NE ATLANTIC MARINE BIOLOGICAL ANALYTICAL QUALITY CONTROL SCHEME

Annual Report 2022/2023

A report prepared by the NMBAQC Scheme Coordinating Committee
February 2024

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This Annual Report provides synopsis of the scheme year's activities over 2022/2023, the 29th 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 five meetings during the 2022-2023 reporting period. This was on the 28th July 2022, 23rd November 2022, 18th April 2023, 26th July 2023 and 10th November 2023. 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 2022/2023 is shown in Appendix 1.

1 Scheme Review

The scope of the NMBAQC scheme continued to develop in 2022/2023 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 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 Comparison (IPI) exercise on a yearly basis.

The 2022-2023 participation level in the NMBAQC scheme showed similar numbers to the previous period, returning to numbers at pre-Covid levels (See Appendix 2).

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

2 Invertebrate component

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

2.1 Summary of activities

Scheme year 2022/ 2023 (year 29) followed the format of previous year 2021 / 2022. A series of components, 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 Scheme annual reports.

Fifty-one laboratories (with multiple participants from some organizations counted separately) participated in the Benthic Invertebrate Component of the NMBAQC Scheme in 2022 / 2023 (year 29). Nineteen 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; seventeen were UK private consultancies. Fifteen of the participants were non-UK laboratories (including eight government organizations and seven private consultancies); five institutions from three countries responsible for collective monitoring of the Black Sea region joined the scheme under a BRIDGE-BS consortium (https://bridgeblacksea.org/). 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 should at least participate in any relevant own sample audit modules.

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 2021 / 2022 (year 28) of the Scheme.

2.2 Summary of results

Two **Ring Tests (RT)**, each of 25 specimens, were distributed (RT63 and RT64). The second (RT64) was targeted on Peracarida. The methods and policies used in the module followed the Ring Test Protocol (Worsfold & Hall, 2017a).

For RT63, the average numbers of differences per participating laboratory (for a total of 23 laboratories with 21 submissions) were 2.4 generic differences and 4.8 specific differences. Four species (two polychaetes, a nudibranch and a hydrozoan) were responsible for just over half (51%) of the specific differences.

For RT64, the average numbers of differences per participating laboratory (for a total of 23 participants with 21 submissions) were 1.9 generic differences and 3.2 specific differences. Four specimens were responsible for just under 40% of the specific differences.

Laboratory Reference (LR): Six laboratories signed up for the LR27 module and four laboratories submitted specimens for confirmation. Most misidentifications were for Annelida (45%), followed by Arthropoda (29%). 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 OS80-82, extraction efficiency (of individuals) was better than 90% in 90% of the comparisons and better than 95% in 80% of all comparisons. 100% of countable taxa were extracted from the sample residues in 69% 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 73% of comparisons; in 85% of cases, the value of the index was greater than 90% and, therefore, achieved 'Pass' flags. Nineteen samples (18%) achieved 'Pass- Excellent' flags with Bray-Curtis similarity scores of 100%.

2.3 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 co-ordinated.

4. 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.

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.

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. Two of the seventeen 'failing' Own Samples in Scheme Year 2022 / 2023 (Year 29) have already been rectified via the recommended remedial action. Twelve failing samples resulted in optional 'review' remedial actions and these actions are deemed to have been completed. Three samples remain with pending remedial actions (one is a CMA sample). This year there has been an increase in the number of failed samples, along with a decrease in the average BCSI% score. However, the quality of sample processing observed this year remains in line with the general performance over recent scheme years, as the 'dip' is the result of a number of new participants joining the scheme. 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 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.

2.4 Reports

Benthic Invertebrate Component Annual Report, 2022/2023 (Year 29)

Worsfold, T.M., Hall, D.J., and O'Reilly, M. (Ed.), 2024. Benthic Invertebrate Component Annual Report. Scheme Operation 2022/2023 (Year 29). A report from the contractor to the NMBAQC Scheme co-ordinating committee. 30pp, January 2024.

Own Sample Module Summary Report OS 80,81,82 – December 2023

Hall, D.J. 2023. NE Atlantic Marine Biological Analytical Quality Control Scheme. Own Sample Module Summary Report OS80, 81 & 82. Report to the NMBAQC Scheme participants. 17pp, December 2023.

