NE ATLANTIC MARINE BIOLOGICAL ANALYTICAL QUALITY CONTROL SCHEME

Annual Report 2023/2024

A report prepared by the NMBAQC Scheme Coordinating Committee
May 2025

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This Annual Report provides synopsis of the scheme year's activities over 2023/2024, the 30th year of the NMBAQC scheme. Detailed information about each of the scheme components is now available as separate reports or bulletins on the scheme's website. The relevant documents are all cited here and the reader is directed via hyperlinks to the NMBAQC website as appropriate.

The NMBAQC Scheme is jointly run by academic, advisory, commercial, conservation and regulatory bodies of the UK and Ireland. As the current scheme treasurers, the Environment Agency wishes to acknowledge the financial assistance of JNCC Support Co. and also representatives from the agencies and competent monitoring authorities (CMAs) on the NMBAQC coordinating committee.

The NMBAQC coordinating committee held three meetings during the 2023-2024 reporting period. This was on the 10th November 2023, 23rd April 2024 and a face to face meeting in Cardiff on the 25th September 2024. Subsequent meetings will be covered in the next Annual Report. Minutes of these meeting are on the NMBAQC website:
http://www.nmbaqcs.org/reports/

Committee Membership for 2023/2024 is shown in Appendix 1.

Scheme Review

The scope of the NMBAQC scheme continued to develop in 2023/2024 to encompass the requirement to provide quality assurance for assessments under the Water Framework Directive (WFD), for which monitoring commenced in the UK in 2007. The scheme still maintains its role to provide Analytical Quality Control for Invertebrate and Particle Size data collected for the UK CSEMP (Clean Seas Environment Monitoring Programme). Under the UK Marine Monitoring and Assessment Strategy (UKMMAS) the NMBAQC scheme coordinating committee reports to the Healthy and Biologically Diverse Seas Evidence Group (HBDSEG).

The operation of the scheme components followed a similar format to the previous year and involved training and testing exercises for the Benthic Invertebrate, Particle Size, Fish, and

Macroalgae components. The Zooplankton component is held every two years with the last ring test undertaken during early 2023, whilst the Phytoplankton component undertakes its International Phytoplankton Inter-comparison (IPI) exercise on a yearly basis.

The 2023-2024 participation level in the NMBAQC scheme showed similar numbers to the previous period. (See Appendix 2).

Summaries of all the component activities are provided in this document.

Benthic Invertebrate component

Technical Manager: Myles O'Reilly, Scottish Environment Protection Agency.
Component Administrator: David Hall, APEM Ltd.

Summary of activities

Scheme year 2023/ 2024 (year 30) followed the format of previous year 2022 / 2023. A series of modules and exercises involved the distribution of test materials to participating laboratories and the centralised examination of returned data and samples. The labelling and distribution procedures employed previously have been maintained. Specific details can be found in previous Benthic Invertebrate Component annual reports. Worsfold & al., 2019; 2021; 2022; 2023a; 2024a).

Thirty-four laboratories (with multiple participants from some organizations counted separately) participated in the Benthic Invertebrate Component of the NMBAQC Scheme in 2023 / 2024 (year 30). Ten of the participants were UK Competent Monitoring Authorities (CMAs), responsible for the Clean Seas Environment Monitoring Programme (CSEMP) or Water Framework Directive (WFD) sample analysis/data; seventeen were UK private consultancies. Seven of the participants were laboratories/organisations based outside of the UK. Laboratory Codes were assigned in a single series for all laboratories participating in the Benthic Invertebrate component. Separate Laboratory Codes were assigned for the other scheme components, such as the particle size component.

As in previous years, some laboratories elected to be involved in limited aspects of the scheme. UK Competent Monitoring Authorities (CMAs) completing benthic biological analyses for monitoring programmes, including the assessment of MPAs (Marine Protected Areas), as evidence under MSFD (Marine Strategy Framework Directive), WFD (Water Framework Directive) and CSEMP (Clean Seas Environmental Monitoring Programme), must participate in the Benthic Invertebrate component. CSEMP / WFD laboratories are no longer required to participate in all components / modules of the scheme but for the Benthic Invertebrate component, must participate in the Own Sample module as a minimum and complete any required remedial actions.

This component comprised three modules (each with one or more exercises):

1. Own Sample module (OS) - re-analysis by APEM Ltd. of three samples supplied by participating laboratories.

2. Invertebrate Ring Test module (RT) - identification of two sets of twenty-five invertebrate specimens.
3. Laboratory Reference module (LR) - re-identification by APEM Ltd. of a set of up to twenty-five specimens supplied by participating laboratories.

The analytical procedures of the various modules were the same as for 2022 / 2023 (year 29) of the Scheme.

Summary of results

Two **Ring Tests (RT)**, each of 25 specimens, were distributed (RT65 and RT66). The second (RT66) was targeted on deuterostomes (Echinodermata, Cephalochordata, Ascidiacea). The methods and policies used in the module followed the Ring Test Protocol (Worsfold & Hall, 2017a).

For RT65, the average numbers of differences per participating laboratory (for a total of 19 laboratories with 19 submissions) was 2.6 generic differences and 5.7 specific differences. Three species (a bivalve and two polychaetes) were responsible for just under one third (31.2%) of the specific differences.

For RT66, the average numbers of differences per participating laboratory (for a total of 19 participants with 17 submissions) was 4.1 generic differences and 6.5 specific differences. Five species were responsible for just over half (51.8%) of the specific differences.

Laboratory Reference (LR): Six laboratories signed up for the LR28 module but only three laboratories submitted specimens for confirmation. Most misidentifications were for Annelida (48%), followed by Arthropoda (24%). The methods and policies used in the module followed the Laboratory Reference Protocol (Hall & Worsfold, 2017).

