPA staff for their work in providing, or facilitating the acquisition of information for the report:

Hugh Feeley, Gary Free, Bryan Kennedy, Neasa McDonnell, Wayne Trodd, Caroline Plant and Caroline Wynne.

We are grateful for the advice and assistance from Dr. Sebastian Berk.

Cover photo: Glencullin Lough by Ruth Little

ISBN 978-1-84095-954-3

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1. INTRODUCTION

During the previous two rounds of the Northern Geographical Intercalibration Group (N-GIG) exercise, assessment methods using benthic invertebrates from three-member states (Norway, Sweden and the United Kingdom (UK)) were intercalibrated for clear, low alkalinity lakes subjected to acidification pressure. For a member state's data to be included in the intercalibration exercise, matching chemistry and biology data were required - a biological sample and 4 chemical samples (including anions and cations) from the year preceding the biological sample. Ireland (IE) could not meet these requirements and consequently no Irish data were included in the exercise. Additionally, an Irish national method for the assessment of lake quality using benthic macroinvertebrates had not been developed.

Data on lake macroinvertebrates in Ireland has since been collated. The UK assessment method – the Lake Acidification Macroinvertebrate Metric (LAMM) – has been selected for assessing ecological status of low alkalinity lakes in Ireland subjected to acidification pressure. The common intercalibration types are L-N2 and L-N5 (clear low alkalinity lakes).

This report aims to compare the class boundaries of the LAMM generated using IE Data with those agreed in N-GIG intercalibration exercise following the Common Implementation Strategy Guidance Document No. 30 "Procedure to fit a new or updated classification method to the results of a completed Intercalibration Exercise" (EC, 2015 – 085).

2. DESCRIPTION OF NATIONAL ASSESSMENT METHODS

The LAMM is a methodology developed by the United Kingdom for assessing acidification pressure in lakes using littoral macroinvertebrates (McFarland *et al.* 2009). The taxa occurring in each sample is assigned a score based on its sensitivity, tolerance or indifference to acidification pressure and the score for each taxon is weighted into one of three abundance classes (Appendix A). The LAMM is calculated according to the following formula:

$$\text{Observed value for LAMM} = \frac{\sum_{k=1}^{n} Sh_k \times Wh_k \times Hh_k}{\sum_{k-1}^{n} Wh_k \times Hh_k}$$

where

"k"	is a scoring taxon present in the sample
"Shk"	is the acid sensitivity score for taxon "k"
"Whk"	is the weighted score for taxon "k"
"Hhk"	is the relative abundance score which descirbes the proportion of the number of individuals of taxon " k" in a sample

2.1 Methods and Required Biological Quality Element Parameters

Annex V of the Water Framework Directive lists several parameters which should be included when using benthic invertebrates in ecological assessment. The LAMM method addresses three of the four specified parameters indicative of the biology quality element and includes measures of taxonomic composition, relative abundance and taxa sensitivity (Table 1). A direct measure of community diversity has not been included in the metric, justification for which is provided in Sandin *et al.* (2014) Northern GIG technical report. This demonstrated that the inclusion of a diversity score did not improve the response of the metric to a pressure gradient. Relative abundance was included in preference to absolute abundance, which was shown to be too variable in the assessment system (McFarland *et al.* 2009, Sandin *et al.* 2014).

Table 1: Overview of the metrics included in the Lake Acidification Macroinvertebrate Metric for the assessment of lake acidification.

Member State	Taxonomic composition	Abundance	Sensitive taxa	Diversity
IE	Lake acidification macroinvertebrate metric	Relative abundance	Lake acidification metric scores	Not included

Combination rule used in the method: generic weighted averaging equation using the abundance of sensitive species and tolerant species.

Conclusion on WFD Compliance: three of the four indicative parameters for this BQE are included in the metric and the justification for the omission of a direct diversity measure provided by N-GIG has been accepted.

2.2 Sampling and Data Processing

- Sampling Time and Frequency: samples are collected once a year in spring, typically in April, but always in the time between late March and early May.
- Sampling Method: samples are collected preferably from exposed stony lake shores using a standard pond net with 1mm mesh. A single two-minute kick sample is taken in water that is approximately knee deep. The samples are preserved *in situ* in 80% industrial methylated spirits and returned to the laboratory for sorting and identification.
- Identification Level: macroinvertebrates are identified to the lowest taxonomic resolution practicable, typically species for Ephemeroptera, Trichoptera, Plecoptera, Odonata, Coleoptera, Heteroptera, Hemiptera, Megaloptera, Crustacea, Gastropoda, Hirudinea and Turbellaria. Oligochaetes, Chironomidae, Simulidae, Ceratopogonidae, Stratyomiidae, other Diptera, Hydrachnids, Nematoda and Sphaeridae are identified as such.
- Data Processing: raw count data is assigned a weighted abundance acid sensitivity score which are averaged to give an overall score for each sample.

2.3 National Reference Conditions

National reference conditions were set using near natural reference sites. The screening criteria were identical to the pressure data and parameters used in the original NGIG intercalibration exercise (Table 2). Reference lakes were identified using a pressure filter approach, and lakes judged to potentially be affected by anthropogenic pressures were screened to identify lakes at natural or near natural reference conditions.

Table 2: Pressure and Screening Criteria used to identify national reference sites.

Pressure	Criteria
Agriculture	< 10% catchment agricultural land (pasture and arable)
Forestry	< 10% catchment commercial coniferous plantations
Urbanisation	< 0.1% catchment urban areas
Eutrophication	Mean Total Phosphorus < 10µg/l; Mean Chlorophyll a < 5mg/m^3
Hydrology	No regulation on water level or significant abstractions
Invasive	No invasive species that negatively impact on functioning of ecosystem
Point	No major point source pollution
Acidification	Not subjected to anthropogenic acidification (pH < 5.5)
Shore Morphology	No artificial modification of littoral zone within 100m of sampling site
Other Pressures	No fish farms present, no limed lakes

After the screening process, of the 232 IE lake samples, 8 reference sites were identified for clear lakes. The number of reference sites identified in Ireland was similar to the number of sites used in previously intercalibrated member states, where Norway and the United Kingdom identified 7 and 8 reference sites, respectively (Sandin *et al.* 2014).

