NE ATLANTIC MARINE BIOLOGICAL ANALYTICAL QUALITY CONTROL SCHEME

Annual Report 2017/2018

A report prepared by the NMBAQC Coordinating Committee – December 2018

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This Annual Report provides synopsis of the scheme year's activities over 2017/2018, the 24th 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, conservationand 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. Representatives from these agencies and competent monitoring authorities (CMAs) for the NMBAQC coordinating committee.

The NMBAQC coordinating committee held 3 meetings during 2017-2018 on 23rd May 2017, 25th September 2017, and 6th of February 2018 The minutes of the meetings are on the NMBAQC web site **http://www.nmbaqcs.org/reports/.**

Committee Membership for 2017/2018 is shown in Appendix 1.

1 Scheme Review

The scope of the NMBAQC scheme continued to develop in 2017/2018 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 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).

All components followed a similar format to the previous year and involved training and testing exercises for the Invertebrate, Particle Size, Fish, Phytoplankton and Macroalgae components.

The 2017-2018 participation level in the NMBAQC was similar to the previous year (see Appendix 2).

Summaries of all the component activities are provided below:

2 Invertebrate component

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

2.1 Summary of activities

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

- Own Sample module (OS) - re-analysis by APEM Ltd. of three samples supplied by each of the participating laboratories;
- Invertebrate Ring Test module (RT) - identification of two sets of twenty-five invertebrate specimens; and
- Laboratory Reference module (LR) - re-identification by APEM Ltd. of a set of twenty-five specimens supplied by each of the participating laboratories.

Scheme year 2017 / 2018 (year 24) followed the format of year 2016 / 2017. 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.

Forty-nine laboratories (with multiple participants from some organizations counted separately) participated in the Benthic Invertebrate Component of the NMBAQC Scheme in 2017 / 2018 (year 24). Seventeen 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; twenty-nine were private consultancies, one of which was a consortium of sole traders. Seven of the participants were non-UK laboratories (including three government organizations and four private consultancies). 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 the 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.

2.2 Summary of results

The analytical procedures of the various modules were the same as for 2016 / 2017 (year 23) of the Scheme. The results for each of the Scheme exercises are presented and discussed. Comments are provided on the performance of participating laboratories in each of the exercises. A review of recording and identification policy differences for the Own Sample, Laboratory Reference, and former Macrobenthic exercises was produced to help clarify and standardise nomenclatural usages within these exercises (Worsfold and Hall, 2017a)

A new Own Sample Exercise Protocol (Worsfold & Hall, 2017b) was produced to explain and standardise the methods and policies used in the **Own Sample (OS)** module, 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 OS65-67, extraction efficiency (of individuals) was better than 90% in 96% of the comparisons and better than 95% in 86% of all comparisons. 100% of countable taxa were extracted from the sample residues in 65% of samples. The Bray-Curtis similarity index ranged from 42% to 100% with an average of 95.5%. The Bray-Curtis similarity index was greater than 95% in 73% of comparisons; in 89% of cases, the value of the index was greater than 90% and, therefore, achieved 'Pass' flags. Twelve samples (15%) achieved 'Pass-Excellent' flags with Bray-Curtis similarity scores of 100%.

Two **Ring Tests (RT)**, each of 25 specimens, were distributed (RT53 and RT54). The second (RT54) was targeted on Spionidae, to follow the 2016 Scheme experts workshop, which included study of Spionidae and the development of an identification guide. A new Ring Test Protocol (Worsfold & Hall, 2017c) was produced to explain and standardise the methods and policies used in the module.

For RT53, the average numbers of differences per participating laboratory (for a total of 23 laboratories with 23 submissions) were 4.3 generic differences and 8.7 specific differences.

For RT54, the average numbers of differences per participating laboratory (for a total of 21 participants) were 2.1 generic differences and 5.3 specific differences. Seven specimens (small, damaged *Malacoceros vulgaris, M. tetracerus, Dipolydora* 'species B'*, D. quadrilobata, Aurospio banyulensis, Pseudopolydora* 'species A'*,* and *Prionospio plumosa*), were responsible for three fifths (60%) of the specific differences.

Laboratory Reference (LR): Seven laboratories signed up for the LR22 module and four laboratories submitted specimens for confirmation, within the required deadline. A fifth laboratory submitted specimens for confirmation after the deadline; these were reported separately but not included in the statistics for this annual report. Most misidentifications were for Annelida (49%), followed by Mollusca (35%) and Crustacea (11%); many belonged to genera which are either speciose, or for which the taxonomy has yet to be finalized. A new Laboratory Reference Protocol (Hall & Worsfold, 2017) was produced to explain and standardise the methods and policies used in the module.

2.3 Issues and recommendations

As a result of work through the Scheme's Benthic Invertebrate Component, the contractor identified several anomalies in the World Register of Marine Species (WoRMS) through the Scheme year, some of which had caused problems with audits and ring tests. They were brought to the attention of WoRMS editors and, in most cases, resolved. This process had also been carried out in other years, including several

(mainly cirratulids) that related to previous contract periods but were completed by the current contractor. The opportunity is taken to list those WoRMS edits initiated by the contractor over the current contract period:

- *Odostomia conspicua* to *Megastomia conspicua*; Serge Gofas, 07/07/2017;
- *Paraspio decorata* to *Spio decorata*; Geoff Read, 18/09/2017;
- *Parametaphoxus fultoni* to *Metaphoxus fultoni*; Tammy Horton, 05/10/2017;
- *Trichobranchus sikorskii* to *Octobranchus sikorskii*; Geoff Read, 15/12/2017;
- *Chrysallida sarsi* to *Parthenina sarsi*; Serge Gofas, 19/04/2018;
- *Palaemon yuna*, added; Sammy De Grave, 22/02/2018;
- *Palaemon leucurus*, authority corrected; Sammy De Grave, 22/02/2018.

Return of data to APEM Ltd. followed the same process as in previous Scheme years. Spreadsheet-based forms (tailored to the receiving laboratory) were distributed to each laboratory via email. All returned data were converted to Excel 2010 format for storage and analysis. In this, and previous, Scheme years, slow or missing returns for exercises lead to delays in processing the data and resulted in difficulties with reporting and rapid feedback of results to laboratories. Reminders were distributed shortly before each exercise deadline.

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. It would be helpful if laboratories wishing to query Ring Test specimen identifications did so within a week of report receipt. These considerations would greatly facilitate the analysis of results and effective feedback.

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 (due to low volumes of sample processing) and other laboratories offering up to 556 samples across 18 projects for audit selection. 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. There were some instances (OS & LR modules) of **specimens being provided in vials / containers that were not airtight** and, as a consequence, specimens were dry and in some case identification was impossible. Participants are reminded that specimens should be stored in suitable air-tight containers so that viability is maintained for the audit process. Participants should also ensure that OS & LR samples are transported to APEM in accordance with the H&S regulations. Participants should use rigid crates when submitting heavy sample residues to **prevent damage in transit**.

6. 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.

7. 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 was distributed for completion in this year's exercise and will continue into the next exercise to support AQC identifications.

8. 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.

9. 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 reported in their Own Samples even if their samples achieve an overall 'Pass' flag.

10. 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.

11. 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*, i.e.* all analysts extracting and recording all biota. A detailed **taxonomic discrimination policy (TDP) needs to be developed** and added to 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.

12. 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 last year** 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.

13. 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. Eight of the 9 'failing' Own Samples in Scheme Year 2017 / 2018 (Year 24) have already been rectified via the recommended remedial action. **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.**

14. 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*).