The methods and policies used in the **Own Sample (OS)** module followed the Own Sample Exercise Protocol (Worsfold & Hall, 2017b), produced to explain and standardise policies, including details of audit sample selection and determination of 'associated samples' for subsequent remedial actions. Laboratories were asked to submit full completed data matrices from their previous year's CSEMP / WFD, or similar alternative sampling programmes. The OS 'Pass / Fail' flagging system, introduced in Scheme Year 8, was continued (see Hall, 2010: Description of the Scheme Standards for the Benthic Invertebrate Component). In OS83-85, extraction efficiency (of individuals) was better than 90% in 95% of the comparisons and better than 95% in 89% of all comparisons. 100% of countable taxa were extracted from the sample residues in 65% of samples. The Bray-Curtis similarity index ranged from 27.8% to 100% with an average of 94.08%. The Bray-Curtis similarity index was greater than 95% in 79% of comparisons; in 94% of cases, the value of the index was greater than 90% and, therefore, achieved 'Pass' flags. Twelve samples (19%) achieved 'Pass-Excellent' flags with Bray-Curtis similarity scores of 100%.

Issues and recommendations

Several observations may be made from the results of the exercises described above. The following is a summary of the major points of importance:

1. The majority of participating laboratories submit data / samples in accordance with the Scheme's timetable. **Late submissions**, however, are still the major contributing factor for delaying the production of exercise bulletins / reports. Laboratories should endeavour to report their results within the requested time, according to the deadlines circulated at the beginning of each Scheme year.

2. The number of samples in **data sets provided for selection of Own Samples** varied considerably, with several laboratories offering less than the minimum 20 samples for audit selection (due to low volumes of sample processing) and other laboratories offering a full year's benthic data across multiple projects. Best practice for commercial laboratories should be to use the Scheme as an external auditor for most or all of their samples and no 'cherry picking', pre-analysis selection, or pre-submission re- working of samples should be undertaken. **Retention of sample residues** will be required to facilitate this and to ensure that any subsequent remedial actions can be adequately completed.

3. Revised data request and sample submission forms were introduced for the 2017/2018 OS module to capture **data/sample ownership**. Where data belong to CMAs, the submitting participant was required to declare this so that audit results could be shared accordingly and CMA data auditing could be tracked and coordinated. This initiative has been well received and ensured that reporting transparency with data 'owners' can be maintained.

4. Despite a significant reduction in the number of Own Samples being received with biomass data to be audited, there were continued **problems associated with the measurement of biomass** for individual species in the Own Sample module. In this and previous Scheme years, several laboratories, despite using blotted wet weight biomass techniques, rendered some of their specimens too damaged to be re-identified. Additionally, some laboratories had erroneous results where it appeared that biomass had been estimated or mis-transcribed. The initial processing of a sample should in no way compromise the effectiveness of an audit. Biomass procedures should not render the specimens unidentifiable. Biomass must be reported to four decimal places with nominal weights recorded as 0.0001g. A standardised protocol is available in the NMBAQC guidance document (Worsfold, Hall & O'Reilly (Ed.) 2010) and must be followed for CSEMP / WFD analysis.

5. The maintenance of a comprehensive reference collection has numerous benefits for improving identification ability, maintaining consistency of identification between surveys and access to growth series material. The LR exercise can be used as a means of verifying reference specimens. Laboratories are strongly recommended to **implement and expand in-house reference collections of biota**. The inclusion of growth series material is extremely useful for certain groups, *e.g.* molluscs. All surveys should have an associated reference collection to enable ease of cross-checking or adopting future taxonomic developments. It is unfortunate that so few laboratories currently participate in this exercise which helps verify material for reference collections and the LR summary report highlights many taxa where there are identification difficulties.

6. Participants submitting data for **laboratory reference exercises should add a note on habitat / location** of samples, to aid identification. A similar 'Habitat Notes' section to that distributed with the ring test exercises would be appropriate.

7. Laboratories participating in the ring test exercises should attempt to identify all specimens to species and **complete the 'confidence level' section of their ring test datasheets** to enable additional information to be gathered regarding the difficulty of ring test specimens.

8. The Own Sample module has shown **repeated taxonomic errors** for some laboratories over several years. Participating laboratories are encouraged to redress or resolve disagreements for taxonomic errors in their Own Samples even if their samples achieve an overall 'Pass' flag.

9. There are problems of **individuals and taxa missed at the sorting stage** of Own Sample analysis. This is an area that is often the major contributing factor in samples with 'Fail' flags or low Bray-Curtis similarity indices. When taxa and individuals are missed during the extraction of biota from the sediment, laboratories should determine why certain taxa have not been extracted. This could be due to the taxon not being recognised as countable, or due to problems with the effect of stains upon the specimens. There may also be a problem within certain taxonomic groups (e.g. crustaceans floating within samples or molluscs settled within the coarser sediment fractions). Additional training may be required and a review of existing extraction techniques and internal quality control measures may be beneficial. Remedial action should concentrate on the specific causes of the failure and should be targeted accordingly e.g. analyst or method related discrepancies.

10. It is apparent that some laboratories **are not utilizing the NMBAQC guidelines** for processing macrobenthic samples (Worsfold, Hall & O'Reilly (Ed.), 2010) issued with MB18 in Scheme Year 17 to improve the consistency of analysis, e.g. analysts to extract and record all biota, and sample residues to be subsampled if the specified criteria are met. Own Samples have been received that were processed in full despite meeting the NMBAQC subsampling criteria. A detailed **taxonomic discrimination policy (TDP) is available on the NMBAQC website** (Worsfold et al., 2023b) to accompany the processing requirement protocol (PRP) to ensure that macrobenthic data from multiple analysts are as consistent and inter-comparable as possible. The Own Sample pass / fail criteria will be reviewed to ensure that they are fit for purpose and uphold data consistency between the Scheme participants. The number **of taxonomic resolution differences** is higher for some labs than for others. It may be useful to present a percentage calculation for this (as an 'information only' standard to go in AQC reports).

11. Since the beginning of the scheme, continual improvement to the learning structure of the Scheme reports has been maintained. For the LR and OS modules, detailed results have been forwarded as **individual exercise reports** to each participating laboratory as soon after the exercise deadlines as practicable. The **Laboratory Reference Module Summary Reports introduced in 2017** show identification problems found in all LR submissions and should benefit all participants. In the RT module, after each RT exercise a bulletin was circulated, reviewing the literature used, detailing the accepted identification of the taxa circulated, and

including images of relevant specimens. Participants are encouraged to review their exercise reports **and provide feedback concerning content and format** wherever appropriate.