2.4 National Boundary Setting

The Reference value was defined as the median LAMM index value of all the reference sites. It was not possible to set national boundaries using only IE data owing to the absence of a complete pressure gradient. Instead, national boundaries were set by borrowing sites along the gradient from the UK and calculating LAMM scores on all the data. Ecological Quality Ratios (EQR) for both the IE and the UK metric were then calculated using reference values from each member state. The scores of the new IE method were correlated against the scores of the previously intercalibrated UK method to compare the position of the established UK boundaries (Figure 1).

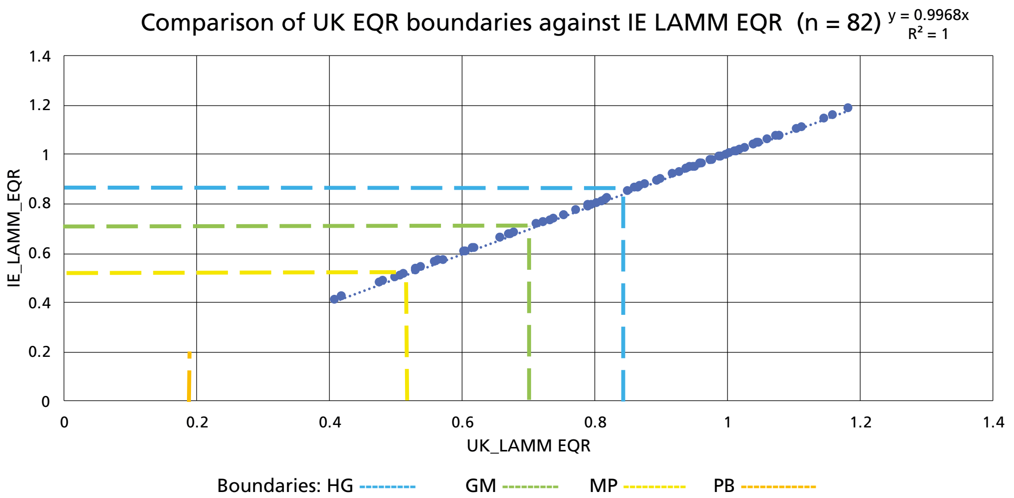

Figure 1: Relationship of the new IE EQR compared with the intercalibrated boundaries of the UK EQR.

The R^2 for the regression equation was 1 and showed a perfect positive correlation, which is unsurprising as the EQR scores calculated by both methods are almost identical. The exact same methodology is used in both member states and the only difference is a minor variation in the reference value, with IE having a LAMM reference value of 5.96, while the UK has reference value of 5.94. Although almost identical, the UK boundaries are slightly more precautionary, and these were subsequently adopted as IE national boundaries (Table 3). A detailed description of the original UK boundary setting procedure and the pressure -response relationship can be found in McFarland *et al.* (2009).

Table 3: National Class boundaries for IE LAMM EQR.

Class boundary	High/ Good	Good/ Moderate	Moderate / Poor	Poor / Bad
LAMM	0.86	0.70	0.54	0.20

2.5 Pressures Addressed

The LAMM score was developed to respond to anthropogenic acidification pressure and the original relationship was tested against Acid Neutralising Capacity (ANC) of surface waters in the UK. The relationship between the metric score and the pressure relationship in IE was tested against pH and alkalinity in the absence of sufficient ANC data. The relationship appears to be non-existent using IE data against this measure of the pressure (Figure 2).

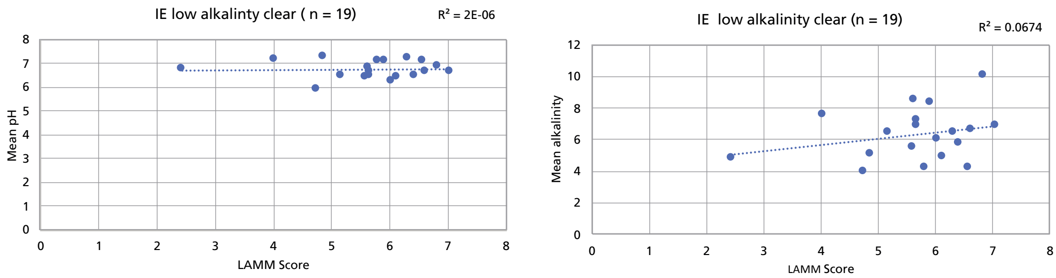

Figure 2: The relationships between IE LAMM score and selected pressure indicators, mean pH and mean alkalinity.

This is not unexpected owing to the relatively small sample size of low alkalinity, clear lakes in IE (n = 19) and the absence of complete pressure gradient. 15 of the 19 IE lakes were High status, two were Good status and only two lakes were less than Good status.

To try and improve the relationship of the IE LAMM score against the pressure, sites were borrowed from the UK and the results are illustrated in Figure 3. Both of the R^2 met the minimum value (> 0.30) required to be included in the intercalibration exercise, and the relationships between the metric score and the pressure was significant for both parameters ($p < 0.01$). The results obtained were similar to results previously reported by the UK, where the UK LAMM score plotted against pH returned an $R^2 = 0.37$ (Sandin *et al.* 2014). However, this metric was developed using ANC which is a more accurate representation of the acidification pressure, and when the same UK data was tested against pressure measured as ANC, the strength of the relationship was $R^2 = 0.64$ indicating that the metric addresses changes due to anthropogenic acidification.