Laboratory Reference Module Summary Report LR27 – July 2023

Worsfold, T.M & Hall, D.J, 2023. NE Atlantic Marine Biological Analytical Quality Control Scheme. Laboratory Reference Module Summary Report LR27. Report to the NMBAQC Scheme participants. 9 pp, July 2023.

RTB64 - May 2023 (Targeted Peracarida excluding amphipods)

Worsfold, T., Hall, D., & Pears, S., 2023. NE Atlantic Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB#64. Report to the NMBAQC Scheme participants. APEM Report NMBAQC RTB#64, 33pp, May, 2023.

RTB63 – January 2023 (General/Mixed taxa)

Worsfold, T., Hall, D., & Pears, S., 2023. NE Atlantic Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB#63. Report to the NMBAQC Scheme participants. APEM Report NMBAQC RTB#63, 40pp, Jan, 2023.

3 Particle Size Analysis component

Technical Manager: Claire Mason, Cefas.

Component Administrator: Lydia McIntyre-Brown and David Hall, APEM Ltd.

3.1 Summary of activities

The particle size component of the scheme comprises of 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 module followed the same format of 2021/22; 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, 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.

Seventeen laboratories signed up to participate in the 2022/23 PS module exercises (PS84, PS85, PS86 and PS87) seven were government laboratories and ten were private consultancies. Eleven laboratories signed up to participate in the PS-OS module exercises (PS-OS25, PS-OS26 and PS-OS27); six were government laboratories and five were private consultancies. One government laboratory had seven Lab Codes to submit twenty-one PS-OS samples for AQC analysis.

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.

3.2 Summary of results

Seventeen laboratories subscribed to the exercises in 2022/23. For the first circulation (PS84 and PS85) thirteen subscribing participants provided results; for the second circulation (PS86 and PS87) eleven 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 (PS84, PS85, PS86 and PS87) have been reported to the participating laboratories.

3.3 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 alternate 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 is humanly possibly 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 two-day workshop was held at Cefas’ Lowestoft laboratory in March 2023.** The first day was a practical session in the lab; a team from Meritics demonstrated the new Bettersizer laser analyser which has the capability to capture particle shape. Whilst staff from Cefas’ sediment lab demonstrated an overview of methodology including sub-sampling and sample handling including mitigations for low levels of asbestos in samples. The second day was a series of presentations; Lydia McIntyre-Brown (APEM) gave an update on the NMBAQC Scheme, David Van Avermate (ILVO) looked at defining pass/fail criteria from ring test data for accreditation purposes, Claire Mason (Cefas) looked at the inclusion of cobbles in particle size data, Clement Garcia looked at the Marine Natural Capital Programme and its relevance to PS methodology, Keith Cooper looked at the One Benthic project and Ken Pye and Simon Blott (KPAL) gave reflections on the NMBAQC PSA Scheme thus far.

6. **Health and Safety.** Recently **the presence of asbestos in marine samples** has been brought to light. Although safe when the sample is wet, asbestos particles could become air-borne when analysing a particle size sample particularly during the dry sieving process. At the PSA workshop in December 2017, laboratories were informed how to mitigate the hazards associated with analysing samples that may contain asbestos. All the natural material used to create PS ring test samples continues to be sent for presence/absence of asbestos before being distributed to participating laboratories. This will continue for subsequent years and participants can request to see the results of the tests by emailing nmbaqc@apem.co.uk

3.4 Reports

PSA Component Annual Report 2022/2023 (Year 29)

McIntyre-Brown, L. and Pye, K. Particle Size Analysis Component Annual Report Scheme Operation 2022/2023 (Year 29). 36pp, September 2023.

PS84

McIntyre-Brown, L. & Hall, D., 2023. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS84 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps84, April 2023.

PS85

McIntyre-Brown, L. & Hall, D., 2023. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS85 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps85, April 2023.

PS86

McIntyre-Brown, L. & Hall, D., 2023. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS86 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps86, September 2023.

PS87

McIntyre-Brown, L. & Hall, D., 2023. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS87 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps87, September 2023.

4 Fish component

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

4.1 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 2022/2023 (Year 29) followed the format of year 2021, with a ring test (RT) and a reverse ring test (RRT) being organised. The Fish Component of the Scheme is currently in its eighteenth year (start 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).