12. The primary aim of the Benthic Invertebrate Component of the Scheme is to improve the quality of biological data via training and audit modules. An informal constructive reporting system exists to assist in the overall improvement of data quality. For example, laboratories struggling with particular taxonomic groups in their Own Samples often receive additional support, as well as receiving their returned OS material separated, according to the AQC identifications, for future reference. Three of the four 'failing' Own Samples in Scheme Year 2023 / 2024 (Year 30) have already been rectified via the recommended remedial action. Only one sample remains with pending remedial actions (and is not a CMA sample). APEM will continue to proactively follow up outstanding remedial actions from previous scheme years to enable these data to be NMBAQC scheme quality assured. **Participants are reminded that completion of remedial action is mandatory for CMA labs and labs submitting data to CMAs. Participants are encouraged to provide feedback and request further information for any of the scheme exercises to improve the quality and consistency of their data.**

13. **Additional guidance for Own Sample 'next steps' following audit results** has been created to ensure that all participants and other stakeholders are aware of the route to quality assured data (Hall, 2016; Own Sample Interim Report Review and Remedial Action Processes).

14. There remain some misconceptions about the nature of the Scheme and the services it provides. It is not an accreditation scheme but provides quality assurance for the UK's CSEMP/WFD programme and other benthic monitoring programmes. In addition, the Scheme can provide **audits of samples** for any marine biological programme or development. It also provides **project-level audits** by applying the OS and LR protocols to examine project data. These services require more extensive communication (Scheme website, information note etc.) to notify all potential users and maintain consistent quality assurance for European marine biological data. A best practice guidance protocol for NMBAQC project-level audits needs to be produced and published on the scheme website. Meanwhile, it should be understood that a project level audit includes a review of data and check of reference collection specimens for the whole project, as well as for selected samples. Audits of samples from a project without more extensive reviews of data and other material do not constitute quality control of the whole project through the Scheme.

15. Despite protocol documents being produced several years ago (Year 21, 2015-2016), misconceptions still exist regarding the purpose and methods for some of the Scheme's modules. **Protocol documents were reviewed and re-issued in 2017. (Ring Test Protocol, Laboratory Reference Protocol and Own Sample Exercise Protocol).**

16. APEM Ltd. strives to ensure smooth running **and transparency of the Scheme** at all times. APEM Ltd. log and make available all correspondence to the Benthic Invertebrate Component Technical Manager (Myles O'Reilly, SEPA). Participants can be assured that their anonymity will be protected if this correspondence is required to be shared with the Committee.

Reports

Benthic Invertebrate Component Annual Report, 2023/2024 (Year 30)

Worsfold, T.M., Hall, D.J., and O'Reilly, M. (Ed.), 2024. Benthic Invertebrate Component Annual Report. Scheme Operation 2023/2024 (Year 30). A report from the contractor to the NMBAQC Scheme coordinating committee. 28pp, August 2024.

Own Sample Module Summary Report OS 83,84,85 – June 2024

Hall, D.J. 2024. NE Atlantic Marine Biological Analytical Quality Control Scheme. Own Sample Module Summary Report OS83, 84 & 85. Report to the NMBAQC Scheme participants. 13pp, June 2024.

Laboratory Reference Module Summary Report LR28 – June 2024

Worsfold, T.M & Hall, D.J, 2024. NE Atlantic Marine Biological Analytical Quality Control Scheme. Laboratory Reference Module Summary Report LR28. Report to the NMBAQC Scheme participants. 8 pp, June 2024.

RTB65 - April 2024 (General/Mixed Taxa)

Worsfold, T., Hall, D., & Pears, S., 2024. NE Atlantic Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB#65. Report to the NMBAQC Scheme participants. APEM Report NMBAQC RTB#65, 46pp, April, 2024.

RTB66 – July 2024 (Targeted – deuterostomes (Echinodermata, Cephalochordata, Ascidiacea)

Worsfold, T., Miller, C., Pennisi.,N,. Hall, D., & Pears, S., 2024. NE Atlantic Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB#66. Report to the NMBAQC Scheme participants. APEM Report NMBAQC RTB#66, 47pp, July, 2024.

Particle Size Analysis component

Technical Manager: Claire Mason, Cefas.
Component Administrator: Lydia McIntyre-Brown and David Hall, APEM Ltd.

Summary of activities

The particle size analysis component of the scheme comprises two modules:

1. The PS Ring Test (PS) analysis of four sediment samples circulated to participant.
2. The PS – Own Sample (PS-OS) – submission of three analysed sediment samples from participant.

The PS Ring Test module followed the same format of 2022/23; a series of exercises involved the distribution of test materials to participating laboratories and the centralised examination of returned data and samples.

The PS-OS module, originally introduced in the 2014/15 Scheme year, followed the same logistical format as the previous year. Selected participant samples are re-analysed by the NMBAQC Scheme PSA contractor and the results are compared. The Particle Size Own

Sample module is a training / audit module and the purpose of this module is to examine the accuracy of particle size analysis for participants' in-house samples.

Fifteen laboratories signed up to participate in the 2023/24 PS Ring Test module exercises (PS88, PS89, PS90 and PS91) six were government laboratories and nine were private consultancies. Nine laboratories signed up to participate in the PS-OS module exercises (PS-OS28, PS-OS29 and PS-OS30); four were government laboratories and five were private consultancies.

To reduce potential errors and simplify administration, Lab Codes were assigned with a prefix to determine the Scheme component; all codes for the Particle Size component were prefixed with "PSA_".

As in previous years, some laboratories elected to be involved in limited aspects of the Scheme. Competent monitoring authorities (CMAs) completing PSA in support of biological analysis for monitoring programmes (including in assessment of MPA (Marine Protected Areas), as evidence under MSFD (Marine Strategy Framework Directive) and WFD (Water Framework Directive), as well as the CSEMP (Clean Seas Environmental Monitoring Programme), must participate in this component of the Scheme. The Scheme is aware of other PSA methodologies (*e.g*. those used in the Regional Seabed Monitoring Plan) and encourages those involved in any relevant PSA monitoring programmes to participate in this Scheme, especially where pass/fail criteria can be used to assess overlapping aspects of different methodologies.

