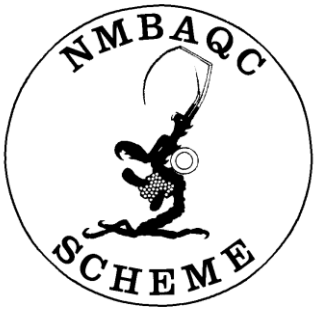

NATIONAL MARINE BIOLOGICAL ANALYTICAL QUALITY CONTROL SCHEME

Annual Report 2014/2015

A report prepared by the NMBAQC Coordinating Committee – June 2016

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This Annual Report provides synopsis of the scheme year's activities over 2014/2015, year 21 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 coordinating committee held 4 meetings during 2014-2015 on 22 July 2014, 10 October 2014, 20 January 2015 and 22 April 2015. The minutes of the meetings are on the NMBAQC web site **http://www.nmbaqcs.org/reports/**.

Committee Membership for 2014/2015 is shown in Appendix 1.

1 Scheme Review

The scope of the NMBAQC scheme continued to develop in 2014/2015 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 Environmental 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).

In 2014/2015 the 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. Tenders were awarded at the start of 2014/2015 to APEM Ltd for the invertebrate and PSA component and to Thomson Ecology Ltd for the fish component. At the end of 2014 the macroalgae tender was up for renewal, and due to the limited number of tenders received, a one year only tender for this component was awarded to Wells Marine in 2015. The macroalgae component tender will be up for renewal in April 2016.

The Year 21 participation level in the NMBAQC scheme 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

Scheme year 2014/2015 (Year 21) followed the format of Year 20. 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.

Thirty-nine laboratories participated in the benthic invertebrate component of the NMBAQC Scheme in 2014/2015 (Year 21). Fourteen participants were Competent Monitoring Authorities (CMAs) and twenty-five were private consultancies. One of the participants was a consortium of sole traders. Seven of the CMA participants were responsible for the Clean Seas Environmental Monitoring Programme (CSEMP) or Water Framework Directive (WFD) sample analysis. Laboratory Codes were assigned in a single series for all laboratories participating in the benthic invertebrate components of the NMBAQC Scheme. Separate Laboratory Codes were assigned for the Particle Size component laboratories.

As in previous years, some laboratories elected to be involved in limited aspects of the Scheme. CSEMP/WFD laboratories were no longer required to participate in all components of the Scheme.

2.2 Summary of results

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

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

The analytical procedures of the various modules were the same as for Year 20 of the Scheme, which includes the specification that the Macrobenthic Sample module and CSEMP/WFD samples within the Own Sample module should be conducted using the NMBAQC guidance for macrobenthic invertebrate sample analysis (**Worsfold, Hall & O'Reilly (Ed.) 2010**). The results for each of the Scheme exercises are presented and discussed. Comments are provided on the performance for each of the participating laboratories in each of the exercises.

Two **Ring Tests (RT)** of 25 specimens were distributed (RT47 and RT48). Both sets contained 25 invertebrate specimens, the second (RT48) was targeted at the polychaete family Syllidae and similar taxa. A draft version of **San Martin & Worsfold, 2015** was included with the circulation data sheets and protocol.

For RT47 each participating laboratory (a total of 20 participants) recorded on average 3.4 generic differences and 6.7 specific differences. Seven taxa (three annelids, two crustaceans, one mollusc and one echinoderm) were responsible for almost two thirds (64%) of the specific differences.

For RT48 each participating laboratory (a total of 18 participants) recorded on average 2.7 generic differences and 7.8 specific differences. Eight taxa (all syllids) were responsible for almost two thirds (64%) of the specific differences.

Laboratory Reference (LR): Five laboratories submitted their specimens for confirmation. Most misidentifications were found to be for Annelida, Gastropoda and Crustacea belonging to genera which are either speciose, or for which the taxonomy has yet to be finalized. The majority of taxonomic errors could be attributed to the submitted polychaetes (53%) and molluscs (18%).