Thirteen laboratories from seven organisations signed up for Scheme year 2022/2023, with a total of 16 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.

4.2 Summary of results

Fish Reverse Ring Test (F_RRT): Six out of eight registered participants, from three laboratories, submitted specimens to the Fish Reverse Ring Test (FRRT14). One problematic specimen was submitted. In almost all cases, the identifications made by APEM Ltd. agreed with those made by the participants, with only three taxonomic errors from 89 specimens being recorded. Seven taxonomic discrepancies were recorded, which were mostly either spelling errors and one instance of obsolete synonym being used. One unidentified specimen was submitted, tentatively identified by the submitting laboratory as possibly being a juvenile herring (*Clupea harengus*), however the specimen was too damaged for a positive visual identification to be made.

Fish Ring Test (F_RT): Samples of 15 specimens were distributed (FRT 16). Twelve participants from six laboratories submitted results for the Fish Ring Test. The results were summarised in the Ring Test Bulletin FRT-16. Out of 175 specimens identified there were twenty-three generic and twenty-nine specific differences. Nine out of 15 specimens were identified by all participants correctly. Only one participant correctly identified all specimens

The juvenile flounder, *Platichthys flesus* seemed to cause the most trouble for participants, with one laboratory leaving the identification at order level, two laboratories at family level and four not attempting identification of the specimen at all. The clupeid *Sardina pilchardus* proved to be the second most problematic, with six incorrect identifications. Five participants indicated that the specimen provided for this latter species was damaged or not in good condition. Four of these participants were from a single laboratory that had multiple submissions, it may be the case that specimens were thawed, handled and refrozen multiple times leading to poor condition. Identification of specimen 04 was contested and following re-examination of the batch of specimens it appears a mixture of species were distributed in error. Therefore, none of the results for this specimen were considered taxonomic errors.

4.3 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. Despite being raised as a problematic group in the past, clupeids continued to be a group with a high number of differences recorded. Three species of flatfish (*Pleuronectiformes*) accounted for sixteen of the taxonomic differences in the FRT. Future Fish Ring test modules are expected to target taxa that were highlighted as

potentially problematic in previous modules. Participants are encouraged to provide feedback on problem taxa that could be included in future modules and are invited to submit specimens for use in future modules (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 analyst 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 Contract 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.

4.4 Reports

Fish Component Annual Report 2022/2023 (Year 29)
Pears, S. and Hall, D., 2024. Fish component - Report from the contractor. Scheme Operation - 2022/2023 (Year 29). A report to the NMBAQC Scheme coordinating committee. 9pp, July 2024.

FRT 16 – July 2024
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5 Phytoplankton component

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

5.1 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 2022, 84 analysts across 45 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.

5.2 Summary of results

Eight species were used in total. There were three 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.

Four analysts were unsuccessful at the overall test from 77 returned results: four analysts failed the quantitation of at least 3 or 4 items which requires training and improvement for the next round. Fifty-eight analysts had all the measurands (8) within the tolerance limits, eleven analysts had one failed measurand and four analysts, two. All analysts passed the qualitative test. Fifty-one analysts identified correctly all measurands. Twelve analysts identified incorrectly one measurand and four analysts, two measurands. Six analysts had a non-detection and one incorrect identification; three analysts had one non-detection each and one analyst had two non-detections.

There were 83 attempts at the OTGA (OceanTeacher) assessment with the overall median grade 92.6%. 73.5% of analysts performed above the proficiency threshold of 90% and 18.1% of all analysts between 80-90%. 7.2% were above 70% and another 1.2% below 70%, requiring improvement.

For further information please find the full IPI 2022 report here. Details of the 2023 IPI exercise will be provided under the 2023/2024 NMBAQC Annual Report.

6 Macroalgae component

Technical Manager: Claire Young, DAERA-NI.
Component Administrator: Georgina Brackenreed-Johnston, APEM Ltd.

This is the seventeenth year of the Macroalgae Component.

6.1 Summary of activities

The format for 2022 - 23 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 all modules were the same as for the previous year of the Scheme. There were nine laboratories participating in the OMB-RT and eight laboratories in the OMC-RT.