Summary of results

Fifteen laboratories subscribed to the Ring Test exercises in 2023/24. For the first circulation (PS88 and PS89) twelve subscribing participants provided results; for the second circulation (PS90 and PS91) nine participants provided results.

Most participating laboratories now provide data in the requested format, although some variations remain. As reported previously, it should be remembered that the results presented may be from a more limited number of analytical laboratories than is immediately apparent since this component of the Scheme is often sub-contracted by participants to one of a limited number of specialist laboratories. Detailed results for each exercise (PS88, PS89, PS90 and PS91) have been reported to the participating laboratories.

Conclusions and recommendations

A number of observations may be made based on the results of the exercises described above. The following is a summary of the major points of importance.

1. Laboratories should ensure that they follow the NMBAQC methodology when participating in the Particle Size (PS) Ring Test. The PS Ring Test is designed to test that all participants are getting comparable results when they follow the same methodology. It is therefore important that **only the NMBAQC methodology** (Mason, 2022) is used where possible and that results for 3 x 3 laser analyses are provided. Participants who do not have access to a laser analyser will be permitted to use alternative methods for samples that

contain sediment less than 1mm as long as the method used is detailed in the summary section of the workbook. Participants can choose to opt out of either the sieve or laser aspects if they do not routinely undertake that type of analysis. The participant must let the administrator know at the start of the scheme year if they wish to opt out of any analysis. Results will only be provided for the analysis that was undertaken and a note will be put on the Statement of Performance that the participant has opted out of certain points.

Samples for the PS-OS module can be analysed following alternative in-house methods. However, these must be thoroughly described and the participant should be aware that re-analysis will be undertaken following the NMBAQC methodology. Samples provided for PS-OS which have been routinely analysed do not necessarily have to provide 3 x 3 laser analysis data but should show that appropriate QC checks have been carried out, including on the final data set.

2. Participants should review their data prior to submission. Errors in datasets can often be spotted in the summary statistics, e.g. percentage gravel, sand and silt/clay, before the data are submitted. All parts of the workbook should be double-checked before submission to ensure that they have been completed correctly. This will help eradicate typing and transcription errors. The workbook was updated for the Scheme Year (Year 28) to help enable the continuity of data through the workbook. Conditional formatting will flag up red cells where there are possible data entry errors.

3. The current NMBAQC Scheme Pass/Fail criteria for the PS modules are under review. Currently results are broken down for review, including, sieve processing, laser and final data. Laboratories then received a "Good" or "Review" flag based on their results; "Review" flags came with accompanying comments as to where mistakes have been made and how to correct them. This approach was thought to be more informative and would help participants to identify errors and correct any issues for future exercises. Following the publication of 'Statistical comparisons of sediment particle size distributions' (Barry *et al*., 2021) in Continental Shelf Research, data from previous and future reports will trial this new statistical method of comparing the benchmark and participant data to understand if we can achieve a pass/fail criteria for the particle size component, with the possibility of a report detailing the outcomes available in the next couple of scheme years.

4. **A Review is not a fail.** Although every attempt is made to ensure that all replicates are as similar as possible there will naturally be some variation, particularly in natural mud samples. A review flag is just to point out that your analysis does differ from that of the Benchmark Lab and other participants. We encourage participants to review their data and, if required, request a new replicate or ask for their replicate to be re-analysed by the Benchmark Lab for a comparison.

5. **A comparison study for different laser manufacturers and models is currently underway.** This study will help to assess the variation between different laser models for different sediment types including muds, sandy muds, muddy sands and sands. Once complete, data and outcomes obtained will be published in the NMBAQC PSA guidance document**.**

Reports

PSA Component Annual Report 2023/2024 (Year 30)

McIntyre-Brown, L. and Pye, K. Particle Size Analysis Component Annual Report Scheme Operation 2023/2024 (Year 30). 34pp, August 2024.

PS88

McIntyre-Brown, L. & Hall, D., 2024. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS88 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps88, June 2024.

PS89

McIntyre-Brown, L. & Hall, D., 2024. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS89 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps89, June 2024.

PS90

McIntyre-Brown, L. & Hall, D., 2024. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS90 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps90, July 2024.

PS91

McIntyre-Brown, L. & Hall, D., 2024. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS91 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps91, July 2024.

Fish component

Technical Manager: Jim Ellis, Cefas.
Component Administrator: Debbie Walsh and David Hall, APEM Ltd.

Summary of activities

This component consisted of two modules, each with a single exercise:

1. Fish Reverse Ring Test (F_RRT) - Re-identification of a set of up to fifteen fish specimens supplied by each of the participating laboratories.
2. Fish Ring Test (F_RT) - Identification of fifteen fish specimens supplied with images.

Scheme year 2023/2024 (Year 30) followed the format of previous years, with a ring test (RT) and a reverse ring test (RRT) being organised. The Fish Component of the Scheme is currently in its nineteenth year (started 2005/06). It involved the distribution of test specimens to participating laboratories and the centralised examination of returned data for the first module (RT), and re-analysis of fish specimens submitted by participants for the second module (RRT). The labelling and distribution procedures employed previously have been maintained. Specific details can be found in the fish reverse ring test protocol and fish ring test protocol (FRRT Protocol and FRT Protocol).

Fifteen laboratories from eight organisations signed up for Scheme year 2023/2024, with a total of 21 participants. Of those, four were government laboratories, two private consultancies and one a University-linked laboratory.

Although some fish are sampled under the Clean Seas Environment Monitoring Programme (CSEMP), the number of target species is relatively few. However, the requirement to monitor fish assemblages in transitional waters for the Water Framework Directive (WFD) provides a major impetus for the Fish Component exercise. As in previous years, some laboratories elected to be involved in either one or both exercises of the scheme.

Summary of results

Fish Reverse Ring Test (F_RRT): Twelve out of thirteen registered participants, from four laboratories, submitted specimens to the Fish Reverse Ring Test (FRRT15). In almost all cases, the identifications made by APEM Ltd. agreed with those made by the participants, with only two taxonomic errors from 169 specimens being recorded. Nine taxonomic discrepancies were recorded, three spelling errors and six instances of junior synonyms being used. One unidentified specimen was submitted, tentatively identified by the submitting laboratory as Syngnathidae, and that was identified as *Syngnathus rostellatus* (Nilsson, 1855) by APEM Ltd.