Four laboratories signed up for the **Macrobenthic module (MB)** but the exercise was completed by only two laboratories. Analysis of the sample by the two participating laboratories and subsequent re-analysis by APEM Ltd. provided information on the efficiency of extraction of the fauna, accuracy of enumeration and identification and the reproducibility of biomass estimations. For MB22, natural marine samples from the south west coast of England were distributed. Results for this macrobenthic exercise showed an extraction efficiency (of individuals) was on average 96.95%. Comparison of the results from the laboratories with those from analysis by APEM Ltd. (following the NMBAQC macrobenthic analysis guidelines) was made using the Bray-Curtis similarity index (untransformed). The value of the index varied between 84% and 89% meaning both laboratories failed when Own Sample standards were applied. Both failures were due to identification differences which ranged from 10 to 12 total errors.

The revised protocols of Scheme Year 10 for 'blind' **Own Sample (OS)** audits were continued in this Scheme year. 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 **Description of the Scheme Standards for the Benthic Invertebrate Component**). In OS56-58, extraction efficiency was better than 90% in 83% of the comparisons and better than 95% in 71% of all comparisons. 100% of countable taxa were extracted from the sample residues in 48% of samples. No residue was submitted for checking in the case of two samples and residue had been discarded on the instruction of the client for a further two samples. The Bray-Curtis similarity index ranged from 52% to 100% with an average figure of 92%. The Bray-Curtis similarity index was greater than 95% in 58% of comparisons and in 77% 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%.

2.3 Issues and recommendations

A number of laboratories use the ring tests for training purposes and have selected them preferentially over other modules. CSEMP/WFD laboratories are required to participate in this exercise though the results are not used to assign 'Pass' or 'Fail' flags.

Misidentifications for lab reference collections were usually found for polychaete, amphipod and gastropod mollusc species and belonging to genera which are either speciose or for which keys are inadequate.

For the Own Sample module, the total numbers of samples for which the participating laboratories submitted data to APEM Ltd to choose for audit ranged from 11 (less than the requested minimum of 12) to 493, with an average of 67 samples. It is evident that some laboratories use the Scheme as a complete audit check of their entire year's work, whereas some laboratories chose certain projects for submission, and may even do so prior to analysis. Since the beginning of the Own Sample Module, 1211 admissible samples have been received (OS01-58). Of these, 230 samples (21%) have fallen below the 90% Pass mark. Overall, these results are acceptable and show the efficacy of the OS module, although a dip in quality has been noticed in year 20 and 21 compared with the previous four years. Some participating laboratories should be able to improve their results by reviewing their extraction methods and their use of taxonomic literature and identification keys.

2.4 Reports & Taxonomic literature

Benthic Invertebrate Component Annual Report, Year 21 (2014/15)

Milner, C., Hall, D.H., and O'Reilly, M., 2016. Benthic Invertebrate component - Report from the contractor. Scheme Operation - Year 21 2014/15. A report to the NMBAQC Scheme co-ordinating committee. 34pp, June 2016

Own Sample Module Summary Report OS56, 57 & 58 - October 2015

Milner, C., Hall, D. and O'Reilly, M. (Ed.) 2015. National Marine Biological Analytical Quality Control Scheme. Own Sample Module Summary Report OS56, 57 & 58. Report to the NMBAQC Scheme participants. 22pp, October 2015.

RTB 48- Aug 2015

Milner, C., Worsfold, T., Hall, D. & Pears, S., 2015. National Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB#48. Report to the NMBAQC Scheme participants. APEM Report NMBAQC RTB#48, 23pp, August, 2015.

RTB 47- Feb 2015

Milner, C., Hall, D., Worsfold, T., Ashelby, C. & Pears, S., 2015. National Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB#47. Report to the NMBAQC Scheme participants. APEM Report NMBAQC RTB#47, 37pp, February, 2015.

MB22 – September 2015

Milner, C. and Hall, D.J. 2015. National Marine Biological Analytical Quality Control Scheme. Macrobenthic Exercise Results - MB22 (2014/2015). Report to the NMBAQC Scheme participants. 9pp, September 2015.