6.2 Summary of results

Biomass of macroalgae (OMB-RT14)

This is the fourteenth 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.

Eleven laboratories were issued with test material, of which seven laboratories completed the macroalgae biomass module of the NMBAQC scheme. Six returned both wet and dry weight data and the seventh returned wet weight data only. All of the participating laboratories were government; no other organisations took part in this component of the macroalgae exercises.

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, particularly for the wool material sample (sample B). The dry weights also showed a high degree of variability between laboratories. Most laboratories remained within the Z-score limit of +/- 2.0 for both the dry weight and wet weight against the mean, however one laboratory with particularly high wet weights was flagged with a 'fail' for all three samples and another laboratory with the highest dry weight scores was flagged with a 'fail' for samples B and C.

Comparing wet and dry weights using z-scores calculated from the expected wet weight and actual dry weight is less accommodating and more sensitive to slight deviations in results than comparisons against the mean. However, for RT14, the z-scores derived from the expected wet weights and actual dry weights only resulted in one additional 'fail' compared to the z-scores calculated from the mean.

Cover of macroalgae & seagrass (OMC-RT14)

This is the fourteenth year in which percentage cover estimations of macroalgae have been included as an element of the NMBAQC scheme and the twelfth 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 (RT03 – RT13).

Eleven laboratories were issued test material. Eight laboratories completed the percentage cover macroalgae/seagrass module with a total of twenty-five participants. Of those laboratories submitting results, all eight 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. For the macroalgae test, methods A and C were equally popular, whilst for seagrass method A was the most popular and method C least popular. The number of 'Fails' between test methods and comparison against mean or image analysis varied considerable with no apparent trend. The overall number of 'Fails' was similar for macroalgae and seagrass particularly when compared against ImageJ. 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.

6.3 Reports

OMB RT14 Final Report 2023
Pears, S., and Brackenreed-Johnston, G.2023. National Marine Biological Analytical Quality Control Scheme. Macroalgae Biomass Component Report Ring Test OMB RT14 2023. Report to the NMBAQC Scheme participants. Apem Report NMBAQCmaomb14, 10pp, April 2023.

OMC RT14 Final Report 2023
Pears, S., and Brackenreed-Johnston, G. 2023. National Marine Biological Analytical Quality Control Scheme. Macroalgae/Angiosperm Percentage Cover Component Report Ring Test OMC RT14 2023. Report to the NMBAQC Scheme participants. Apem Report NMBAQCmaomc14, 15pp, April 2023.

7 Epibiota component

Technical Manager: James Albrecht, JNCC.

7.1 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.

The Big Picture Project

Big Picture Project Working Group (PWG) meetings have been running throughout this financial year (contact TheBigPicture@jncc.gov.uk for more information).

JNCC has run a contract to quality assure our in-house reference collections. This will be done in batches based on broad taxonomic groups. In FY23/24 the focus will be on Echinoderms and Crustaceans. 284 reference images of Echinoderms and 230 reference images of Crustaceans have been reviewed to ensure that they have been identified to suitable taxonomic level. The plan is to have these quality assured reference images uploaded to the Standardised Marine Taxon Reference Image Database (SMarTar-ID)[1] early in FY24/25.

The quality assurance contract was also used as an opportunity to test the Echinoderm and Crustacean sections of the draft UK Morphotaxa Classification System (UKMCS), with the outcome and any recommended changes to be explained in an analysis report.

A review of quantification techniques has been completed this financial year. Based on a literature review, this report summarises commonly employed quantification techniques used to analyse still imagery. For each of the quantification techniques, a clear definition, with both the advantages and disadvantages provides a useful comparison between techniques and when they may be appropriate to use. Davies and Dissanayake (in press) will be published on the JNCC website and linked to from the NMBAQC literature and taxonomic keys web page[2].

8 Zooplankton component

Technical Manager: Marianne Wootton, CPR Survey, Marine Biological Association.

This is the fourth official NMBAQC scheme zooplankton component ring-test, with the test occurring biennially. In December 2022, the Continuous Plankton Recorder (CPR) Survey, with the Marine Biological Association (MBA), on behalf of the NMBAQC scheme, sent out a call of interest for the fourth official zooplankton ring-test, to organisations and individuals known to be involved in zooplankton research and monitoring.