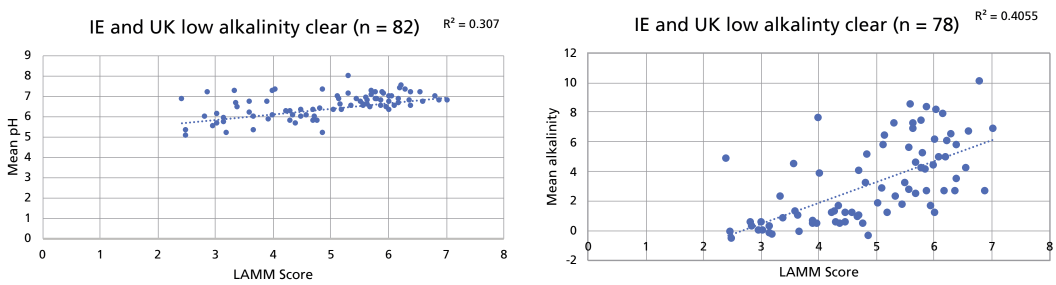

Figure 3: The relationship between IE LAMM score calculated on UK and IE invertebrate data against mean pH and mean alkalinity.

3. WATER FRAMEWORK COMPLIANCE CHECKING

The Intercalibration process requires checking the proposed national method with WFD compliance criteria. Table 4 lists the compliance criteria and the results. Given that the LAMM method has previously been intercalibrated, it has been found to be compliant with the WFD.

Table 4: List of the WFD compliance criteria and the WFD compliance checking process and results.

Compliance Criteria	Compliance Checking
Ecological status is classified by one of **five classes** (High, Good, Moderate, Poor and Bad)	LAMM metric for Clear lakes has four classes with Poor / Bad combined
High, Good and Moderate ecological status are set in line with the WFD's **normative definition**s	Yes. Discontinuities in the relationship of the anthropogenic pressure (ANC) and the biological communities at High, Good and Moderate status is given in McFarland *et al.* (2009)
A**ll relevant parameters** indicative of the biological quality element are covered (See Table 1 in the Intercalibration Guidance). A combination rule to combine parameter assessment into BQE assessment has to be defined. If parameters are missing, Member States need to demonstrate that the method is sufficiently indicative of the status of the quality element as a whole	Composition, Abundance and Sensitive taxa are included. Diversity is not explicitly included as it did not improve the methods response
Assessment is adapted to **intercalibration common types** that are defined in line with the typological requirements of the Annex II WFD and approved by WG-ECOSTAT	Yes, all assessed lakes were assigned to common types
The waterbody is assessed against **type specific near natural reference conditions**	Yes, the lakes are assessed against near natural reference sites
Assessment results are expressed as **EQRs**	Yes
Sampling procedure allows for representative information about water body quality / ecological status **in space and time**	Yes
All data relevant for assess the biological **parameters** specified in the WFD's normative definitions are covered by the **sampling procedure**	Yes
Selected taxonomic level achieves adequate **confidence and precision** in classification	Yes (typically species level)

4. INTERCALIBRATION FEASIBILITY CHECKING

This section documents the intercalibration feasibility of the LAMM in terms of lake typology, addressed pressure and assessment concepts to avoid the comparison of dissimilar methods and ensure that the actual intercalibration analysis addresses the same common types, pressures and follows a similar assessment concept.

4.1 Typology

The national typology in Ireland largely categorises lakes into 12 types based on four abiotic factors - altitude, alkalinity, average depth and surface area, with an additional 13th lake type for high altitude lakes (Appendix B). For the intercalibration exercise, participating member states in N-GIG examined the common lake types for that region defined by van de Bund *et al.* (2004) which categorised lakes largely based on altitude, mean depth, alkalinity, and colour (Table 5).

Table 5: Northern GIG common intercalibration types (after van de Bund *et al.* 2004).

Type	Lake Characterisation	Altitude (m)	Mean Depth (m)	Alkalinity (meq/l)	Colour (mg Pt/l)
L-N1	Lowland, shallow, moderate alkalinity, clear	< 200	3 -15	0.2 - 1	< 30
L-N2a	Lowland, shallow, low alkalinity, clear	< 200	3 - 5	< 0.2	< 30
L-N2b	Lowland, deep, low alkalinity, clear	< 200	> 15	< 0.2	< 30
L-N3	Lowland, shallow, low alkalinity, humic	< 200	3 - 5	< 0.2	> 30
L-N5	Mid-altitude, shallow, low alkalinity, clear	> 200	3 - 5	< 0.2	< 30
L-N6	Mid altitude, shallow, low alkalinity, humic	> 200	3 - 5	< 0.2	> 30
L-N8	Lowland, shallow, moderate alkalinity, humic	< 200	3 - 5	0.2 - 1	> 30

For the intercalibration exercise, the N-GIG working group combined some of these common types into two intercalibration types based solely on their buffering capacity and humic content, which are the two relevant parameters for the acidification pressure being addressed. This resulted in two common intercalibration types in the GIG, clear lakes and humic lakes, based on alkalinity and dissolved organic carbon (Table 6).

Table 6: List of N-GIG common lake types for acidification intercalibration

Common IC Type	Type Charactersatics	Disolved Organic Carbon (mg/l)	Alkilinity (meq/l)
L-N2+L-N5	Clear, low alkalinity lakes	<5	<0.2
L-N3+L-N6	Humic, low alkalinity lakes	>5	>0.2

It did not turn out to be feasible to intercalibrate the humic lake type for acidification pressure and the work within N-GIG only proceeded for the clear, low alkalinity lakes. There were data from 19 Irish lakes which corresponded to this common type. These were used in the intercalibration and the IE method is relevant to these types.