Workshop key and Appendices citations (Zip file):

- Identification guide to Northern European interstitial opisthobranchs (Gastropoda: Heterobranchia), 2015
- Brenzinger, B. 2015. Identification guide to Northern European interstitial opisthobranchs (Gastropoda: Heterobranchia). Version 2.1. NMBAQC 2014 taxonomic workshop, Dove Marine Laboratory. 23pp, August 2015.

- Identification guide to Northern European interstitial opisthobranchs (Gastropoda: Heterobranchia) Key Appendix, 2015
- Brenzinger, B. 2015. Identification guide to Northern European interstitial opisthobranchs (Gastropoda: Heterobranchia). Keys Appendix, Version 2.1. NMBAQC 2014 taxonomic workshop, Dove Marine Laboratory. 3pp, August 2015.

Guide and keys for the identification of Syllidae (Annelida, Phyllodocida) from the British Isles (reported and expected species).
San Martín, G. & Worsfold, T.M. 2015. Zookeys, 488 pp.1-29.

Guide to identification of Sabellidae and Fabriciidae (Polychaeta) in north east Atlantic and Mediterranean waters, 2015
Giangrande, A., Licciano, M. & Wasson, B. 2015. Guide to identification of Sabellidae and Fabriciidae (Polychaeta) in north east Atlantic and Mediterranean waters. NMBAQC 2014 taxonomic workshop, Dove Marine Laboratory. 91pp, January 2015.

For further taxonomic literature, see the NMBAQC web site, **Literature and Taxonomic Keys for the invertebrate component.**

3 Particle Size Analysis component

Contract Manager: Claire Mason, Cefas.
Component Administrator: David Hall, APEM Ltd.

3.1 Summary of activities

The 2014/15 NMBAQC scheme year saw the administrative contractor for the Particle Size component change from Thomson Unicomarine Ltd to APEM Ltd.

The **Particle Size (PS)** module followed the format of 2013/14. A series of exercises involved the distribution of test materials to participating laboratories and the centralised examination of returned data and samples.

As well as the regular PS module, the 2014/15 scheme year introduced a new module into the particle size component; the **Particle Size Own Sample (PS-OS)** module. The purpose of this exercise was to examine the accuracy of particle size analysis for participants' in-house samples. The Particle Size Own Sample module is a training / audit module. Participants' samples are re-analysed by the NMBAQC Scheme PSA contractor and the results are compared. PS-OS exercises will carry pass/fail criteria; these criteria will be reviewed and assessed in this annual report. In this Scheme year 21, (2014/15), results will not be used to assess the performance of a laboratory.

Fifteen laboratories participated in the 2014/15 PS module's exercises (PS52, PS53, PS54 and PS55); six were government laboratories; nine were private consultancies. Eight laboratories participated in the PS-OS module's exercises (PS-OS01, PS-OS02 and PS-OS03); six were government laboratories and two were private consultancies.

The PSA guidance has been updated as a result of comments received through the scheme. There are no fundamental changes, and these changes are aimed at refining details. The updated guidance is available at **http://www.nmbaqcs.org/scheme-components/particle-size-analysis/reports/psa-guidance/.**

3.2 Summary of results

The samples distributed as PS52, PS53, PS54 and PS55 appeared from an analysis of replicates to be good replicates with very little variance. Results from participating laboratories showed a general similarity in distribution curves, except for that of PSA_2107 in PS52; who provided data that was a mix up between PS52 and PS53 for the interim report. They were subsequently sent spare replicates and repeated the exercises with a satisfactory result.

PSA_2107 had the same issues with PS53 as with PS52, and they were sent a spare replicate PS53 sample to re-analyse, which was returned with a satisfactory result. PSA_2111 provided good raw sieve and laser data for PS53 but did not merge these data correctly, resulting in the final merged data having a much higher percentage of gravel. The main issue with exercise PS54 was whether or not to incorporate the base sieve pan weight into the final merged data. Three labs (PSA_2110, PSA_2113 and PSA_2114) did not include the base pan weight into the final data but divided by the total initial dried weight > 1mm to create percentages. This caused the final data not to equal 100%. The weights recorded in the base pan are only very small but can still have an impact. For example, by recording this small weight in the 0 to 0.5phi category has caused lab PSA_2101 to record a z-score greater than 1.96, suggesting that PSA_2101 were outliers when in fact they entered the data correctly, this shows another weakness in the z-score approach to comparing data.
PSA_2111 was the main deviant in PS55 by recording a much higher percentage of sediment <1mm. Subsequent communication revealed that this was due to the recorded weight being a wet weight rather than the dry weight specified for the NMBAQC methodology.