[1] SMarTaR-ID https://smartar-id.app/

[2] NMBAQC literature and taxonomic keys web page https://www.nmbaqcs.org/scheme-components/epibiota/literature-and-taxonomic-keys/

8.1 Summary of activities

A ring test comprising: 10, single taxon, tubed zooplankton specimens for identification (from the North Atlantic); 8 written questions and an enumeration exercise (counting of copepods and decapods), was sent out in Jan/Feb 2023. Sixteen participants, from eleven different laboratories signed up for the ring test (prior to completion one analyst withdrew from the test). All participants were from Europe, with 80% of participants from UK organisations. This year we welcomed two new laboratories from Germany to the Scheme.

Participants were given ten weeks to complete the written quiz and five weeks to complete the practical components (specimen ID and enumeration); results were assessed by the senior plankton analysts at the CPR Survey, Plymouth.

8.2 Materials and methods

Specimen identification test: the CPR Survey acquired various mixed zooplankton net caught samples from different areas of the North Atlantic. From these samples, single species were picked and verified by an analyst, and subsequently confirmed by the Senior Analyst. Single taxa were then transferred to centrifuge tubes and the success of the transfer was checked. Where possible more than specimen of the same taxon was placed in each tube.

Written quiz: the quiz was prepared by the CPR Survey Senior Analyst and included photographs of taxa to be identified, together with general taxonomic questions related to zooplanktonic organisms.

Enumeration component: counting and basic identification of copepods and decapods. For the enumeration component, *Calanus finmarchicus* stage/sex-sorted specimens were supplied from culture by Biotrix, Norway; *Metridia* specimens from samples collected in the Norwegian Sea, by the Institute of Marine Research, Norway and brachyuran zoea from the L4 sampling station off Plymouth, collected by the MBA. Specimens were sorted, counted and tubed according to sex and stage. To help the sample look more like a natural/wild sample, other non-target organisms were included in the enumeration tube (e.g. cirripede larvae, non-brachyuran decapod zoea and non-*Calanus* copepods); these wild sample specimens were collected in Plymouth coastal waters. Prior to posting out to participants, contents were checked by the Senior Analyst with another experienced analyst as witness.

8.3 Summary of results

Following on from participant feedback from previous NMBAQC zooplankton ring tests, the ring test should be community driven and 'self-policed'. To help accomplish this, a two-day results and training workshop was organised and took place at the MBA, Plymouth, on the 20th and 21st July 2023. Fifteen participants, from eleven different laboratories took part in the workshop, where results were discussed and consensus for marking of results was reached.

The average result for the specimen identification section was 79.3%, slightly higher that than the previous year, with individual results ranging between 40% and 100%. The worst identified specimen was a Leptothecata hydrozoan medusa: the specimens belonged to either the genus *Clytia* or *Phialella*, and to tell them apart from each other, ideally fresh specimens are needed. Fine structures such as the marginal vesicles and concretions help to split these two organisms, but they often become difficult to observe in preserved material, for this reason identification in preserved specimens should be made with caution and limited to the broad grouping of Leptothecata. Approximately a quarter of participants approached the specimen with caution and gave the correct ID. The majority of other participants assigned the specimens to either *Clytia* or *Phialella*; interestingly with a near 50% split between the two, indicating the difficulty and confusion in correctly identifying this type of specimen. In contrast, a juvenile mysid was correctly identified by 100% of participants. Encouragingly, most participants (93%) were able to correctly identify the non-native copepod *Pseudodiaptomus marinus*.

For the written exercise, the average score was a 91.7%, a 10% improvement in the previous year: with individual marks ranging from 61.4% to 100%. The most poorly answered question concerned the identification a brachiopod larvae, with 25% of participants misidentifying it as a Bivalvia larva.

Four questions scored 100%, with all participants gaining full marks; the subject of these questions concerned: identifying the larva of a hemichordate; identifying a juvenile scypho-medusa; recognising an anchovy egg; and identifying the copepod *Isias clavipes*.