15. 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. 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 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.

16. Despite protocol documents being produced for a recent Scheme year (Year 21, 2015- 2016), misconceptions still exist regarding the purpose and methods for some of the Scheme's modules. **Protocol documents for all modules were reviewed and re-issued ahead of the exercises for this scheme year (Ring Test Protocol, Laboratory Reference Protocol, Own Sample Exercise Protocol).**

17. 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 Contract 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 & Taxonomic literature

An update to the Scheme's taxonomic literature database was produced as a text document Bibliography of taxonomic literature (Worsfold et al., 2018). This lists over 3,100 citations for identification literature for northeast Atlantic marine and brackish water biota by taxonomic group, with sections for benthic invertebrates, fish, benthic algae, zooplankton, phytoplankton and non-native species.

Worsfold, T., Hall, D., & O'Reilly, M., 2018. Bibliography of taxonomic literature for marine and brackish water Fauna and Flora of the North East Atlantic. NMBAQC Scheme, 198 pp., February 2018.

Benthic Invertebrate Component Annual Report, 2017/2018 (Year 24) Worsfold, T.M., Hall, D.J., and O'Reilly, M. (Ed.), 2018. Benthic Invertebrate Component Annual Report.

Scheme Operation 2017/2018 (Year 24). A report from the contractor to the NMBAQC Scheme co-ordinating committee. 28pp, July 2018

Own Sample Module Summary Report OS65, 66 & 67 – July 2018 Hall, D. 2018. NE Atlantic Marine Biological Analytical Quality Control Scheme. Own Sample Module Summary Report OS65, 66 & 67. Report to the NMBAQC Scheme participants. 14pp, July 2018.

Laboratory Reference Module Summary Report LR22 – March 2018 Worsfold, T. and Hall, D., 2018. NE Atlantic Marine Biological Analytical Quality Control Scheme. Laboratory Reference Module Summary Report LR22. Report to the NMBAQC Scheme participants. 9pp, March 2018.

RTB54 – Mar 2018 (Targeted - Spionidae) Worsfold, T., Hall, D. & Pears, S., 2018. NE Atlantic Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB#54. Report to the NMBAQC Scheme participants. APEM Report NMBAQC RTB#54, 32pp, Mar, 2018.

Review of recording and identification policy differences in Benthic Invertebrate Component exercises (OS, LR, MB) for Scheme Operation 2014 - 2016 (Years 21, 22, 23). Worsfold, T.M., Hall, D.J., 2017a. Report to the NMBAQC Scheme committee and participants. 18pp, July 2017

Benthic Invertebrate component - Own Sample Exercise Protocol. Worsfold, T.M. and Hall, D.J., 2017b. Report to the NMBAQC Scheme participants. 16pp, August 2017.

Benthic Invertebrate component - Ring Test Protocol. Report to the NMBAQC Scheme participants. Worsfold, T.M. and Hall, D.J., 2017c. 6pp, August 2017

Benthic Invertebrate component - Laboratory Reference Protocol. **Hall**, D.J. and Worsfold, T.M., 2017. Report to the NMBAQC Scheme participants. 5pp, August 2017

3 Particle Size Analysis component

Contract 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:

- The PS Ring Test (PS).
- The PS – Own Sample (PS-OS).

The PS module followed the same format of 2016/17; 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.

Sixteen laboratories signed up to participate in the 2017/18 PS module exercises (PS64, PS65, PS66 and PS67); seven were government laboratories and nine were private consultancies. Thirteen laboratories signed up to participate in the PS-OS module exercises (PS-OS10, PS-OS11 and PS-OS12); eight were government laboratories and five were private consultancies. One government laboratory had two Lab Codes to submit six PS-OS samples for AQC analysis.

3.2 Summary of Results

Sixteen laboratories subscribed to the exercises in 2017/18.

Ring Test results – PS Module - PS64, PS65, PS66, PS67:

For the first ring test circulation (PS64 and PS65) all subscribing participants provided results; for the second ring test circulation (PS66 and PS67) all but one participant provided results. PSA_2409 did not participate in exercise PS66 and PSA_2415 did not participate in exercise PS67; both provided email confirmation of their non-participation.

Sample PS64 indicated an average composition of 0.01% gravel, 22.32% sand and 77.66% mud, classified as "Slightly Gravelly Sandy Mud".

Sample PS65 was a mixed sediment and contained an average of 50.26% gravel, 48.79% sand and 0.95% mud, classified as a 'Sandy Gravel'.

Sample PS66 was a diamicton and both sieve and laser analyses were required. The sample contained an average of 8.39% gravel, 66.89% sand and 24.72% mud and was classified as Gravelly Muddy Sand'.

Sample PS67 was a gravel sample and only required sieve analysis. The results showed an average of 84.72% gravel and 15.28% sand.

For PS64 there was generally good agreement between the results for the replicates and those supplied by most of the participating laboratories, Despite these samples being pre-sieved through a 0.5mm sieve, small weights (on average 0.058g) of sediment greater than 1mm were found. This reflects variability in the efficiency with

which elongate particles, mainly shell fragments, pass through a given sieve size. Six participants chose to undertake both sieve and laser analysis on this sample, the remainder only undertook laser analysis. Of the labs using a laser the percentage of sand ranged from 10.3% to 39.0% (PSA_2405) and mud ranged from 61.0% to 89.8%. Those that undertook sieve analysis found small amounts (0.04g – 0.08g) of sediment greater than 1mm, equating to a gravel percentage of 0.01% to 0.09% and recorded the sample as Slightly Gravelly Sandy Mud. The participants who only undertook laser analysis recorded the samples as Sandy Mud or a derivative. Those participants using Beckman Coulter instruments recorded a higher percentage of clay than those using Malvern Mastersizer instruments.

For PS65 there was generally good agreement between the results from the analysis of the benchmark replicates and those from the participating laboratories , except for one lab who found no sediment greater than 1mm. Two labs did not follow NMBAQC methodology and split the sample at 63 microns rather than 1mm. The majority of participants recorded the sample as Sandy Gravel or a derivative e.g. Sandy Fine Gravel or Very Fine Gravel.

For PS66 there was a large amount of variation between the results reported by the participating laboratories and those obtained for the benchmark replicates. One lab did not analyse sediment above 1mm and one did not follow NMBAQC methodology as they had no laser. One lab appears to have only analysed a sub-sample of the replicate as indicated by a lower total weight. One lab recorded a high amount of sediment at 16mm which turned out to be a data entry error. Percentage clay showed variation with laser instrument type, with the Beckman Coulter users recording a higher percentage clay than those using the Malvern Mastersizer. Although the majority of participants classified the sample as Gravelly Muddy Sand, there were differences in the proportions of mud and sand reported.

For PS67 there was very good agreement in results between the laboratories and the benchmark data. All participants classified the sample as Gravel, with an average of 84.79% Gravel and 15.19% Sand. The sample was supplied as a dry sample and it was not possible to undertake a wet separation at 1mm as stated by the NMBAQC methodology. As a result of this the sample only required dry sieve analysis. Five participants chose not to follow the NMBAQC methodology and dry sieved down to 63microns (rather than 1mm) For those participants following the NMBAQC methodology and dry sieving to 1mm the process produced some less than 1mm material that was collected in the base pan. Some Participants PSA_2403, PSA_2404, incorporated this base pan weight into their final data in the 0.0 to 0.5 phi size interval. Those that did not incorporate the less than 1mm base pan weight into the final data ended up with the total sample weight in the Sieve section not matching the total sample weight in the Final data. One participant chose to laser the less than 1mm base pan fraction thus recording 0.02% Mud

In previous years laboratories meeting or exceeding the required standard for a given PS exercise would be considered to have performed satisfactorily and a flag indicating a “Pass” or “Fail” would be assigned to each laboratory for each exercise. As the Pass/Fail criteria are still under review for the PS exercises, in 2017/18 (Scheme year 24) a “Good” or “Review” flag has been issued for methodology and summary data, laser and sieve processing and data merging.