Participating laboratories were asked to provide a visual description of the PS52, PS53, PS54 and PS55 samples prior to analysis and instructed to describe the sediment using the Folk triangle post analysis, as well as to report the percentages of gravel, sand and silt/clay in each exercise. Data were provided by all but two (PSA_2110 and PSA_2111) participating laboratories for PS52 and PS53, all laboratories for PS54 and all but one (PSA_2110) for PS55. APEM Ltd checked participants calculations using GRADISTAT based on the participants' final merged data. Of the data provided for PS52, all were correct apart from PS_2112, who provided data that was 1% out for sand and silt/clay. All data provided for PS53 and PS54 was correct. For PS55 two laboratories (PSA_2106 and PSA_2114) had summary statistics that differed from the APEM verification. However, these discrepancies were only small, 0.4% in both cases.

Eleven laboratories originally subscribed to the PS-OS module in 2014/15. Of these eleven, three pulled out and did not participate and four laboratories did not submit returns for any of the exercises. Of these four laboratories, one did not provide any explanation for their non-participation. The other three sets of PS-OS samples

belonged to one participant who sub-contracted their work. A concerted effort was made by APEM, the contract manager Claire Mason and the participant to obtain the samples from the subcontractor. However, Year 2015-2016 was well under way before the matter could be resolved and it was decided that it was too late to now process the Year 21 (2014/2015) samples. All labs involved now understand the PS-OS protocol and have submitted data sets and samples for Year 2015/2016.

Each laboratory received detailed comparisons of their data to the re-run by the NMBAQC Scheme's contractor along with a provisional pass/fail flag. Of the four laboratories that submitted data the correlation between the participant results and the NMBAQC Scheme contractor results were good. Based on the provisional pass/fail criteria being trialled, 91.6% of the samples would receive a Pass flag.

Labs generally provided workbooks with all the correct information. Three labs provided all necessary fractions of their sample for re-analysis. One lab (PSA_2103) did not provide any laser sub-sample, the < 1mm fraction for laser analysis was therefore reconstituted from the dried <1mm fraction. This caused these samples to have a slightly larger coefficient of variance; this was considered when comparing the samples.

3.3 Issues and recommendations

Laboratories should ensure that their PS results are reported in the requested format and data should be reviewed before submission. Data should be provided at half phi intervals to enable the direct comparison of data from all participants and simplify the creation of cumulative curve figures. The workbook was modified for use in 2014/15 to assess whether laboratories are merging data correctly in their in-house methods. It is therefore even more important that that data are reported correctly. Raw sieve data should be reported in grams, with the >1mm and <1mm weights provided. Raw laser data should be reported as volume percentages. (NB, following the conversion of sieve weights to weight percentages the data are merged with the volume percentages obtained from the laser analysis on the basis of weight proportions of the wet separated >1mm and <1mm fractions; merging of weight per cent and volume percent data introduces degree of error in the final merged data frequency distribution, but this is relatively small for most sample types).

Particle Size exercises (PS) over the past twenty years have shown differences in the results obtained by different techniques (laser and sieve / pipette), in-house methods (e.g. pre-treatment) and also differences between equipment (e.g. Malvern Mastersizer 2000, Mastersizer X and Coulter LS230 lasers). The PS data also indicate that the variance between laser and sieve results is further emphasised by certain sediments characteristics, notably particle shape and density (Blott and Pye, 2006; Blott et al., 2004). The overall range of these variances needs to be determined if combining data sets derived from different methods. It is essential that particle size data are presented with a clear description of the method of analysis and equipment used, including nature of any ultrasonic or other dispersion process, and the optical model values which have been assumed.