Fish Ring Test (F_RT): Samples of 15 specimens were distributed (FRT17). Fourteen participants from eight laboratories submitted results for the Fish Ring Test. The results were summarised in the Ring Test Bulletin FRT-17. Out of 210 specimens identified there were seven generic and nine specific differences. Ten out of 15 specimens were identified by all participants correctly. Six participant correctly identified all specimens.

There were relatively few taxonomic errors for the specimens circulated. Ten out of 15 specimens were identified by all participants correctly. Norway pout, *Trisopterus esmarkii* (F-RT1703), seemed to cause the most trouble for participants, with one generic difference being submitted and four specific differences being submitted.

Several specimens were noted by the participants as degraded, reducing the number of possible identifiable features for ID, which could have been the reason for their misidentification. Examples of the specimens in poor condition were poor cod *Trisopterus minutus* and scaldfish *Arnoglossus laterna*, and both were misidentified by some participants. The only specimen that was submitted with an outdated name was highlighted as a mistake due to the use of out-of-date literature used during the identification process.

Issues and recommendations

A number of observations may be made from the results of the exercises described above. The following is a summary of the major points of importance:

1. The latest fish ring tests suffered significant delays, partly due to difficulties sourcing sufficient specimens for distribution. Other potential sources of specimens are being actively investigated to hopefully avoid such problems in the future. No issues were reported with the existing ring test and reverse ring test formats. These will therefore be

continued in the next scheme year. **Participants are encouraged to provide feedback to enable protocols and implementation to be improved where possible.**

2. All participating laboratories submitted data/specimens in accordance with the amended Scheme's timetable. **Participants are encouraged to continue to supply data/specimens according to the exercise deadlines to ensure timely summary reporting.**

3. Some identification differences might be the results of inadequate literature. Participants are encouraged to collate fish identification literature for problematic groups or juvenile specimens and follow the most recent taxonomy. **Participants are encouraged to review the bibliography of taxonomic literature available on the NMBAQC website and give details of additions where possible. Reference to online databases for the validity of scientific names (FishBase, WoRMS and Eschmeyer's Catalog of Fishes) is also recommended.**

4. The maintenance of a comprehensive reference collection has numerous benefits for improving identification ability, maintaining consistency of identification between surveys and access to growth series material. The FRRT exercise can be used as a means of verifying reference specimens. Laboratories are strongly recommended to **implement and expand in-house reference collections of fish; these should include images alongside physical specimens**. The inclusion of early-stage juvenile specimens in reference collections is also useful, especially for certain groups (*e.g.* clupeids). Ideally, **all surveys should include a photographic reference of all species encountered as a minimum.**

5. Laboratories participating in the ring test exercises should attempt to **identify all specimens to species and complete the 'confidence level' section of their ring test datasheet** to enable additional information to be gathered regarding the difficulty of ring test specimens.

6. The *Gadiformes* accounted for nine of the taxonomic differences in the FRT. *Callionymidae* were also flagged as being a problematic family across both modules. Future Fish Ring Test exercises are expected to target taxa that were highlighted as potentially problematic in previous exercises. Participants are encouraged to provide feedback on problem taxa that could be included in future exercise and are invited to submit specimens for use in future exercises (approximately 20 specimens of similar size and condition).

7. The distribution of fresh frozen specimens was for the most part successful. Following feedback from previous exercises, fish were placed in individual bags and packed so the larger fish do not damage specimens in transit.

8. One of the laboratories submitted multiple data sets for the Fish Ring Test. **Participants are encouraged to submit multiple data sets for sub-teams and individual analysts where possible, to improve the training aspect of the exercise.**

9. APEM Ltd. always strives to ensure smooth running and **transparency of the Scheme**. APEM Ltd. log and make available all correspondence to the Fish Component Technical Manager (Jim Ellis, CEFAS). Participants can be assured that their anonymity will be protected if this correspondence is required to be shared with the Committee.

Reports

Fish Component Annual Report 2023/2024 (Year 30)

Nightingale, C. and Hall, D., 2025. Fish component - Report from the contractor. Scheme Operation - 2023/2024 (Year 30). A report to the NMBAQC Scheme coordinating committee. 9pp, March 2025.

FRT 17 – March 2024

Nightingale,C., and Walsh, D., 2024. NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: FRT#17. Report to the NMBAQC Scheme participants. APEM Report NMBAQC FRTB#17, 22pp, March 2024.

FRRT 15 - March 2025

Nightingale, C., and Walsh D. 2025. NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test Bulletin: FRRT15. Report to the NMBAQC Scheme participants. APEM Report NMBAQC FRRT15, 26pp, March 2025.

Phytoplankton component

Technical Manager: Rafael Salas, Observatorio Canario de Algas Nocivas (OCHABs)

Summary of activities

The phytoplankton component is administered from the Canary Islands Harmful Algal Bloom Observatory (OCHAB), University of Las Palmas de Gran Canaria, Spain in collaboration with the IOC Science and Communication Centre on Harmful Algae, Denmark (and in association with the NMBAQC, UK). Previously, this component undertook intercomparison exercises under the BEQUALM banner. However, as the BEQUALM programme closed in 2014, these exercises were renamed in 2016 as IPI (International Phytoplankton Intercomparison).

In 2023, 79 analysts across 43 laboratories around the world participated in the IPI exercise. European countries accounted for 66% of the total participation, 5% came from South America, 10% from African countries, 6% from Oceania and13% from Asia.

Summary of results

Nine species were used in total. There were four dinoflagellates and five diatoms in the samples distributed in a batch system. The robust average and standard deviation for each measurands was calculated using the Q/Hampel method in ProLab Plus statistical software. The expanded standard deviation was input manually into the programme to take into consideration the heterogeneity of the samples.

Six analysts were unsuccessful at the overall test from 75 returned results. There were a very small number of warning and action signals across measurands for the quantification results. In 2023, most analysts passed the qualitative test except for one analyst (181) with 2 incorrect and one non-detected flag. 53 analysts identified correctly all measurands (8). 13 analysts identified incorrectly 1 measurand and 3 analysts 2 measurands.