This aims to highlight any potential errors but will not be used to assess the performance of a laboratory.

Own Sample results – PS-OS Module

Participants' "own" samples are re-analysed by the NMBAQC Scheme PSA contractor and the results are compared. The purpose of this exercise was to examine the accuracy of particle size analysis for participants' in-house samples. The results were split into sieve processing, laser processing, data merging and whether a representative sample was supplied. Participants received a "Good" or "Review" flag based on their results. Where a "Review" flag was issued comments were supplied detailing problems that had arisen.

Thirteen laboratories subscribed to the PS-OS module in 2017/18 and all provided data and submitted samples for re-analysis. Laboratories generally provided workbooks with all the correct information. All participants except one provided all necessary fractions of their sample for re-analysis; one participant did not provide any laser sub-sample, therefore the dried < 1mm fractions were used for laser analysis but this required soaking for 48 hours to soften, before thoroughly mixing and subsampling.

There was generally good agreement between the participants and the AQC results, particularly in terms of basic sediment textural classification. There were a few discrepancies in the sieve data but these are to be expected due to factors such as breakage of particles during repeat analysis and variations in sieving time and vibration amplitude. The AQC analysis of a few samples found small amounts of material greater than 1mm in samples where participants had undertaken laser analysis only, therefore sieve and laser analysis should have originally been carried out, however these small amounts of greater than 1mm particles had minimal effect on the overall distribution of the sample and were usually deemed not to be materially significant. One of the main issues with the participant data supplied was that laser data did not sum to 100%; this had a knock-on effect on the final merged data not summing to 100%. In some of the results there was a fair amount of variability in the laser analysis between the primary data and the Benchmark re-analysis; some of this variability can be explained by differing laser instruments used by the AQC lab and participants.

The Malvern Mastersizer 2000 and 3000 instruments do not have the same resolution as the Beckman Coulter LS13320. Often the Beckman Coulter system reports higher mud content than the Malvern machines and the distributions produced by the Malvern tend to be more smoothed, and less able to identify discrete size modes. The output size distribution from the Malvern instruments machines is very dependent on the diffraction pattern interpretation model used; this can be selected by the operator as "General Purpose, Unimodal, and Multimodal etc." and can give rise to uncertainty. There is no such specification requirement with the Coulter instruments.

3.3 Issues 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, 2016) 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. 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. Participants will be reminded of this in the PS protocol document in the next Scheme year.

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 are all filled in correctly. This will help eradicate typing and transcription errors.
3. The current NMBAQC Scheme Pass/Fail criteria for the PS modules are under review. Currently results are broken down for review, including methodology, sieve processing, laser processing, data merging and summary statistics. 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. Research into more robust "Pass/Fail" criteria will continue, in the meantime the format will remain the same.
4. The PS and PS-OS module results both highlighted differences between the sensitivity of laser instruments. Comparison of laser data in the PS-OS and PS results showed that the Beckman-Coulter LS13320 instrument used by the AQC lab, which includes a Polarization Intensity Differential Scattering (PIDS) and gives enhanced measurement capability in the clay-size range (< 2 um) compared to other lasers models used by many of the NMBAQC scheme participants. The NMBAQC PSA workshop in December 2017 looked at possible ways to minimise the differences created by the use of different laser instruments and optical models, and the possibility of standardising so that all laboratories following the same procedures. It was agreed that the **recommended optical model is Mie Theory with values of 1.55 for the 'Real' and 0.1 for the 'Imaginary' components of the Particle Refractive Index, respectively** Experimental results have demonstrated that use of the Fraunhoffer optical model reduces the differences between laser instruments, albeit by loss of 'detail' within the very fine silt and clay size fractions. However, the potential suitability of using the Fraunhofer model to achieve greater inter-laboratory comparability will need to be explored in more detail when enough data have been collected. It has been suggested that in the next scheme year participants should submit data using both the Mie Theory and Fraunhoffer

model to allow further assessment to be made. Obscuration will vary depending on sample type; only a small amount of mud is needed to reach an obscuration of 10%, and the presence of relatively small but potentially significant amounts sand may be missed; it may therefore be better to run at a higher obscuration where the presence of sand is observed during sample preparation. A gap can appear between the sieve and laser data in the final merged distribution if not enough sample is added to the laser to detect the sand. The 2017/18 workbook was modified to make the process of providing metadata simpler, and it is essential that participants complete the relevant sections. **The 2018/19 workbook will be modified to have the opportunity to provide laser data below 0.086um for those who wish to.**

5. A successful Particle Size Workshop was held at NLS in Leeds during December 2017 and an end-users workshop in Peterborough, June 2018. The December workshop included demonstrations by representatives of both major laser analyser manufacturers Malvern Instruments and Meritics on behalf of the Beckman Coulter, as well as presentations by the Benchmark Lab (KPAL – Prof. Ken Pye and Dr. Simon Blott) and scheme manager, Claire Mason (Cefas). The workshop demonstrated that there are still varying interpretations of the NMBAQC standard methodology and with changes in staff not all labs are fully aware or compliant with the procedures recommended in the Guidance. **In future scheme years it would be useful to consider either a practical workshop or making video to train new staff in the NMBAQC methodology** The June workshop focused on the end users of particle size data rather than those producing the data. The aim was to establish what the minimum requirements were both in terms of data quality and quality assurance for the laboratories producing data to meet the needs of the end users. As well as to produce quality data and metadata so that analyses can be reliably used for future studies.

3.4 Reports

PS67 January 2018 McIntyre-Brown, L. & Hall, D., 2017. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS67. Report to the NMBAQC Scheme participants. Apem Report NMBAQCps67, 38pp, January 2018.

PS66 January 2018 McIntyre-Brown, L. & Hall, D., 2017. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS66. Report to the NMBAQC Scheme participants. Apem Report NMBAQCps66, 39pp, January 2018.

PS65 October 2017 McIntyre-Brown, L. & Hall, D., 2017. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS65. Report to the NMBAQC Scheme participants. Apem Report NMBAQCps65, 37pp, October 2017.

PS64 October 2017 McIntyre-Brown, L. & Hall, D., 2017. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS64. Report to the NMBAQC Scheme participants. Apem Report NMBAQCps64, 37pp, October 2017.

4 Fish component

Contract Manager: Jim Ellis, Cefas.
Component Administrator Ruth Barnich, Thomson Unicomarine Ltd.

4.1 Summary of activities

The twenty-fourth year of the NE Atlantic Marine Biological Analytical Quality Control (NMBAQC) Scheme (2017/18) followed the format of the twenty-third year, with a ring test (RT) and a reverse ring test (RRT) being organised. This involved the distribution of test specimens to participating laboratories and the centralised examination of returned data for the first module, and re-analysis of fish specimens submitted by participants for the latter. The component was managed by the contractor Thomson Unicomarine Ltd., while the results of both ring tests were analysed by PISCES Conservation Ltd.