4.2 Pressures Addressed

The method being intercalibrated addresses the same pressure (anthropogenic acidification) as previously addressed by the other methods in the intercalibration group. The relationship between the method and the pressure can be seen in Section 2.5. Additional information on the development of the metric and its response to anthropogenic acidification is available in Monteith and Simpson (2007), McFarland *et al.* (2009) and Sandin *et al.* (2014). The IE national method is relevant to the pressures addressed.

4.3 Assessment Concept

The IE national method is exactly the same method as the previously intercalibrated UK national method and follows the same assessment concept in terms of sampling approach, timing, sample processing, species identification and metric calculation. The only difference between the two methods is a slight variation in the reference value, which was derived independently from each member states reference lakes. The IE method is feasible regarding the assessment concept of the intercalibrated methods.

4.4 Conclusion on the Intercalibration Feasibility

The IE national method is feasible regarding the common intercalibration types, pressures and assessment concept. This method is currently applied in the United Kingdom, has previously been intercalibrated and is in full compliance with the intercalibration results as presented in the Commission Decision 2013 / 480 / EU.

5. DEMONSTRATING THE COMPLIANCE WITH THE COMPLETED INTERCALIBRATION EXERCISE

5.1 Background

The intercalibration was carried out using Option 3 with reference sites as there were a sufficient number of these sites available at a national level. In order to choose this option, it is preferable to have no fewer than the smallest number of sites provided by any member state in the completed exercise. Ireland had eight reference sites, similar to the number of reference sites provided by the UK and Norway, who had 8 and 7 sites, respectively. This option was chosen following the Guidance Document No. 30 on the procedures to fit a new or updated classification method to the results of a completed intercalibration exercise (European Commission, 2015). Case B2 was chosen from the guidance document following Willby *et al.* (2014) User's Manual.

5.2 Description of the Intercalibration Data Set

The Irish Environmental Protection Agency provided a data set of 232 lake littoral invertebrate samples collected from 212 lakes. This data set covers the whole geographical area of Ireland and most national lake types. Additional data, detailed below, were collated in order to meet the screening criteria for reference conditions and compliance with the common intercalibration types.

In selecting the reference lakes, Corine land use data was used to collate information on catchment areas under pasture or arable cultivation, commercial forestry plantations and urban areas. Additionally, mean chemistry data for total phosphorus and chlorophyll a were used to screen out lakes subjected to eutrophication; and minimum pH was used to exclude lakes subjected to anthropogenic acidification. Additional databases containing information on abstraction rates, point sources, hydromorphological alterations (dams) and fish farms were further used to screen the data and identify true reference sites. All lakes were then sorted into the common intercalibration types using alkalinity, dissolved organic carbon and colour. Of the 232 samples available in the initial data set, 19 sites were finally included in the intercalibration exercise as clear, low alkalinity lakes, including eight reference sites. Once the LAMM score was calculated and the sites assigned Ecological status, the final IE intercalibration set consists of 15 sites at High status, two Good status and one each of Moderate and Poor / Bad (Table 7).

Table 7: Summary chemical statistics (average) and ecological status of IE intercalibration dataset.

Lake Water body Code	Lake	Reference	Alkalinity (mg/lCaCO$_3$)	pH (pH units)	Dissolved Organic Carbon (mg/l)	Total Phosphorus (µg)	Chloro-phyll a (µg/l)	BQE Status
SW_22_208	Acoose	NO	6.43	6.52	4.50	11	11	High
WE_33_1892	Acorrymore	NO	4.00	5.91	4.67	6	3	Good
SW_21_402	Brin	REF	10.03	6.89	3.77	9	5	High
SW_22_207	Caragh	REF	7.20	6.50	5.20	10	3	High
SW_21_443	Cloonaghlin	REF	4.88	6.47	3.33	9	5	High
SW_21_457	Currane	NO	6.86	6.70	4.50	9	7	High
SW_21_457	Currane	NO	6.86	6.70	4.50	9	7	High
WE_31_227	Derryclare	NO	4.22	7.13	5.26	5	3	High
WE_32_490	Doo MO	NO	5.08	7.28	3.68	6	1	Good
SW_21_444	Glenbeg	NO	7.60	7.19	3.79	7	10	Moderate
WE_32_487	Glencullin	NO	4.21	7.10	4.52	5	2	High
SW_22_172	Guitane	NO	6.65	6.67	3.78	7	2	High
SW_21_452	Inchiquin KY	REF	5.74	6.49	3.90	11	3	High
WE_32_509b	Kylemore	NO	6.48	7.25	4.73	5	2	High
SW_22_184	Muckross	REF	8.50	6.86	4.09	8	2	High
SW_21_421	Namona	REF	5.56	6.47	3.09	9	4	High
WE_32_509a	Pollacappul	REF	8.33	7.11	3.82	5	1	High
SW_22_186	Upper KY	REF	6.07	6.27	4.55	7	2	High
EA_10_32	Upper Lake Glendalough	NO	4.87	6.77	4.19	6	1	Poor Bad

5.3 Description of the Intercalibration Procedure

The intercalibration was carried out using a Best Related and Intercalibrated National Classification method (BRINC). The UK_LAMM method was selected as the BRINC and used as the "common metric" for the purposes of intercalibrating the IE_LAMM.

In the original exercise, the UK had significantly higher LAMM scores for the reference data than Sweden and Norway. Therefore, benchmark standardisation was done in the Excel sheet for option 3 where the class boundaries are standardised and normalised.

However, no benchmark standardisation was necessary for intercalibrating the IE LAMM because the reference conditions have been established against the same reference criteria (**Section 2.3**). The R^2 of almost one between the two methods shows that there is an insignificant difference in the reference values between the two methods (0.02) ; IE LAMM and UK LAMM (**Section 2.4**). Both the UK LAMM and the IE LAMM are fully comparable. In addition, the same mathematical processes i.e. standardisation, normalisation, translation to the Pseudo Common Metric (PCM) were applied to the UK LAMM tool in the original intercalibration. These processes will not affect measures of class proportion (Class Bias), which is the ultimate measure sought to check for intercalibration compliance.