There were 73 attempts at the OTGA (OceanTeacher) assessment with the overall median grade 90.3%. 60.8% of analysts performed above the proficiency threshold of 90% and 27.0% of all analysts between 80-90%. 5.4% were above 70% and another 5.4% below 70%, requiring improvement.

For further information please find the full IPI 2023 report here. Details of the 2024 IPI exercise will be provided under the 2024/2025 NMBAQC Annual Report.

Macroalgae component

Technical Manager: Gillian Annett, DAERA-NI.
Component Administrator: Georgina Brackenreed-Johnston, APEM Ltd.

This is the eighteenth year of the Macroalgae Component.

Summary of activities

The format for 2023 - 24 followed that of the previous year.
The component consisted of two modules:

1**. Opportunistic Macroalgae Biomass Ring Test (OMB - RT)**: - synthetic samples of different weights for washing and drying to both wet and dry weights.
2. **Opportunistic Macroalgae/Seagrass Cover Ring Test (OMC - RT)**: - estimation of percentage cover of opportunistic macroalgae and seagrass based on photographs of field quadrats.

The analytical procedures of both modules were the same as for the previous year of the Scheme. There were eight laboratories participating in the OMB-RT and eleven laboratories in the OMC-RT.

Summary of results

Biomass of macroalgae (OMB-RT15)

This is the fifteenth year in which biomass of macroalgae has been included as a module of the NMBAQC scheme and was included as a single exercise. The format followed that established by Wells Marine during the previous years of the module (OMB RT01 – RT12 - see NMBAQC website). Test material was distributed to participating laboratories along with data forms, which were completed with algal biomass results and returned for analysis.

Eight laboratories were issued with test material, of which six laboratories completed the macroalgae biomass module of the NMBAQC scheme. All participants returned both wet and

dry weight data. All of the participating laboratories were government; no other organisations took part in this module of the macroalgae component.

As with previous years, results for wet weight of biomass varied between laboratories with some laboratories producing very different measures of biomass when compared against the average biomass and actual/expected biomass. The level of accuracy remains greater for measurement of dry weight than of wet weight, although in RT15 each of the samples had a single dry weight outlier that was noticeably higher than the other five results.

Most of the results for both the dry and wet weights when compared against either mean values or expected/actual weights could be considered acceptable with only three results flagged as 'fails' based on resulting z-scores. However, with the low sample size of only six laboratories, high standard deviation values can greatly reduce the chances of a z-score exceeding the +/- 2 cutoff value. The three 'fails' represented extreme outliers and were each 2-3 times higher than the expected/actual weights and the results of other participants, suggesting that the instructions were not adhered to for these samples. In each case the results for other samples from the same laboratory did not show the same extreme values, which suggests that there may be differences in methodologies being followed by different individuals processing different samples.

This year has been the second to use mixtures of different materials for two of the samples, following six consecutive years in which each sample consisted of a different artificial material. This approach was well received by participants as being more representative of the mixtures of different algal types that are often found on the shore, although one respondent indicated that their laboratory mostly processed single types of algae in their samples. Based on this feedback samples containing mixtures of different materials will continue to be used in future tests, but at least one of the three samples will still use only a single material type.

Cover of macroalgae & seagrass (OMC-RT15)

This is the fifteenth year in which percentage cover estimations of macroalgae have been included as an element of the NMBAQC scheme and the thirteenth year for which seagrass has been assessed as a separate exercise. This module included one exercise for macroalgae and one for seagrass, both of which were split into three additional tests based on methodology. The format followed that established by Wells Marine during the previous years of the module (OMC - RT03 – RT12).

Eleven laboratories were issued test material. Nine laboratories completed the percentage cover macroalgae/seagrass module with a total of 33 participants. Of those laboratories submitting results, all but one were government organisations.

Results for percentage cover of both opportunist macroalgae and seagrass varied between participants and between the different methods used. Several results deviated from the sample mean and from the % cover as calculated by image analysis. Deviation from the latter was more noticeable and this has also been reported in previous years. There was a considerable lack of consistency between the three methods in terms of the degree of

continuity between participants as well as how the data compared with the image analysis % cover. The range of results provided was higher this year than the previous year but was still consistent with results observed in earlier years of the percentage cover exercises.

For both the macroalgae and seagrass tests, method C was the most popular. In theory test method C should provide the least subjective method of estimation, as counting the number of crosshairs under which macroalgae or seagrass lay should be a relatively straight forward method. However, there is still a large disparity in results, often much higher than for the other test methods that may suggest the method is either not being used consistently between participants or that the use of an overlaid grid may obscure the photograph and make it more difficult to confirm whether there is algae/seagrass beneath. One of the participating laboratories observed that they found this method highly subjective between individuals and tended towards higher estimations of percentage cover than the open quadrat method.

The number of 'Fails' between test methods and comparison against mean or image analysis varied considerably with no apparent trend. The macroalgae results showed that for comparisons against the mean the number of fails was consistent for all three methodologies, whereas for the comparisons against ImageJ results, the number of fails was lowest for Test A and highest for Test C. The seagrass results had the lowest numbers of 'fails' for Test B and highest number for Tests A and C for comparisons against the mean and the highest number of fails for Test C and the lowest number of 'fails' for Test A for comparisons against the ImageJ results. The tests continue to produce a broad range of results thereby increasing the standard deviation, this results in the Z-scores being unable to pick up slight deviations from mean or ImageJ analysis percentage cover.

Reports

OMB RT15 Final Report 2024

Pears, S. & Brackenreed-Johnston, G. 2024. National Marine Biological Analytical Quality Control Scheme. Macroalgae Biomass Component Report Ring Test OMB RT15 2024. Report to the NMBAQC Scheme participants. Apem Report NMBAQCmaomb15, 12pp, May 2024.

OMC RT15 Final Report 2024

Pears, S. & Brackenreed-Johnston, G. 2024. National Marine Biological Analytical Quality Control Scheme. Macroalgae/Angiosperm Percentage Cover Component Report Ring Test OMC RT15 2024. Report to the NMBAQC Scheme participants. Apem Report NMBAQCmaomc15, 18pp, May 2024.