The Fish Component of the Scheme is currently in its eleventh year (2007/08). Twenty-four laboratories participated in the 2017 / 2018 Scheme year. Nineteen participants were government laboratories, four were private consultancies and one was a University 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 modules.

4.2 Summary of results

The analytical procedures of both modules were the same as for the tenth year of the Fish Component.

Fish Reverse Ring Test (F_RRT09): The identification of fifteen fish specimens selected and supplied by the participating laboratories was relatively accurate with only five taxonomic errors for 235 specimens submitted. The errors concerned species of wrasse, gurnard, sole, grey mullet, rockling and flounder/dab. The majority of specimens were collected during the 2017 autumn monitoring surveys. As observed in previous years, there were differences in the approach to the reverse ring test by the participating laboratories; some used this as a test for confirming voucher specimens, whilst others submitted problematic specimens, hence comparison of results is not applicable.

Fish Ring Test (F_RT11): Fifteen fish specimens were distributed to the participants by the contractor. The Fish Ring Test produced good agreement between the participating laboratories and the analysing laboratory, PISCES Conservation Ltd. On average 0.23 generic and 0.85 specific differences were recorded per participating laboratory. Differences were noted for species of mackerel, gurnard, goby, rockling, and pipefish.

4.3 Issues and recommendations

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

1. The latest Fish Reverse Ring Test (F_RRT09) and Fish Ring Test (F_RT11) were successfully implemented and their format can be continued in the next Scheme year. Participants are encouraged to provide feedback to enable protocols and bulletins to be improved where necessary.

2. The majority of participating laboratories submitted their data / specimens before the deadline, or were only slightly late. This allowed for an efficient analysis and delivery of bulletins and annual report on time.

3. Laboratories are encouraged to collate fish identification literature to improve their identification skills and follow the most recent results in taxonomy. The Scheme has produced a UK Standard Taxonomic Literature database. Participants are encouraged to review the content and give details of additions wherever possible. Referring to databases such as Catalog of Fishes, FishBase or WoRMS is recommended to check the validity of scientific names. Discrepancies between those databases were highlighted in the F_RRT09 bulletin.

4. The maintenance of a comprehensive reference collection has numerous benefits, such as improving identification ability, training new staff and maintaining consistency of identification between surveys.
The inclusion of growth series is extremely useful for certain taxa. Ideally all surveys should have an associated reference collection to facilitate cross-checking or keep track of changes in taxonomy. It is strongly recommended that laboratories implement and expand in-house reference collections of fish; these collections could include images and physical specimens.

5. Future Fish Ring Test circulations will target taxa identified in the Fish Reverse Ring Tests as potentially problematic. Participants are encouraged to inform the contractor of difficult taxa that should be included in ring tests. Participants are also invited to submit specimens for use in such exercises (approximately 20 specimens of equal size and condition would be required for inclusion).

6. The Ring Test and Reverse Ring Test modules offer training and baseline data for fish; a quality control module could be devised to provide quantifiable data assurance.

7. This year's Fish Ring Test (F_RT11) produced thirteen sets of results from thirteen participating laboratories. No participant submitted multiple data sets. The option of multiple data submissions per participant laboratory will be continued into future ring tests. Participants should not submit multiple sets of data if these data represent a replicated consensus; multiple data submissions are to allow subteams and individual analysts to receive specific results and feedback.

4.4 Reports

Fish Component Annual Report, Year 2017/2018 Barnich, R., 2018. Fish component - Report from the contractor. Scheme Operation - 2017/2018. A report to the NMBAQC Scheme co-ordinating committee. 13pp, April 2018.

FRT 11 February 2018 Barnich, R. and Seaby, R., 2018. NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: FRT#11. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb#11, 32pp, Feb 2018.

RRT 09 - March 2018 Seaby, R., and Barnich, R., 2018. National Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test: FRRT09. Final report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQC FRRT09, 9pp, March 2018.

5 Phytoplankton component

Scheme Administrator: Joe Silke, Marine Institute, Republic of Ireland.

5.1 Summary of activities

The phytoplankton component is undertaken by the Marine Institute (Ireland) 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).

Participants undertake Identification and Enumeration exercises on three preserved 50ml marine water samples which have been spiked with cultured material. They also take part in an online Harmful Algal Bloom (HAB) quiz where they are required to identify planktonic algae from photos or diagrams. Each year the exercises are followed by workshop with discussion of the exercise results and additional presentations on phytoplankton issues.

For the 2017 exercise (PHY-ICN-17-MI1) a total of 91 analysts from 45 laboratories took part. 91 analysts returned sample results and 84 completed the online HAB quiz. 85% of

participants come from laboratories across Europe, 8% from South America, 4% from Australia and 3% from Africa (Figure 1).

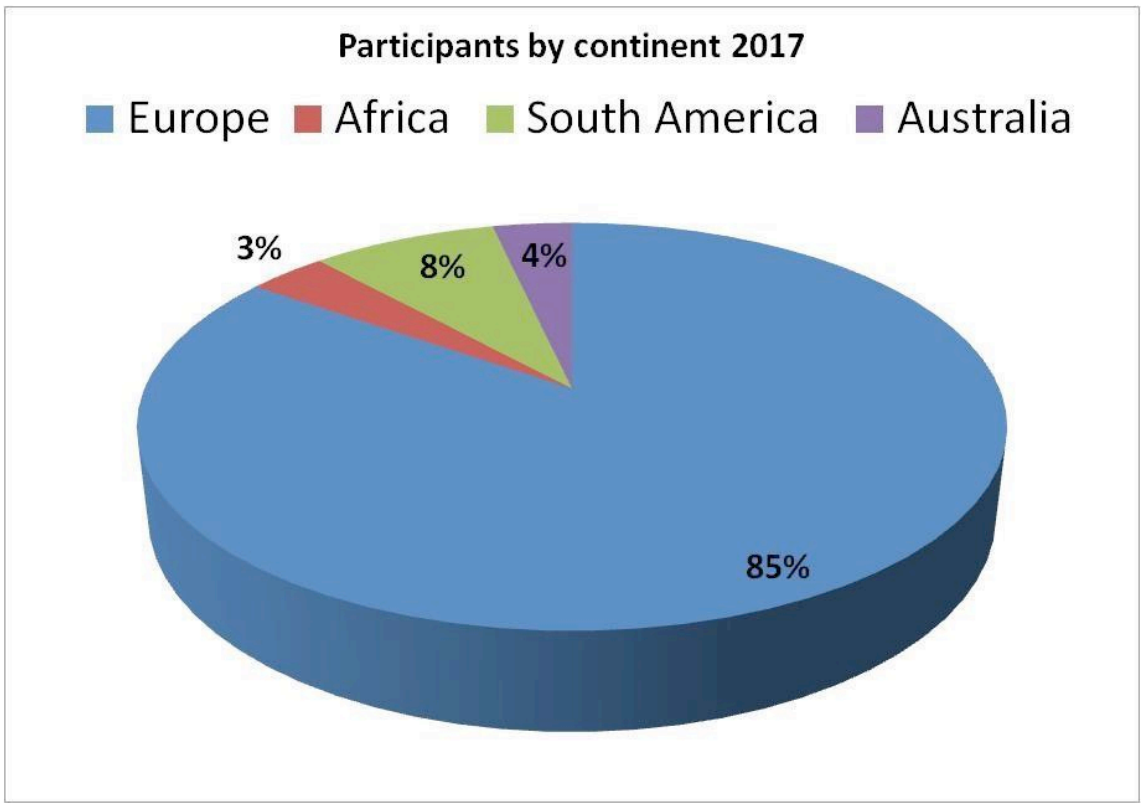

Figure 1:Breakdown of participants by continent

18 countries are represented in this intercomparison exercise. The list of participating laboratories can be found in Annex V and a breakdown of participation from each country in figure 2.