Global Mean Values (GMVs) were established for the High/Good and Good/Moderate boundaries in the original intercalibration exercise. These were the average of the member state boundary values expressed as the PCM.

The distance between a member states boundary (PCM value) and the corresponding GMV (of the PCM) for that boundary was calculated. This distance was expressed as a portion of a class width or bias. If the member states boundary was more stringent, that is, it had a higher value than the GMV, then the GMV value fell within the good class of that member state classification. The class bias is then expressed as a portion of the good class width. Likewise, if the member states boundary was more lax, that is, it had a lower value than the GMV, then the GMV value fell within the high class of that member state classification.

The distance between the IE LAMM High/Good and Good/Moderate boundaries and the GMV for that boundary needs to be calculated. It is not known where on the IE LAMM the GMV boundary values are. But the GMV value on the UK LAMM can be calculated from the original intercalibration exercise. The relationship between the IE LAMM and UK LAMM is known. This relationship is used to translate the GMV expressed as UK LAMM to IE LAMM, and thus the distance between the IE LAMM boundaries and the GMV can be calculated.

5.3.1 Global Mean View translated into UK LAMM (BRINC)

To translate the GMV of the completed intercalibration exercise into the units of the BRINC (i.e. the UK LAMM method), the values of the UK LAMM boundary positions and the boundary-specific class biases documented in Tables 7.3 and 7.4 (boundary bias and national class boundaries) of the NGIG Technical Report (Sandin *et al.* 2014). The GMV in BRINC units are calculated:

GMV High-Good boundary expressed as UK LAMM (BRINC)

H/G GMV = UK H/G boundary - (UK G width * H/G bias_CW)

= 0.860 - (0.160 * 0.147)

= 0.836

GMV Good-Moderate boundary expressed as UK LAMM (BRINC)

GMV G/M = UK G/M boundary - (UK M width * G/M bias_CW)

= 0.700 - (0.160 * 0.061)

= 0.690

GMV expresses as UK LAMM (BRINC) translated into IE LAMM

The relationship between IE LAMM and UK LAMM is already known (**Section 2.4**):

y = 0.9968x + 1E-14 or

IE LAMM = 0.9968*UK LAMM + 1E-14.

High-Good boundary GMV expresses as UK LAMM (BRINC) translated into IE LAMM:

= 0.9968(0.836) + 1E-14

= 0.834

Good-Moderate GMV expresses as UK LAMM (BRINC) translated into IE LAMM

= 0.9968(0.690) + 1E-14

=0.688

5.3.2 Calculating Class Bias

There are three steps needed to calculate the class bias.

Step 1: Calculate the distance between the GMV expressed as IE LAMM and IE LAMM for both boundaries:

= GMV IE LAMM boundary value – IE LAMM boundary value

h/g boundary = 0.834-0.86 = **0.026**

g/m boundary= 0.6880- 0.70 =**0.012**

Step 2: Estimate the Class Width of the MS tool:

= difference between class boundary values

High class width = 1- h/g boundary

Good class width = h/g boundary – g/m boundary

High class width = 1- 0.84 =**0.160**

Good class width = 0.86 – 0.70=**0.160**

The class widths are the difference between each boundary value. In this case, the class widths are the same.

Step 3: Calculate class bias, which is the distance between GMV and IE boundary, expressed as a portion of the width of the class within which the GMV boundary is. This is the boundary differences expressed as a portion of a class width.

= distance between GMV and IE boundary/class width where GMV is on IE LAMM

h/g class bias = 0.026/0.160=**0.164**

g/m class bias= 0.012/0.160=**0.075**

Both IE LAMM boundaries are more stringent than the corresponding GMV values (Table 8, Figure 4). Both GMV boundary values are in the IE class below the IE LAMM boundaries (Figure 4). Therefore, the class widths for the Good and Moderate class are used to calculate the class bias. The resulting bias values are within +/-0.25 of the GMV for both boundaries.

Table 8: A summary of the steps and values used to estimate class bias.

Boundaries	IE LAMM Values	GMV as IE LAMM	Boundary Difference	Class	Class Width	Class Bias
HG	0.86	0.84	0.026			0.164
GM	0.70	0.69	0.012	Good	0.16	0.075
MP	0.54			Moderate	0.16	

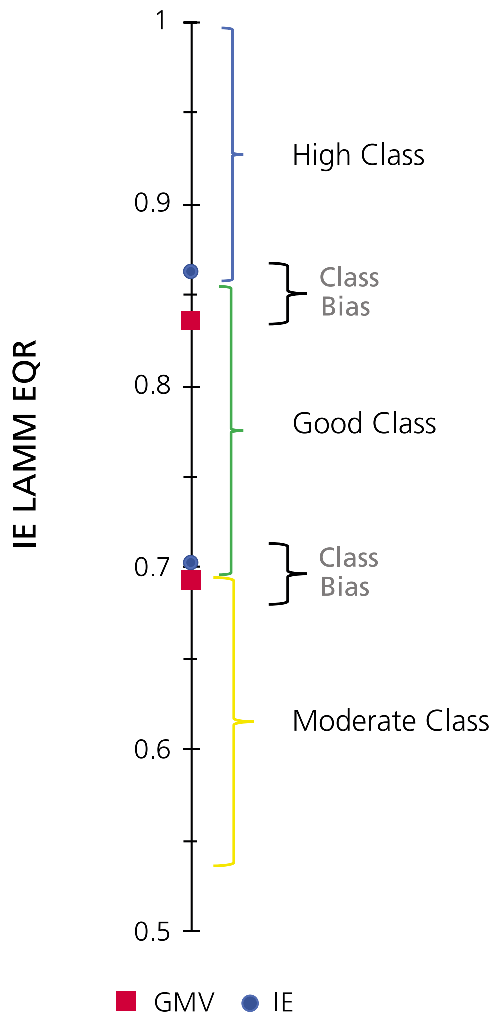

Figure 4: The position of the GMV boundary values and the IE boundary values on the IE LAMM tool.