The Year 21 PS-OS module highlighted differences in methodology between laboratories, particularly in the creation of laser data (at those laboratories where laser diffraction is used). Some labs clearly use methods that vary substantially from those described in the NMBAQC's Best Practice Guide. In view of the results obtained from the Year 21 PSA exercises, and from parallel experimental work undertaken by the NMBAQC QC analytical contractor, the need has been identified for certain aspects of the Guidance to be clarified and modified. It is intended that these amendments to the Guidance will be published shortly. It has been suggested by KPAL that, for the vast majority of samples, the accuracy of reported results does not increase greatly with analysis of multiple replicates and averaging of the data obtained, provided that appropriate guidelines for sample mixing, sub-sampling and dispersion are followed, and that perhaps the guidance should be updated to reflect this.

The current NMBAQC Scheme standards for PSA are under review. The alternative use of z-scores for each phi-interval, trialled in Scheme Year 17 appears inappropriate for such a low number of data returns where two erroneous results can significantly alter the pass / fail criteria. The z-score method also assumes that the data submitted by the majority of respondents are broadly correct; the fact that this is not always the case raises genuine concerns regarding technique and method bias. Alternative flagging criteria using z-scores descriptive statistics combined with robust statistics have been reviewed during the current year and will used to inform quality assessment procedures in future years.

3.4 Reports

PSA Component Annual Report, Year 2014/2015

Finbow, L, Pye, K. and Hall, D. Particle Size component - Report from the contractor. Scheme Operation - Year 2014/2015. A report to the NMBAQC Scheme co-ordinating committee. 21pp, Feb 2016.

PS55 February 2015

Finbow, L. & Hall, D., 2015. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS55. Report to the NMBAQC Scheme participants. Apem Report NMBAQCps55, 43pp, February 2015.

PS54 February 2015

Finbow, L. & Hall, D., 2015. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS54. Report to the NMBAQC Scheme participants. Apem Report NMBAQCps54, 43pp, February 2015.

PS53 December 2014

Finbow, L. & Hall, D., 2014. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS53. Report to the NMBAQC Scheme participants. Apem Report NMBAQCps53, 47pp, December 2014.

PS52 December 2014

Finbow, L. & Hall, D., 2014. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS52. Report to the NMBAQC Scheme participants. Apem Report NMBAQCps52, 45pp, December 2014.

NMBAQC's Best Practice Guidance - Particle Size Analysis

Mason, C. 2011. NMBAQC's Best Practice Guidance. Particle Size Analysis (PSA) for Supporting Biological Analysis. National Marine Biological AQC Coordinating Committee, 77pp, Updated 2015.

4 Fish component

Contract Manager: Jim Ellis, Cefas.
Component Administrator: Sarah Hussey, Thomson Unicomarine.

4.1 Summary of activities

The Fish component of the scheme commenced in its 2005/06 (Year 12). The 2014/15 format for year 21 followed the previous year.

Fish Ring Test (F_RT): - Identification of one set of fifteen different fish specimens circulated by the component administrator.
Fish Reverse Ring Test (F_RRT): Re-identification of a set of fifteen different fish specimens supplied by each of the participating laboratories to the component administrator.

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

Twenty nine laboratories / fish teams participated in the Fish component of the Year 2014 / 2015 NMBAQC Scheme. Twenty four participants were government laboratories / fish teams, and five were private consultancies. Although some fish are sampled under the Clean Seas Environmental Monitoring Programme (CSEMP) the number of target species is relatively few. However the requirement to monitor fish communities in transitional waters for the Water Framework Directive (WFD) provides the major impetus for fish component exercises.