This year the enumeration section was made to look more like a wild sample. It included a set number of *Calanus* copepods at different life stages, a set number of brachyuran decapod zoea and was spiked with other common planktonic taxa, such as cirripede nauplii, non-brachyuran decapods, and other copepods such as *Oithona* and *Metridia*. The aim of the test was to assess counting expertise, together with basic copepod/decapod identification skills and ability to separate basic copepod life stages. Participants were asked to count *Calanus* and separate their different stages (e.g. adult female, adult male) and count the number of brachyuran zoea in the sample. *Calanus* is an important component of Northeast Atlantic Zooplankton, so it is reasonable to expect that participants are able to separate it from other co-occurring similar sized taxa. Similarly brachyuran decapods are a common occurrence in coastal samples, an important part of the meroplankton and easily separated in appearance from other larval decapod groups. To give a statistical measurement of counting accuracy, a modified z-score was given for each required counting element. Adult female *Calanus* were counted with the most accuracy; however, individual scores ranged from a perfect z-score of 0 to 3.5; similarly for adult males z-scores ranged from 0 to 3.0. Perhaps surprisingly, brachyuran zoea also showed a wide variability in accuracy from 0 to 3.

8.4 Training workshop

As well as discussing the results of the test, participants were given presentations and practical sessions on ichthyoplankton. Linford Mann from the Centre for Environment, Fisheries and Aquaculture Science (CEFAS), UK gave an interesting talk on the International Triennial England Mackerel Egg Survey with fish egg identification practical. Invited guest speaker, Nalani Schnell from the Muséum National d'histoire Naturelle, France, kindly delivered an informative lecture on "an introduction to fish larvae identification" followed by a practical session.

Other lectures also included "non-native news" and participants were also given the opportunity to deliver a short presentation about their work and laboratory.

8.5 Conclusions and Recommendations

The consensus amongst participants was that the zooplankton ring test was again deemed a success. It showed that the level of zooplankton identification amongst participants overall is very good, and that it provides a useful training exercise and opportunity to discuss problematic taxa.

For those outside of the UK, long postal delays (several weeks) were experienced in receiving the physical samples. Meaning that extensions to the results deadline had to be made. A discussion arose, at the workshop, about how we might overcome this issue in the future: should the test move to completely online, negating the need for physical specimens; or include a reverse test approach; or hold the test and workshop at the same time in Plymouth (i.e. participants would have to sit the test all together in one place)? A move to completely online, relying on drawings and images was not favoured. If postage becomes unreliable in the future, a move to all participants taking the test at the same time and same venue was thought of as a possible move forward.

A recommendation from the previous year's test for the specimen ID component, was that an indication of where a specimen has been collected from would help with identification. This was included in this year's test for specimens which have a distinctive distribution beyond just the broad level of NE Atlantic.

Of particular discussion was the lack of information in hyrdomedusa identification guides stating which features can/cannot be reliably used to identify preserved material.

Participants enjoyed the more "wild" looking nature of the enumeration sample and recommended this should be carried forward.

At the end of the results workshop, participants were again given an opportunity to give feedback on the ring test and training, both verbally and anonymously via a feedback form. The overall feeling was that participants found the test useful and enjoyable, saying that it challenged them at the right level; also, the length of time it took to complete the test was about right.

Appendix 1 - NMBAQC Co-ordinating Committee – 2022/2023

Name	Organisation	Position /Role
David Johns	The Marine Biological Association (MBA)	Chair
Graham Phillips	Environment Agency (EA)	Finance Manager and CMA representative
James Albrecht	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)	Invertebrate Technical Manager and CMA representative
Rafael Salas	Observatorio Canario de algas nocivas	Phytoplankton Technical Manager
Marianne Wootton	The Marine Biological Association (MBA)	Zooplankton Technical Manager
Claire Young	Department of Agriculture, Environment and Rural Affairs, Northern Ireland (DAERA)	Macroalgae Technical Manager
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, 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 2022/2023

(Participants from UK unless otherwise stated)

Invertebrates 2022-2023 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	-	-	✓
Bureau Waardenburg B. V	✓(x2)		
Cefas Lowestoft Benthic Laboratory	✓	-	-
Cyfoeth Naturiol Cymru / Natural Resources Wales	-	-	✓(x9)
DAERA Environment, Fisheries and Marine Group Laboratory	✓	✓	✓
Eco Marine Consultants Ltd	-	-	✓
Ecospan Environmental Ltd	✓	✓	✓
Environment Agency, Kingfisher House	-	-	✓(x6)
Eurofins Hydrobiologie France	-	-	✓
Eurofins Omegam BV	✓	-	-
Fishlab, Denmark	✓	-	-