6. DESCRIPTION OF THE BIOLOGICAL COMMUNITIES

This method is an abundance weighted index based on acid sensitive and tolerant taxa. The numbers and presence of acid sensitive taxa decline, together with a concomitant increase in the presence and abundance of tolerant taxa, when the community is exposed to anthropogenic acidification. Each of the status classes was determined by faunal composition at demonstrated levels of acidification impact.

6.1 Description of the Biological Communities at High Status

The following description of the biological communities at High Status is taken from Sandin *et al.* (2014) after original method development by McFarland *et al.* (2009) who states that clear lake communities were dominated by Plecopteran, Trichopteran, Crustacean and Dipteran (typically Chironomidae) taxa. Other important components in these typically lentic faunas include molluscs, leeches and hemipterans. Fifteen of the 19 IE sites included in this intercalibration exercise were assess as being at High status and these communities contained relatively large numbers of acid sensitive taxa, typically between 6 -12 different species.

6.2 Description of the Biological Communities at Good Status

At Good status, a number of acid sensitive taxa are still present, however the community composition and abundance differ slightly from High or undisturbed conditions, but the proportion of sensitive taxa is still higher than those of tolerant taxa. Ephemeroptera typically assume increasing importance at this status, often with large numbers of Leptophlebiids. Two of the IE sites were assessed as being at Good status because these contained only two and four of the most acid sensitive taxa respectively.

6.3 Description of the Biological Communities at Less than Good Status

Benthic macroinvertebrate communities at less than Good status differ significantly in terms of composition and abundance from the undisturbed site communities. The proportion of acid sensitive taxa decreases or are absent altogether with a concomitant increase in tolerant taxa. Two of the IE sites were less than Good status, with one at Moderate and the second at Poor / Bad. Both of these sites were missing all of the acid sensitive crustaceans and Mollusca and only had very low numbers of one acid sensitive mayfly with more acid tolerant taxa dominating the community.

Addendum

This report was accepted by the EU intercalibration review panel in September 2020 and approved at a meeting of the Ecological Status Group (ECOSTAT) in October 2020.

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Appendix A – LAMM scoring taxa

Taxa	Sk	Wk	Hk
Adicella reducta	2	0.352	1, 3, 5
Agapetus ochripes	6.67	0.469	1, 3, 5
Agapetus sp.	8	0.469	1, 3, 5
Agrypnia obsoleta	2	0.328	1, 3, 5
Agrypnia sp.	2	0.32	1, 3, 5
Alainites muticus	8	0.432	1, 3, 5
Ameletus inopinatus	5	0.648	1, 3, 5
Amphinemoura standfussi	4	0.384	1, 3, 5
Amphinemoura sulcicollis	2.5	0.384	1, 3, 5
Ancylus fluviatilis	7	0.529	1, 3, 5
Anodonta sp.	7	0.268	1, 3, 5
Arthroplea congener	2	0.577	1, 3, 5
Asellus aquaticus	4	0.284	1, 3, 5
Asellus meridianus	8	0.287	1, 3, 5
Athripsodes aterrimus	2.67	0.378	1, 3, 5
Athripsodes bilineatus	8	0.378	1, 3, 5
Athripsodes cinereus	5.33	0.306	1, 3, 5
Baetis rhodani	6	0.685	1, 3, 5
Baetis scambus/fuscatus	7.33	0.581	1, 3, 5
Baetis vernus gp.	6	0.581	1, 3, 5
Bathyomphalus contortus	7.33	0.67	1, 3, 5
Brachycentrus subnubilus	8	0.604	1, 3, 5
Brachyptera risi	3	0.55	1, 3, 5
Caenis horaria	6.67	0.455	1, 3, 5
Caenis luctuosa gp.	8	0.617	1, 3, 5
Caenis rivulorum	8	0.413	1, 3, 5
Caenis robusta	8	0.413	1, 3, 5
Callicorixa wollastoni	2	0.5	1, 3, 5
Calopteryx virgo	6	0.387	1, 3, 5
Capnia atra	6	0.661	1, 3, 5
Capnia bifrons	4	0.661	1, 3, 5
Capnia vidua	2	0.661	1, 3, 5
Centoptilum luteolum	5.33	0.45	1, 3, 5
Ceraclea annulicornis	8	0.566	1, 3, 5
Chaetopteryx villosa	2	0.659	1, 3, 5
Cheumatopsyche lepida	8	0.58	1, 3, 5
Chloroperla tripunctata	8	0.261	1, 3, 5
Cloeon dipterum	6	0.411	1, 3, 5
Cloeon simile	6	0.366	1, 3, 5
Crangonyx pseudogracilis	6	0.585	1, 3, 5