Epibiota component

Technical Manager: Kate Wade, JNCC.

Summary of activities

External quality assurance processes

JNCC, Cefas and Marine Scotland Science continued to include external quality assurance processes for further quality assuring results of imagery analyses undertaken in-house and sub-contracted for offshore Marine Protected Area monitoring. These include a full reanalysis of a subset of 10% of the imagery data by an independent analyst, a subsequent comparison of the two analyses to check for differences and remediation where necessary before the imagery analysis is deemed complete. The processes run alongside internal quality assurance checks undertaken by the primary analysts. The protocols are set out in each project specification with a summary of the protocol followed and results/remedial action undertaken captured in each project report. Costs relating to these external quality assurance processes are absorbed into the imagery analysis costs of each project on a per project basis.

The Big Picture Project

The work of the Big Picture Group continues to be coordinated by JNCC. Work initiated and contracted by JNCC in FY23/24 to test the UK Morphotaxa Classification System (UKMCS) and create reference collections for Echinoderms and Crustaceans was finalised this year. The quality assured reference collection consisting of 284 reference images of Echinoderms and 230 reference images of Crustaceans are awaiting upload to the Standardised Marine Taxon Reference Image Database (SMarTar-ID) which has been refreshed this year.

FY24/25 saw a change in coordinator with Kate Wade taking over from James Albrecht. Steering group meetings have been held throughout the year. A lack of resources and high pressure on members, including Project Working Group (PWG) leads has led to challenges in finding time for many of the PWGs to meet. Despite this, projects funded through other sources, such as DEFRA's marine Natural Capital and Ecosystem Assessment programme, have enabled work under the UK Benthic Imagery Action Plan to be progressed, with members of PWGs meeting through this alternative forum. Notable work aimed to 1) pilot AUV data collection for statutory monitoring, 2) create a demonstrator of an image broker service for participating organisations to unify their individual repositories of marine imagery and annotations into a federated database and 3) explore how artificial intelligence can improve and assist in analysing underwater imagery, through the creation of a model trained to detect different benthic taxa groups. Outputs and reports from these projects are awaiting review by Defra and will be published in FY25/26.

JNCC initiated work to update the existing NMBAQC Epibiota Operational and Interpretation Guidelines. These documents, published in 2015 and 2016, provide a summary of best practice for the acquisition and interpretation of video and stills imaging of benthic substrata and epibenthic species to ensure that data collected are fit for purpose in relation to the needs and requirements of a survey. A working group, formed following an expression of interest call to all members, reviewed both documents and established that substantial updates were needed to reflect significant advancements in the field. A decision to move to a rolling update model for the guidelines was agreed. This will enable a more flexible approach to updating the documents, with individual sections able to be updated more frequently, ensuring that

the guidance reflects the most current knowledge. Work to update these documents has begun with plans to publish updated versions of both documents in FY25/26.

For more information on any projects, please contact thebigpicture@jncc.gov.uk.

JNCC have applied for funding for FY25/26 through the Defra R&D programme to support the work of The Big Picture Group and progress actions under the Benthic Imagery Action Plan Tracker (BIAPT). We are awaiting to hear if the bid is successful. Priorities identified for FY25/26 include continuation of NMBAQC epibiota guidelines update work, a gap analysis of training resources and how to fill these, continued development of quality assured reference collections.

Zooplankton component

As this ring test is undertaken every other year, the most recent programme was previously covered in the last annual report. The next NMABQC Annual Report covering 2024_2025 will include this year's forthcoming ring test.

Appendix 1 - NMBAQC Co-ordinating Committee – 2023/2024

Name	Organisation	Position /Role
David Johns	The Marine Biological Association (MBA)	Chair
Graham Phillips	Environment Agency (EA)	Finance Manager and CMA representative
Kate Wade	Joint Nature Conservation Committee (JNCC)	Epibiota Technical Manager
Jim Ellis	Centre for Environment, Fisheries & Aquaculture Science (Cefas)	Fish Technical Manager
Claire Mason	Cefas	PSA Technical Manager
Myles O'Reilly	Scottish Environment Protection Agency (SEPA)	Benthic Invertebrate Technical Manager and CMA representative
Rafael Salas	Observatorio Canario de algas nocivas	Phytoplankton Technical Manager
Marianne Wootton (departed)	The Marine Biological Association (MBA)	Zooplankton Technical Manager
Gillian Annett	Department of Agriculture, Environment and Rural Affairs, Northern Ireland (DAERA)	Macroalgae Technical Manager
Vera Fonseca	Cefas	eDNA Technical Manager – component under development
Tim Mackie	Department of Agriculture, Environment and Rural Affairs, Northern Ireland (DAERA)	CMA Representative
Ross Griffin	Ocean Ecology Ltd	Contractors' Representative
David Hall	APEM Ltd	Component Administrator for Benthic Invertebrate, Fish and PSA
Paul McIlwaine	Cefas	CMA Representative

Lydia McIntyre Brown	APEM Ltd	Component Administrator for PSA
Debbie Walsh	APEM Ltd	Component Administrator for Fish
Matthew Green	Natural Resources Wales (NRW)	CMA Representative
Adele Boyd/Alex Callaway	Agri-Food Biosciences Institute, Northern Ireland (AFBI)	CMA Representatives
Claire Taylor	The Marine Biological Association (MBA)	Technical Secretary

Appendix 2 - NMBAQC Scheme – Component Participation for 2023/2024

(Participants from UK unless otherwise stated)

Benthic Invertebrate Component 2023-2024 Participants:

	Ring Test (RT) Module (intercalibration / training)	Laboratory Reference (LR) Module (intercalibration / training)	Own Sample (OS) Module (audit)
Agri Food Biosciences Institute (AFBI) NI	-	-	✓
APEM	Administrator	Administrator	Administrator
Benthic Solutions Limited	-	-	✓
Biofar, Faroes	✓	✓	-
Biotikos Limited	-	-	✓
Cefas Lowestoft Benthic Laboratory	✓	-	-
DAERA Environment, Fisheries and Marine Group Laboratory	✓	✓	✓
Eco Marine Consultants Ltd	-	-	✓
Ecospan Environmental Ltd	✓	✓	✓
Environment Agency, Kingfisher House	-	-	✓(x6)
Eurofins Omegam BV	✓	-	-
Fishlab, Denmark	✓	-	-