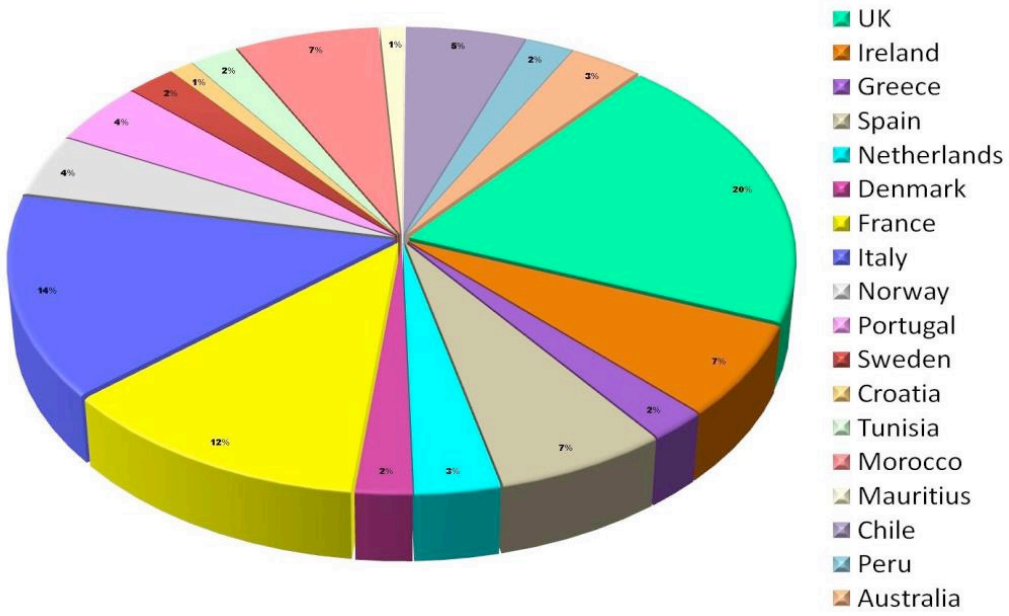

Figure 2: Breakdown participation per country of the Phytoplankton intercomparison exercise IPI 2017

5.2 Summary of results

a) Identification and Enumeration exercise

• Nine species were used in this test. These were the dinoflagellates *Azadinium spinosum* Elbrächter & Tillmann, 2009, *Scrippsiella trochoidea* (Stein) Loeblich III, 1976, *Akashiwo sanguinea* (K.Hirasaka) G.Hansen & Ø.Moestrup, 2000, *Prorocentrum mexicanum* Osorio-Tafall, 1942 and the diatoms *Pseudo-nitzschia pungens* (Grunow ex Cleve) G.R.Hasle, 1993, *Trieres chinensis* (Greville) M.P.Ashworth & E.C.Theriot, 2013, *Cylindrotheca closterium* (Ehrenberg) Reimann & J.C.Lewin, 1964, *Chaetoceros danic*us Cleve, 1889 and *Chaetoceros curvisetus* Cleve, 1889.

• All the species consensus cell counts were used to generate z-scores and final results

• The average and confidence limit for each test item was calculated using the robust algorithm in annex C of ISO13528 which takes into account the heterogeneity of the samples and the between samples standard deviation from the homogeneity and stability test. ISO 13528 is only valid for quantitative data. We have used the consensus values from the participants.

• All measurands passed the expanded criterion for homogeneity according to ISO13528:2015 except for *P.pungens. P.pungens* and *P.mexicanum.* These species did not pass the stability test according to the harmonized protocol ISO13528:2015, but the test for significant hererogeneity according to the same protocol was undecided.

• The consensus values new Standard deviation (STD) was used for all measurands regardless of the Pass/Fail flags from the homogeneity test.

• There were a small number of action signals across all measurands. 5 Red flags in total (0.6%), 22 (2.7%) yellow flags and 29 (3.5%) non-id flags from 819 scores is evidence of good performance overall.
Nine analysts did not pass the full test with a below 80% score. 5

b) Harmful Algal Bloom (HAB) quiz

• The Ocean teacher online HAB quiz results suggests a high rate of proficiency. 72.62% of analysts achieved a score over 90% (Proficient). Another 20.24% of analysts above 80%, 5.95% between 70 and 80% and 1.19% need improvement.

• In the taxonomic online assessment, there was good consensus on the various identifications of *Chaetoceros* species from images in matching questions 1 to 5 of the quiz, over 90% matched the right answer. This contrasted with the ability to identify the same *Chaetoceros* in real samples where evidence suggests the consensus is not so clear (for example: at least 8 different species answers were given for *C.curvisetus*).

• The most difficult question in the quiz turned out to be a numerical question (Q6) where only 57% of participants gave correct answers. This question was based on a chain of

Chaetoceros curvisetus where 8 cells were visible but not all the cells had the same amount of cytoplasmic content, with 4 cells showing that their chloroplasts had plasmolised. This has implications in real samples where a decision must be made on whether a cell should be counted or not.

• There were no real issues identifying dinoflagellates and on dinoflagellate terminology.

5.3 Reports

Phytoplankton Enumeration And Identification Ring Test, 2017 Salas, R.G., Walsh, D., Larsen, J., 2017. International Phytoplankton Intercomparison profiency test in the abundance and composition of marine microalgae 2017 report. PHY-ICN-17_MI1 VR 1.0. 183 pp.

6 Macroalgae component

Contract Manager: Claire Young, DAERA-NI.
Component Administrator: Emma Wells, Wells Marine.

6.1 Summary of activities

The component consisted of three modules:

· **Opportunistic Macroalgae Biomass Ring Test (OMB - RT)**: - synthetic samples of different weights for washing and drying to both wet and dry weights.
· **Opportunistic Macroalgae/Seagrass Cover Ring Test (OMC-RT)**:- estimation of percentage cover of opportunistic macroalgae and seagrass based on photographs of field quadrats.
· **Rocky Shore Macroalgae Ring Test (RM - RT)**: - Identification of twenty macroalgae species based on a series of images.

The analytical procedures of all modules were the same as for the previous year of the Scheme.

6.2 Summary of results

Opportunistic Macroalgae Biomass module (OMB RT09)

This is the ninth year in which biomass of macroalgae has been included as an exercise of the NMBAQC scheme. The format followed that of previous years.

Nine laboratories were issued with test material. All nine laboratories completed this component. A single test consisting of three biomass samples was distributed. This year each sample consisted of a different synthetic material including j-cloths, wool and

synthetic stuffing material. These are currently considered the most representative materials in terms of imitating the overall look and feel of various opportunist macroalgae species. Cloths and wool were cut to different lengths and sizes to represent different foliose and filiform taxa (e.g. *Ulva*). The synthetic stuffing is considered to be more representative of finer opportunist algae such as *Ectocarpus sp*. and *Chaetomorpha sp*. Each sample was contaminated with debris and sediment of a sandy-muddy nature consistent with the substrate type known to support opportunist macroalgal blooms.

Results for wet weight of biomass varied between laboratories with some laboratories producing high measures of biomass compared against the average biomass and actual/expected biomass. The dry weights showed a similar level of variability. Two laboratories failed to remain within the Z-score limit of +/- 2.0 for both the dry weight and wet weight against the mean despite the high standard deviation caused by the high range of results.