Taxa	Sk	Wk	Hk
Crenobia alpina	5	0.057	1, 3, 5
Cyrnus flavidus	2.67	0.391	1, 3, 5
Cyrnus insolutus	2	0.316	1, 3, 5
Cyrnus sp.	2.67	0.392	1, 3, 5
Cyrnus trimaculatus	2.67	0.529	1, 3, 5
Dicranota sp.	2	0.472	1, 3, 5
Diplectrona felix	8	0.58	1, 3, 5
Diura bicaudata	4.67	0.587	1, 3, 5
Dixa sp.	7	0.408	1, 3, 5
Ecdyonurus sp.	8	0.577	1, 3, 5
Electrogena lateralis	8	0.577	1, 3, 5
Elmis aenea	6	0.307	1, 3, 5
Empididae	6	0.608	1, 3, 5
Ephemera danica	8	0.544	1, 3, 5
Ephemera vulgata	6.67	0.631	1, 3, 5
Erpobdella octoculata	6	0.31	1, 3, 5
Erpobdella testacea	6	0.365	1, 3, 5
Esolus parallelepipedus	7	0.307	1, 3, 5
Galba truncatula	7.33	0.386	1, 3, 5
Gammarus lacustris	7.33	0.517	1, 3, 5
Gammarus pulex/Gammarus duebeni	7	0.464	1, 3, 5
Glossiphonia complanata	7	0.304	1, 3, 5
Glossosoma sp.	8	0.469	1, 3, 5
Glyphotaelius pellucidus	2	0.344	1, 3, 5
Goera pilosa	4	0.324	1, 3, 5
Gyraulus albus	6.67	0.637	1, 3, 5
Habrophlebia fusca	8	0.353	1, 3, 5
Halesus radiatus	2	0.325	1, 3, 5
Helobdella stagnalis	6.5	0.288	1, 3, 5
Hemiclipsis marginata	7	0.308	1, 3, 5
Heptagenia sulphurea	5.5	0.608	1, 3, 5
Holocentropus dubius	2.67	0.281	1, 3, 5
Hydraena gracilis	8	0.096	1, 3, 5
Hydropsyche angustipennis	3.33	0.58	1, 3, 5
Hydropsyche instabilis	8	0.58	1, 3, 5
Hydropsyche pellicidula	5.5	0.58	1, 3, 5
Hydropsyche siltalai	4.5	0.58	1, 3, 5
Hydroptila sp.	7	0.465	1, 3, 5
Isoperla grammatica	8	0.618	1, 3, 5
Isoperla obscura	4	0.618	1, 3, 5
Ithytrichia sp.	6.67	0.457	1, 3, 5

Taxa	Sk	Wk	Hk
Kageronia fuscogrisea	2	0.577	1, 3, 5
Lepidostoma hirtum	6	0.538	1, 3, 5
Leptophlebia marginata	2	0.321	1, 3, 5
Leptophlebia sp.	2	0.133	1, 3, 5
Leptophlebia vespertina	2	0.133	1, 3, 5
Leuctra fusca	4	0.438	1, 3, 5
Leuctra geniculata	8	0.438	1, 3, 5
Leuctra hippopus	2	0.438	1, 3, 5
Leuctra inermis	4	0.438	1, 3, 5
Leuctra nigra	2	0.438	1, 3, 5
Limnebius truncatellatus	8	0.096	1, 3, 5
Limnephilus centralis	2	0.325	1, 3, 5
Limnephilus extricatus	2	0.325	1, 3, 5
Limnephilus flavicornis	2	0.325	1, 3, 5
Limnephilus lunatus	2	0.325	1, 3, 5
Limnephilus rhombicus	2	0.325	1, 3, 5
Limnephilus sp.	2	0.325	1, 3, 5
Seratella ignita	7	0.475	1, 3, 5
Sericostoma personatum	5.5	0.204	1, 3, 5
Sialis fuliginosa	5	0.289	1, 3, 5
Sialis lutaria	4	0.25	1, 3, 5
Silo pallipes	5.33	0.324	1, 3, 5
Simuliidae	4	0.494	1, 3, 5
Siphlonurus alternatus	6	0.502	1, 3, 5
Siphlonurus lacustris	4.67	0.502	1, 3, 5
Siphlonurus sp.	4.67	0.502	1, 3, 5
Siphonoperla torrentium	2	0.261	1, 3, 5
Spaerium corneum	4.67	0.537	1, 3, 5
Stenophylax permistus	2	0.325	1, 3, 5
Tabanus gp.	4	0.289	1, 3, 5
Taeniopteryx nebulosa	2.67	0.55	1, 3, 5
Theromyzon tessulatum	7	0.541	1, 3, 5
Tinodes waeneri	6	0.256	1, 3, 5
Tipulidae sp.	4	0.472	1, 3, 5
Trianodes bicolor	6	0.3	1, 3, 5
Wormaldia sp.	8	0.57	1, 3, 5

Appendix B National Typology of lakes in Ireland

National Lake Type	Altitude	Alkalinity (mg/L $CaCO_3$)	Average Depth (m)	Lake Area (km^2)
1	< 200m	< 20	< 4	< 0.5
2	< 200m	< 20	< 4	> 0.5
3	< 200m	< 20	> 4	< 0.5
4	< 200m	< 20	> 4	> 0.5
5	< 200m	20 - 100	< 4	< 0.5
6	< 200m	20 - 100	< 4	> 0.5
7	< 200m	20 - 100	> 4	< 0.5
8	< 200m	20 - 100	> 4	> 0.5
9	< 200m	> 100	< 4	< 0.5
10	< 200m	> 100	< 4	> 0.5
11	< 200m	> 100	> 4	< 0.5
12	< 200m	> 100	> 4	> 0.5
13	> 300m			

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL

Tá an GCC freagrach as an gcomhshaol a chosaint agus a fheabhsú, mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ar thionchar díobhálach na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialáil: *Rialáil agus córais chomhlíonta comhshaoil éifeachtacha a chur i bhfeidhm, chun dea-thorthaí comhshaoil a bhaint amach agus díriú orthu siúd nach mbíonn ag cloí leo.*

Eolas: *Sonraí, eolas agus measúnú ardchaighdeáin, spriocdhírithe agus tráthúil a chur ar fáil i leith an chomhshaoil chun bonn eolais a chur faoin gcinnteoireacht.*

Abhcóideacht: *Ag obair le daoine eile ar son timpeallachta glaine, táirgiúla agus dea-chosanta agus ar son cleachtas inbhuanaithe i dtaobh an chomhshaoil.*

I measc ár gcuid freagrachtaí tá:

Ceadúnú

- Gníomhaíochtaí tionscail, dramhaíola agus stórála peitril ar scála mór;
- Sceitheadh fuíolluisce uirbigh;
- Úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe;
- Foinsí radaíochta ianúcháin;
- Astaíochtaí gás ceaptha teasa ó thionscal agus ón eitlíocht trí Scéim an AE um Thrádáil Astaíochtaí.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Iniúchadh agus cigireacht ar shaoráidí a bhfuil ceadúnas acu ón GCC;
- Cur i bhfeidhm an dea-chleachtais a stiúradh i ngníomhaíochtaí agus i saoráidí rialáilte;
- Maoirseacht a dhéanamh ar fhreagrachtaí an údaráis áitiúil as cosaint an chomhshaoil;
- Caighdeán an uisce óil phoiblí a rialáil agus údaruithe um sceitheadh fuíolluisce uirbigh a fhorfheidhmiú
- Caighdeán an uisce óil phoiblí agus phríobháidigh a mheasúnú agus tuairisciú air;
- Comhordú a dhéanamh ar líonra d'eagraíochtaí seirbhíse poiblí chun tacú le gníomhú i gcoinne coireachta comhshaoil;
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Dramhaíola agus Ceimiceáin sa Chomhshaol

- Rialacháin dramhaíola a chur i bhfeidhm agus a fhorfheidhmiú lena n-áirítear saincheisteanna forfheidhmithe náisiúnta;
- Staitisticí dramhaíola náisiúnta a ullmhú agus a fhoilsiú chomh maith leis an bPlean Náisiúnta um Bainistíocht Dramhaíola Guaisí;
- An Clár Náisiúnta um Chosc Dramhaíola a fhorbairt agus a chur i bhfeidhm;
- Reachtaíocht ar rialú ceimiceán sa timpeallacht a chur i bhfeidhm agus tuairisciú ar an reachtaíocht sin.

Bainistíocht Uisce

- Plé le struchtúir náisiúnta agus réigiúnacha rialachais agus oibriúcháin chun an Chreat-treoir Uisce a chur i bhfeidhm;
- Monatóireacht, measúnú agus tuairisciú a dhéanamh ar chaighdeán aibhneacha, lochanna, uiscí idirchreasa agus cósta, uiscí snámha agus screamhuisce chomh maith le tomhas ar leibhéil uisce agus sreabhadh abhann.

Eolaíocht Aeráide & Athrú Aeráide

- Fardail agus réamh-mheastacháin a fhoilsiú um astaíochtaí gás ceaptha teasa na hÉireann;
- Rúnaíocht a chur ar fáil don Chomhairle Chomhairleach ar Athrú Aeráide agus tacaíocht a thabhairt don Idirphlé Náisiúnta ar Ghníomhú ar son na hAeráide;
- Tacú le gníomhaíochtaí forbartha Náisiúnta, AE agus NA um Eolaíocht agus Beartas Aeráide.

Monatóireacht & Measúnú ar an gComhshaol

- Córais náisiúnta um monatóireacht an chomhshaoil a cheapadh agus a chur i bhfeidhm: teicneolaíocht, bainistíocht sonraí, anailís agus réamhaisnéisiú;
- Tuairiscí ar Staid Thimpeallacht na hÉireann agus ar Tháscairí a chur ar fáil;
- Monatóireacht a dhéanamh ar chaighdeán an aeir agus Treoir an AE i leith Aeir Ghlain don Eoraip a chur i bhfeidhm chomh maith leis an gCoinbhinsiún ar Aerthruailliú Fadraoin Trasteorann, agus an Treoir i leith na Teorann Náisiúnta Astaíochtaí;
- Maoirseacht a dhéanamh ar chur i bhfeidhm na Treorach i leith Torainn Timpeallachta;
- Measúnú a dhéanamh ar thionchar pleananna agus clár beartaithe ar chomhshaol na hÉireann.

Taighde agus Forbairt Comhshaoil

- Comhordú a dhéanamh ar ghníomhaíochtaí taighde comhshaoil agus iad a mhaoiniú chun brú a aithint, bonn eolais a chur faoin mbeartas agus réitigh a chur ar fáil;
- Comhoibriú le gníomhaíocht náisiúnta agus AE um thaighde comhshaoil.

Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéil radaíochta agus nochtadh an phobail do radaíocht ianúcháin agus do réimsí leictreamaighnéadacha a mheas;
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha;
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta;
- Sainseirbhísí um chosaint ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Ardú Feasachta agus Faisnéis Inrochtana

- Tuairisciú, comhairle agus treoir neamhspleách, fianaise-bhunaithe a chur ar fáil don Rialtas, don tionscal agus don phobal ar ábhair maidir le cosaint comhshaoil agus raideolaíoch;
- An nasc idir sláinte agus folláine, an geilleagar agus timpeallacht ghlan a chur chun cinn;
- Feasacht comhshaoil a chur chun cinn lena n-áirítear tacú le hiompraíocht um éifeachtúlacht acmhainní agus aistriú aeráide;
- Tástáil radóin a chur chun cinn i dtithe agus in ionaid oibre agus feabhsúchán a mholadh áit is gá.

Comhpháirtíocht agus líonrú

- Oibriú le gníomhaireachtaí idirnáisiúnta agus náisiúnta, údaráis réigiúnacha agus áitiúla, eagraíochtaí neamhrialtais, comhlachtaí ionadaíocha agus ranna rialtais chun cosaint chomhshaoil agus raideolaíoch a chur ar fáil, chomh maith le taighde, comhordú agus cinnteoireacht bunaithe ar an eolaíocht.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an GCC á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóir. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inbhunaitheacht i leith Cúrsaí Comhshaoil
- An Oifig Forfheidhmithe i leith Cúrsaí Comhshaoil
- An Oifig um Fhianaise agus Measúnú
- An Oifig um Chosaint ar Radaíocht agus Monatóireacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tugann coistí comhairleacha cabhair don Ghníomhaireacht agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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