Fugro GB Marine Limited (Edinburgh)	✓	-	✓
Fugro GB Marine Limited (Gt. Yarmouth)	✓	-	-
Fugro GB Marine Limited (Portsmouth)	✓	-	✓
HEBOG Environmental Limited	✓	-	✓
Hull Marine Laboratory	✓	-	✓
Institute for Applied Ecosystem Research (IfAÖ)	✓	-	-
ILVO (Institute for Agricultural and Fisheries Research) -	✓	✓	✓
Marine Invertebrate Ecological Services	-	-	✓
Marinescope Taxonomy Ltd	✓	-	-
MBM Benthic Identification Services (The Lab Shed)	✓	-	-
Ocean Ecology	✓	-	✓
Pharmaq Analytic Limited (formerly Fish Vet Group)	✓	-	✓
Precision Marine Survey Ltd	✓	-	-
Rijkswaterstaat CIV	✓	✓	-
Scottish Environment Protection Agency	✓	✓	✓
Shalla Benthic Identification Services	✓	-	-
Thomson Ecology Ltd	-	-	✓
WMR (Wageningen Marine Research)	✓	✓	-

Particle Size Analysis Component 2023-2024 Participants:

Organisation	Particle Size (PS) Module (intercalibration/training)	Particle Size (PS-OS) Module (audit)
ABPmer		√
AFBI	√	
APEM Ltd.	Administrator	Administrator
Benthic Solutions	√	
Biotikos Limited		√
Cefas	√	√
DAERA Environment, Fisheries & Marine Group	√	√
Environment Agency (Monitoring Labs)	√	√

Fugro GB Marine Ltd	√	√
Hull Marine Laboratory, University of Hull	√	√
ILVO	√	
Kenneth Pye Associates	√	√
Marine Directorate	√	
Natural Resources Wales	√	√
Ocean Ecology Ltd.	√	√
Precision Marine Survey ltd	√	
Rijkswaterstaat	√	
RPS Environmental Management Ltd	√	
Scottish Environment Protection Agency	√	√
Thomson Environmental Consultants	√	

Fish Component 2023-2024 Participants:

Organisation	Fish - Reverse Ring Test	Fish - Ring Test	Country
Agri Food Biosciences Institute (AFBI) NI	1	1	UK
CIBM "G.Bacci"	1	0	Italy
Environment Agency	10	8	UK
Fugro GB Marine Ltd.	0	1	UK
Hull Marine Laboratory (University of Hull)	0	1	UK
Northern Ireland Environment Agency	1	1	UK
Ocean Ecology Ltd.	0	1	UK
The Marine Biological Association of the UK	0	1	UK

Phytoplankton Component 2023-2024 Participants:

Organisation	Country
Agri Food Biosciences Institute (AFBI) NI	UK
Agencia de Gestión Agraria y Pesquera	Spain
Aristotle University of Thessaloniki	Greece
ARPAE: Regional Agency for Prevention, Environment and Energy in Emilia-Romagna, Technical Directorate and Hydro-Meteo-Climate Service	Italy
ARPA FVG: Agenzia Regionale per la Protezione dell'Ambiente del Friuli Venezia Giulia)	Italy
ARPAL: Agenzia Regionale per la Protezione Dell'Ambiente Ligure	Italy
ARPALAZIO: Agenzia Regionale Protezione Ambientale Del Lazio	Italy
ARPAM: Agenzia Per La Protezione Ambientale Delle Marche	Italy
ARPA Puglia: Agenzia Regionale per la Prevenzione e la Protezione dell'Ambiente	Italy
AWI: Alfred Wegener Institute	Germany
Bureau Veritas	Belgium

Bureau Waardenburg	Netherlands
CEFAS: Centre for Environment, Fisheries and Aquaculture Science	UK
Centro Ricerche Marine	Italy
Cerper: Certificaciones del Peru	Peru
Core Laboratories	USA
Dalcon Environmental	Australia
Department of the Environment	UK
Environmental Protection Agency	USA
FITOTAX	Spain
IFREMER: French national institute for ocean science and technology	France
Institute of Oceanology, Chinese Academy of Science	China
INRH: Institut National de Recherche Halieutique	Morocco
Institute of Marine Research	Norway
Instituto de Formento Pesquero	Chile
INSTM: Institut National Des Sciences Et Technologies De La Mer	France
Institut Za Biologiju Mora	Serbia
IRTA: Institute of Agrifood Research and Technology	Spain
Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe)	Italy
Jinan University	China
Marine Institute	Ireland
MEDINS	Sweden
Microalgal Services	Australia
Ministry of Ocean Economy & Fisheries	Mauritius
National Institute of Biology	Slovenia
NIVA: Norwegian Institute for Water Research	Norway
Orbicon/WSP: Global Wetland Technology	The Netherlands
Phytobs	France
Plankton Andino	Chile
POS3IDON	France
SAMS: Scottish Association for Marine Science	Scotland
SANIPES: National Authority for Health and Safety in Fisheries and Aquaculture	Spain
SASQAP: SA Shellfish Quality Assurance Program	Australia
Scottish Government	UK
SMHI: Swedish Metereologicaland Hydrological Institute	Sweden
Stazione Zoologica Anton Dohrn	Italy
Sydney Water	Australia
TechnologicaL Institute for the Control of the Marine Environment of Galicia	Spain
Tasmanian Government	Australia
The Marine Biological Association	UK
UACH Sede Puerto Monti	Chile

UMR Marbec	France
Wageningen University & Research	The Netherlands

Macroalgae Component 2023-2024 Participants:

Organisation	Opportunistic macroalgae cover ring test (OMC-RT)	Opportunistic macroalgae biomass ring test (OMB-RT)	Country
Abrehart Ecology	1	-	UK
DAERA Environment, Fisheries and Marine Group Laboratory	1	1	UK
Environment Agency	9	7	UK