Four further laboratories showed significant deviation from the actual sample dry weight with a further three 'Fails' against wet weight. It is worth noting that this means of assessment is not as accommodating towards outliers. There was a total of eleven 'Fails' across all assessments of which seven could be attributed to one laboratory. No one sample resulted in significantly more or fewer 'Fails' with all receiving 3 or 4 'Fails'. Two laboratories had dry weights lower than that of the actual dry weight, suggesting minor losses of material during the rinsing process, however in most cases this loss was very minimal and had limited effect on the overall results.

Opportunistic Macroalgae/Angiosperms % Cover Component– (OMC RT09)

This is the ninth year in which % cover estimations of macroalgae have been included as an element of the scheme and the seventh year for which seagrass has been assessed as a separate entity.

Twelve laboratories were issued test material. All twelve laboratories completed the % cover macroalgae/seagrass component with a total of 38 participants. Of those laboratories submitting results, all twelve were government organisations.
Two sets of fifteen quadrat photographs showing various % covers of opportunist macroalgae and seagrass were used for the exercise. These sets of photographs were duplicated to allow three different assessment methods utilised by the various participating laboratories. The set of quadrat photos differed by the use of grid squares of varying quantities; open quadrat, 5 x 5 square grid and 10 x 10 square grid. Each photo represented natural levels of opportunist macroalgae and seagrass cover.

Results for % 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. There was greater preference for methods A and C for both macroalgae and seagrass and as seen in previous years method B had far fewer participants. The number of total 'Fails' between test methods and comparison against mean or image analysis varied considerably with no apparent trend. The overall number of 'Fails' was the same for both the seagrass and macroalgae tests suggesting little difference in the approach or results between the two tests.

Algal Identification Module (RM RT12)

Images of twenty macroalgae specimens were distributed to the five subscribing laboratories with a total of ten participants. The labs were scored on their identification at genus and species level with a maximum possible score of 40.
At the generic level, there were a total of twenty-five differences (from a potential two hundred) across the ten sets of data received from the five participating laboratories (12.5%). At the specific level, there were a total of thirty-nine differences (19.5%). Although the total number of differences was much lower than the previous year the overall % of incorrect species identification did not change due to the lower number of participants in the current ring test.

The differences in species identifications could be attributed primarily to four taxa which showed the highest number of incorrect identifications at both the genus and species level. The four species were *Antithamnionella ternifolia* (RT1207) with 5 generic and 5 species differences, *Halopteris filicine* (RT1208), *Derbesia marina* (RT1211) and *Capsosiphon fulvescens* (RT1216) all of which had 6 generic and 6 species differences recorded. These four species accounted for 72% of differences. *Vertebrata nigra* and *Ulothrix flacca* contributed to a further 5 and 8 differences, respectively, albeit only at the species level. Of the remaining three species where a misidentification was recorded none had more than 1 incorrect genus or species. These results indicate most of incorrect identifications could be attributed to a few species. Incorrect identifications could not be attributed to one specific phylum with Chlorophyta, Rhodophyta and Phaeophyta species proving equally problematic. In total eleven specimens were identified correctly across all participants which is significantly higher than in previous years.

6.2 Issues and recommendations

A wide range of observations and issues are noted in the module reports. Only the key issues and/or recommendations from each module are provided below:

a) Opportunistic Macroalgae Biomass

1. It seems there is now a general agreement that the use of artificial material to mimic algae is an acceptable surrogate for the test. It may be possible in the future to utilise alternative materials that may be more representative of the texture and general nature of opportunist algae.

2. This has been the second year in which each sample has consisted of a different artificial material which has enabled a better comparison against actual macroalgae samples. Due to the mixed opinions on which material is the most representative all three materials will continue to be used for future tests or until a more realistic alternative is sourced. However, it was suggested at least one of the samples be a combination of all three materials to represent mixed algal stands in the field and more realistic sampling conditions.

3. This year all laboratories submitting results managed to complete both wet and dry weights for all samples, however some participants still question the necessity to incorporate both dry and weights within the ring test. Although many in-house field procedures do not incorporate dry weight of algal samples these values are included within the NMBAQC scheme to enable comparison of laboratory procedures. The values provide evidence of insufficient rinsing of samples, whereby the dry weight would be considerably higher than the actual dry weight. Also, there is no definite wet weight from which to compare the individual laboratories submissions, so it is difficult to conclude which results are the most representative. The dry weight however can be compared directly with the original weight of the samples which was measured very accurately prior to addition of debris. Most laboratories submitted dry weight values that were considered well within an acceptable limit of the actual biomass; however wet weight remains highly variable. Therefore, the level of squeezing remains an issue within the overall procedure and should be addressed.

4. There are further requests that more *Hydrobia* could be added to the sample or material to mimic *Hydrobia.* This is something that has been considered and all attempts will be made to incorporate it into future tests.

5. There may be future requirements to include biomass analysis within a workshop to further discuss processing procedures and levels of intensity for manual removal of debris and water.

6. There is some question as to whether the methodology for both wet weight and dry weight is being read and followed consistently across all laboratories. This applies to the appropriate squeezing of samples and the removal of debris.

7. The differences in sample processes have become evident through the degree of variation in the results submitted. There needs to be a greater level of consistency in the methodology utilised for both rinsing and squeezing of samples and documented in guidance procedures to be distributed to all laboratories involved in such practices.

8. It has also been questioned whether the procedures of the test should be followed or those of the individual laboratory. The two methods may vary in terms of the amount of squeezing pressure applied to the sample. It is important that an individual laboratory has consistent results that are comparable from year to year. However, if they are consistently higher of lower than other labs they may be under or overestimating the actual biomass, particularly with regards to wet weight, which may then be reflected in the overall classification of a water body when applying the WFD blooming tool or any other quality status assessment.

b) Macroalgae and Seagrass % cover

1. There is evidently still a high degree of difference between tests as well as between participants and this may prompt the need for a specific workshop whereby methods can be discussed, and possibly % cover estimations compared in the field.

2. There is still a high level of difference between z-scores calculated from the mean and z-scores calculated from image analysis results and given the varied levels of deviation between the two it is unclear which is the most accurate method from which to compare participants results.

3. The image analysis method used during RT09 is considered more objective than skilled eye estimation and likely to produce a more accurate result. However, this method is still under development and will continue to undergo improvements prior to the next round of tests. It is recommended at this time that participants should use the Z-scores derived from comparisons with the mean if they are required for internal quality reports.

4. Following consultation with current participants, it has been agreed that the tests are being distributed at the most appropriate time of year for most labs, with a longer time scale within which to complete the exercises. Therefore, tests will continue to be distributed early in the New Year with a time limit of 6 weeks. It will remain the responsibility of the laboratory to ensure all results are submitted within the time provided.

5. It may be considered that during field sampling it may be possible to estimate % cover of opportunist algae with more accuracy than when using photos. The nature of the photographs can produce difficulties when assessing the density of the algae and the presence of some shadows and the grids can hinder this further

6. It was noted during RT08 that when using the 9 x 9 cross hair method it was difficult to keep orientated when zooming in and out to check cross hair points, therefore was suggested that a central grid in an alternative colour be place on both axis, thereby dividing the quadrat into four, to assist with the method. However, feedback suggests the additional colour added to assist with counting cross hairs is also distracting, this will need to be considered in subsequent tests.