Fugro GB Marine Limited (Edinburgh)	✓	-	-
Fugro GB Marine Limited (Gt. Yarmouth)	✓	-	-
Fugro GB Marine Limited (Portsmouth)	✓	-	✓
GEM (Institutul National de Cercetare Dezvoltare Pentru Geologie si Geoecologie Marina (GEOECOMAR), Romania	-	-	✓
HEBOG Environmental Limited	✓	-	✓
Hull Marine Laboratory	✓	-	✓
IBER-BAS (Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences), Bulgaria	-	-	✓
ILVO (Institute for Agricultural and Fisheries Research) -	✓	✓	✓
IO-BAS (Institute of Oceanology-BAS), Bulgaria	-	-	✓
Marine Invertebrate Ecological Services	-	-	✓
Marinescope Taxonomy Ltd	✓	-	-
MBM Benthic Identification Services (The Lab Shed)	✓	-	-
Myriad Taxonomy	-	-	✓
NIMRD (National Institute of Marine Research and Development "GRIGORE ANTIPA"), Romania	-	-	✓
Ocean Ecology	✓	-	✓
Pelagia Nature & Environment AB, Sweden	✓	-	-
Pharmaq Analytic Limited (formerly Fish Vet Group)	-	-	✓
Precision Marine Survey Ltd	✓	-	-
Rijkswaterstaat CIV	✓	✓	-
Scottish Environment Protection Agency	✓	-	✓
Shalla Benthic Identification Services	✓	-	✓
Thomson Ecology Ltd	-	-	✓
TSU (Ivane Javakhishvili Tbilisi State University), Georgia	-	-	✓
WMR (Wageningen Marine Research)	✓	✓	-

Particle Size Analysis 2022-2023 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	√	√
Fugro GB Marine Ltd	√	
Hull Marine Laboratory, University of Hull	√	√
ILVO	√	
KPAL	√	√
Marine Scotland Science	√	
National Laboratory Services (NLS- EA)	√	√
Natural Resources Wales	√	√ (x7)
Northern Ireland Environment Agency (NIEA)	√	√
Ocean Ecology Ltd.	√	√
Precision Marine Survey ltd	√	
Rijkswaterstaat	√	
RPS Environmental Management Ltd	√	
Scottish Environment Protection Agency	√	√
Thomson Environmental Consultants	√	

Macroalgae 2022-2023 Participants:

Organisation	Opportunistic macroalgae cover ring test (OMC-RT)	Opportunistic macroalgae biomass ring test (OMB-RT)	Country
Cyfoeth Naturiol Cymru / Natural Resources Wales	1	2	UK
DAERA Environment, Fisheries and Marine Group Laboratory	1	1	UK
Environment Agency	9	8	UK

Phytoplankton 2022-2023 Participants:

Fish 2022-2023 Participants:

Organisation	Fish - Reverse Ring Test	Fish - Ring Test	Country
Agri Food Biosciences Institute (AFBI) NI	1	1	UK
Cyfoeth Naturiol Cymru / Natural Resources Wales	0	2	UK
DAERA Environment, Fisheries and Marine Group Laboratory	1	1	UK
Environment Agency	6	1	UK
Fugro GB Marine Ltd.	0	1	UK
Hull Marine Laboratory (University of Hull)	0	1	UK
Ocean Ecology Ltd.	0	1	UK

Zooplankton 2022-2023 Participants:

Organisation	Country
APEM Ltd	UK
Cefas	UK
CPR Survey	UK
Dove Marine Laboratory	UK
Finnish Environment Institute (SYKE)	Finland
Fishlab	Denmark
Fugro Ltd	UK
German Centre for Marine Biodiversity Research	Germany
Istituto Nazionale di Oceangrafia e di Geofisica Sperimentale - OGS	Italy
Marine Scotland Science	UK
National Oceanography Centre	UK
National Reference Laboratory for Marine Biotoxins	Italy
Nautica Environment Associates LLC	UAE
Ocean Ecology	UK
Stazione Zoologica Anton Dohrn	Italy
Zooplankton Laboratory, Institute of Marine Research	Norway