7. Many labs use a slightly alternative method of a 10 x 10 grid and counting the presence within in each square. This is a point worth discussion should a workshop be held. The methods that are currently included within the ring test were those considered to be most frequently used. It is agreed that where laboratories use alternative methods such as subtidal quadrat % cover estimations these methods may not accurately represent their commonly used procedures. However, by completing all three methods for both seagrass and macroalgae it is still possible to compare results with other laboratories in order gauge the level of accuracy.

8. Further suggestions have been made to consider a 2 x 2 squared quadrat as partially achieved by the additional coloured cross hairs in Method C. Adding an additional method at this stage is likely to be unfavourably received due to the amount of time already required to use the current three methods however, should a field workshop be organised for the future this is a method worth incorporating for comparison against other methods.

c) Algal Identification

1. The high range of performance levels within this ring test provided evidence of a high range of proficiency but with the number of cryptic and microscopic species included within the test this does not necessarily indicate a reduced level of competence within and between laboratories. There are, naturally, several problematic areas but this is to be expected, as some taxa are inherently more difficult than others. The errors occurring

were at both the generic and specific level and within all three divisions, Rhodophyta, Phaeophyta and Chlorophyta. Many of these errors occurred due to confusions with taxonomically and morphologically similar species which share similar characteristics and are therefore hard to separate. Such species will be noted for possible future workshops and will be targeted in future exercises.

2. There were still several incorrect spellings; therefore, participants are urged to take more care prior to submitting results to ensure all names are spelled correctly. It is also important that only one genus and one species name is to be entered per specimen, where more than one name is recorded it is becomes difficult to assess whether the species has been correctly identified. Where there is limited confidence in the final identification it should be remembered that this scheme does not specify a definite qualifying performance level, and NMBAQC ring tests should be treated as training exercises.

3. Several data spreadsheets were also not fully completed, often missing out the keys or guides that were used. This may seem trivial information but can help identify where the participant has been misled with the keys or help explain how or why an alternative identification was reached. For future ring tests it is requested that the data spreadsheets be completed in full, including level of confidence in the identification. Participants should include the authority alongside taxon names, as this also aids in the analysis of returns.

4. All laboratories are encouraged to keep all test photographs within a reference collection. This has several benefits particularly with regards to improving identification ability, training new staff and maintaining consistency of identification between surveys and staff. This reference collection should also be extended through to literature to ensure current keys are used with up to date nomenclature. A list of identification works will be given on the NMBAQC website. However, this is not exhaustive, and does not necessarily include unpublished keys provided at workshops unless specifically authorised by the key's author.

5. There was a general agreement from participants that this years test was considered reasonably difficult there was less agreement on the overall quality, detail and use of photographs with most participants. It is unclear as to where such problems lay as no further comments were provided. However, all attempts will be made to ensure more clarity in subsequent tests. It is hoped that recommendations from previous tests have been taken on board and that for most species enough photos and key

characteristics were provided for correct and confident identification. However, it must be recognised that even when looking at fresh specimens not all such characteristics may be present, e.g. reproductive structures. No staining is currently used, and this shall remain for the following test. All attempts will be made in the future to ensure that sufficient material is provided, allowing correct identification to species level.

Graham Phillips from the Environment Agency contacted Wells Marine to offer an informal contract extension and they have agreed to continue to deliver this component for 2019.

Agreed 2019 dates below;

Exercises to be sent out by the contractor 7th January 2019
Results to be returned to the contractor by 15th February 2019
Ring test bulletins by mid-March, final bulletin by early April.

6.4 Reports

OMB RT09 Final report 2018. Wells, E., 2018. National Marine Biological Analytical Quality Control Scheme- Macroalgae Identification Module Report -OMB RT09 2018. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

OMC RT09 Final report 2018. Wells, E., 2018. National Marine Biological Analytical Quality Control Scheme- Macroalgae Identification Module Report -OMC RT09 2018. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

RM RT12 Final report 2018. Wells, E., 2018. National Marine Biological Analytical Quality Control Scheme- Macroalgae Identification Module Report -RM RT12 2017. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

7 Epibiota component

Component Administrator: Hayley Hinchen, JNCC.

7.1 Summary of activities

NMBAQC is now hosting a draft epibenthic Taxonomic Discrimination Protocol (TDP) and received expert input during early 2018 to review it. The TDP provides guidance on the level of taxonomic resolution that can be achieved for biotope-related species using different epibenthic sampling techniques e.g. video footage, stills or looking at specimens. Our aim for

this resource is to improve the consistency of epibenthic data collection and analysis across the North East Atlantic marine region.

The TDP spreadsheet can be accessed from this page: http://www.nmbaqcs.org/scheme-components/epibiota/ . We are expecting some further input from NRW during the autumn 2018 and will then look to publish the resource for wider use and review it annually to incorporate further developments.

A concept note on epibenthic imagery data was presented jointly by Cefas and JNCC to the last Marine Protected Areas survey and evidence delivery Group (MPAG) meeting in June 2018 to propose an exercise to gather lessons learnt from imagery data acquisition and analysis, with a view to feeding into a wider workshop discussion to agree best practice recommendations, building on the work done to date. Cefas have been asked to establish a task and finish group within MPAG to undertake the collation of lessons learnt from recent imagery data collection and analysis work. Analogous discussions are ongoing with colleagues from Scotland, Wales and Northern Ireland.

JNCC are currently exploring avenues to fund a comparative study of imagery annotation techniques to support any workshop recommendations on improving consistency and quality, with the aim of completing a contract and workshop by the end of 2018/19.

8 Zooplankton component

Component Administrator: David Johns, MBA.

8.1 Summary of activities

Whilst no Ring test was planned for the 2017/2018 NMBAQC year, work continued on the design of the next test (autumn 2018), with a new enumeration component and targeted species investigated.

Appendix 1 - NMBAQC Co-ordinating Committee – 2017/2018

Name	Organisation	Position /Role
David Johns	The Marine Biological Association (MBA)	Chair and Zooplankton Component Administrator
Tim Mackie	Department of Agriculture, Environment and Rural Affairs, Northern Ireland (DAERA)	CMA Representative
Graham Phillips	Environment Agency (EA	Finance Manager and CMA representative
Myles O'Reilly	Scottish Environment Protection Agency (SEPA)	Invertebrate Contract Manager and CMA representative
Joe Silke/ Rafael Salas	Marine Institute, Ireland (MI)	Phytoplankton Component Administrators
Claire Young	Department of Agriculture, Environment and Rural Affairs, Northern Ireland (DAERA)	Macroalgae Contract Manager
Grant Rowe (until August 2018) Ross Griffin (from August 2018)	Fugro EMU Ltd Ocean Ecology Ltd	Contractors' Representative
Hayley Hinchen Henk van Rein	Joint Nature Conservation Committee (JNCC)	Epibiota Component Administrators
Jim Ellis	Centre for Environment, Fisheries & Aquaculture Science (Cefas)	Fish Contract Manager
Claire Mason	Cefas	PSA Contract Manager
Keith Cooper (until May 2018) Pail McIlwaine (from May 2018)	Cefas	CMA Representative
Paul Brazier (until Aug 2017) Matt Green (from Aug 2017)	Natural Resources Wales (NRW)	CMA Representative
Annika Clements	Agri-Food Biosciences Institute, Northern Ireland (AFBI)	CMA Representative
Astrid Fischer (until Aug 2017) Clare Ostle (from Aug 2017)	The Marine Biological Association (MBA)	Technical Secretary

Appendix 2 - NMBAQC scheme participation for 2017/2018

8.1.1.1 Invertebrates 2017-2018 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	✓	-	-
Biotikos Limited	-	-	✓
Cefas Lowestoft Benthic Laboratory	✓	-	-
Cyfoeth Naturiol Cymru / Natural Resources Wales	-	-	✓
Bureau Waardenburg - Koeman en Bijkerk BV	✓	-	-
eCoast	✓	-	-
Ecospan Environmental Ltd	✓	✓	✓
Environment Agency, Kingfisher House	-	-	✓
Eurofins Omegam BV	✓	-	-
Fish Vet Group	✓	-	✓
Fugro GB Marine Limited (Edinburgh)	✓	-	-
Fugro GB Marine Limited (Gt. Yarmouth)	✓	-	-
Fugro GB Marine Limited (Portsmouth)	✓	-	✓
HEBOG Environmental Limited	✓	✓	✓
Hunter Biological	-	-	✓
Jacobs	✓	-	-
ILVO (Institute for	✓	✓	✓

Agricultural and Fisheries Research) - ANIMALAB			
IMARES Wageningen UR benthos team	✓	✓	-
Institute of Estuarine & Coastal Studies	✓	-	✓
Marine Ecological Surveys Ltd	✓	-	✓
Marine Invertebrate Ecological Services	-	-	✓
Niras Consulting Ltd.	✓	-	-
Myriad Taxonomy	✓	-	✓
Natural England	-	-	✓
NIEA - (DAERA Environment, Fisheries and Marine Group Laboratory)	✓	✓	✓
Ocean Ecology	✓	-	✓
Precision Marine Survey Ltd	✓	-	-
Rijkswaterstaat	✓	-	-
Seastar Survey Ltd	-	-	✓
SEPA	✓	✓	✓
Sue Hamilton	-	-	✓
Thomson Unicomarine Ltd	-	-	✓

8.1.1.2 PSA 2017-2018 Participants:

	Particle Size (PS) Module (intercalibration / training)	Particle Size Own Sample (PS-OS) Module (audit)
ABPmer	-	✓
Agri Food Biosciences Institute (AFBI) NI	✓	✓
APEM	Administrator	Administrator
Benthic Solutions Limited	-	✓
Biotikos Limited	-	✓
Cefas Lowestoft Benthic Laboratory	✓	✓
Cyfoeth Naturiol Cymru / Natural Resources Wales	✓	✓
Fish Vet Group	✓	✓
Fugro GB Marine Limited	✓	-

Gardline Environmental Ltd	✓	✓
Institute of Estuarine & Coastal Studies	✓	✓
Kenneth Pye Associates Ltd	✓	-
Marine Scotland Laboratory	✓	-
National Laboratory Services (EA)	✓	✓
Natural England	-	✓
NIEA - (DAERA Environment, Fisheries and Marine Group Laboratory)	✓	✓
Niras Consulting Ltd.	✓	-
Ocean Ecology	✓	-
Precision Marine Survey Ltd	✓	-
SEPA	✓	✓
Thomson Unicomarine Ltd	✓	-

8.1.1.3 Fish 2017-2018 Participants:

	Ring Test (RT) Module (intercalibration / training)	Reverse Ring Test (RT) Module (intercalibration /training
Environment Agency	✓	✓
Thomson Unicomarine Ltd	Administrator	Administrator
Agri-Food and Biosciences Instititute (AFBI)	✓	✓
Institute of Estuarine & Coastal Studies, University of Hull		✓
SEPA (Scottish Environment Protection Agency)	✓	✓
DAERA NI Environment, Fisheries and Marine Group Laboratory	✓	✓
Fugro EMU Ltd		✓
Ocean Ecology Limited		✓
APEM Ltd		✓
Consorzio per il Centro Interuniversitario di Biologia Marina ed Ecologia Applicata "G. Bacci" (CIBM)	✓	
Precision Marine Survey Ltd		✓
Natural Resources Wales	✓	✓

8.1.1.4 Macroalgae 2017-2018 Participants:

ORGANISATION	RM-RT	OMC-RT	OMB-RT
APEM Ltd	✓		
Department of Agriculture Environment & Rural Affairs (DAERA)	✓	✓	✓
Environment Agency (WSX Blandford)		✓	✓
Environment Agency (EAN Brampton)		✓	✓
Environment Agency (DCS Bodmin)		✓	✓
Environment Agency (DCS Exeter)		✓	✓
Environment Agency (EAN Ipswich)		✓	
Environment Agency (CLA Preston)		✓	
Environment Agency (SSD Chichester)		✓	✓
Environment Agency (LNA Spalding)		✓	✓
Environment Agency (NEA Newcastle)		✓	✓
Fugro EMU Limited	✓		
Natural Resources Wales	✓	✓	
SEPA (Scottish Environment Protection Agency)	✓	✓	✓

8.1.1.5 Phytoplankton 2017-2018 Participants:

- Agri Food and Biosciences Institute (AFBI), Northern Ireland
- APEM Limited, UK
- Aristotle University of Thessaloniki, Greece
- ARPA Campania, Italy
- ARPA FVG, Italy
- ARPA Puglia - DAP BARI - U.O.S. Biologia delle Acque , Italy
- ARPA Puglia Dap Brindisi, Italy
- ARPAE, Italy
- ARPAL, Italy
- Biologia delle Acque - DAP Taranto - ARPA Puglia, Italy
- Cefas, UK
- Department of Primary Industries, Parks, Water & Environment, Australia
- Dipartimento Provinciale di Lecce - ARPA Puglia, Italy
- Fondazione Centro Ricerche Marine, Italy
- IFREMER, France
- Inspectorate Services Perú S.A.C., Chile
- Institut National de Recherche Halieutique, Morocco
- Institut za oceanografiju i ribarstvo (IOR) (Institute of Oceanography and Fisheries), Croatia
- Institute of Marine Research, Flødevigen, Norway
- Instituto de Fomento Pesquero, Chile
- IPMA (Portuguese Institute for Sea and Atmosphere), Portugal

- IRTA, Spain
- Istituto Zooprofilattico Sperimentale della Sardegna, Italy
- Istituto Zooprofilattico Sperimentale delle Venezie , Italy
- Kenya Marine and Fisheries Research Institute, Kenya
- Koeman en Bijkerk bv, The Netherlands
- Laboratorio de Control de Calidad de los Recursos Pesqueros, Spain
- LIttoral ENvironnement et Sociétés (LIENSs) - UMR 7266, France
- Marine Institute, Oranmore/Bantry
- Marine Scotland Marine Laboratory, UK
- MEA-nl , The Netherlands
- Microalgal Services, Australia
- Ministry of Ocean Economy, Marine Resources, Fisheries, and Shipping, Republic of Mauritius
- National Institute of Science and Technology of the Sea, Tunisia
- Northern Ireland Environment Agency (NIEA), Northern Ireland
- NSF INASSA S.A.C., Peru
- Orbicon A/S, Denmark
- Polo specializzazione Biologia avanzata Acque, Italy
- SAMS Research Services Ltd (SRSL), Scotland
- Scottish Environment Protection Agency, Scotland
- Sir Alister Hardy Foundation for Ocean Science (SAHFOS), UK
- SMHI / Swedish Meteorological and Hydrological Institute, Sweden
- Sydney Water, Australia
- UMR Marbec (IRD), France
- University of the Basque Country, Spain
- Wageningen Marine Research , The Netherlands

8.1.2 There is no Zooplankton ringtest planned for 2017-2018

8.1.3 Epibiota component: There are no current participants.