4.2 Summary of results

Ring Test (F_RT08) - this was the eighth fish ring test circulated through the NMBAQC Scheme and the results were comparable with those from the seven previous exercises (RT28 (F_RT01), RT31 (F_RT02), RT33 (F_RT03), F_RT04, F_RT05, F_RT06 and F_RT07) with a high level of agreement between participating laboratories for the majority of distributed species. The Fish Ring Test F_RT08 contained fifteen fish specimens. The agreement at the generic level was good; twenty one errors (from a potential two hundred and fifty five) were recorded from the seventeen data sets received via the sixteen participating laboratories. Agreement at the specific level was also good; with twenty nine differences recorded. Three laboratories (F_2102, F_2110 and F_2116B) correctly identified all of the specimens. Four of the fifteen circulated species were

correctly identified by all participating laboratories (*Dicentrarchus labrax, Agonus cataphractus, Scomberesox saurus,* and *Merlangius merlangus*). Differences were across a relatively broad range of taxa, some of which are described below. The majority of the generic and specific differences were recorded from *Pleuronectes platessa* and *Cottus gobio* with the next highest number of differences recorded from *Trisopterus luscus*, *Oncorhynchus mykiss* and *Sprattus sprattus*.

The F_RT component is considered to provide a valuable training mechanism and be an indicator of problematic groups and possible areas for further targeted exercises or inclusion at taxonomic workshops. Multiple data entries from some laboratories and the inclusion of images in the ring test bulletins (RTB) have further emphasised the learning aspect of these exercises. F_RT08 indicated that the majority of laboratories are using the same three literature works to identify most specimens: Wheeler, A. (1969) The fishes of the British Isles and North West Europe. Macmillan, London; Wheeler, A. (1978) Key to the fishes of Northern Europe. Warne, London and Maitland, P.S. & Herdson, D. (2009) Key to the Marine and Freshwater Fishes of Britain and Ireland. Environment Agency, UK. 476pp. However, only eight of the seventeen data submissions provided information as to the literature used for identification.

Ring test specimens were sent to participating laboratories preserved in 70% alcohol which could have made identifications more difficult to conclude than if they were sent out frozen. Frozen specimens tend to maintain their integrity and preserve colour better than those in alcohol. Deterioration of ring test material may have also contributed to some mis-identifications; reasons for this include fin and scale damage due to repeated examination which could result in inaccurate fin ray and scale counts. Further details and analysis of results can be found in the fish ring test bulletin (Fish Ring Test Bulletin – F_RT08) which was circulated to all participants and is available on the Scheme's website (www.nmbaqcs.org).

Reverse Ring Test (F_RRT06) - in the majority of instances, identifications made by Thomson Unicomarine Ltd. were in agreement with those made by the participating laboratories with thirty errors occurring from a potential three hundred and twenty. Most identification issues were associated with gobies, with misidentifications amongst the following species: *Pomatoschistus microps; Pomatoschistus minutus* and *Pomatoschistus pictus.*

Ten out of the forty six goby specimens submitted by participating laboratories were identified incorrectly. The grey mullets were another taxonomic group with which identification issues were associated (*Liza aurata; Chelon labrosus* and *Liza ramada*). Similar errors were noted in the previous two reports F_RRT05 and F_RRT04.
There were also discrepancies for other groups including the herrings, pipefish, gurnards and sandeels. Potentially difficult taxa such as the grey mullets could be specifically targeted in future fish ring tests (F_RT exercises) to quantify and resolve problems via the circulation of standardised specimens

4.3 Reports

FRT 08 April 2015

Hussey, S., 2015. National Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: FRT#08. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb#08, 20pp, April 2015.

RRT 06 - March 2015

Hussey,S., 2015. National Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test: FRRT05. Final report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQC FRRT06, 33pp, March 2015.

Fish Component Annual Report, Year 21 (2014/15)

Hussey, S., 2015. Fish component - Report from the contractor. Scheme Operation - Year 21 - 2014/15. A report to the NMBAQC Scheme co-ordinating committee. 15pp, July 2015.

5 Phytoplankton component

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

5.1 Summary of activities

- The Phytoplankton Bequalm intercomparison study in 2014 was designed to test the ability of analysts to identify and enumerate correctly marine phytoplankton species in lugol's preserved water samples. As in previous years, samples have been spiked using laboratory cultures. There were six species of interest in this intercomparison exercise. These were: *Chaetoceros diadema* (Ehrenberg) Gran, *Rhizosolenia setigera* Brightwell, *Paralia sulcata* (Ehrenberg) Cleve, *Pseudo-nitzschia australis* Frenguelli, *Heterocapsa triquetra* (Ehrenberg) F.Stein and *Thalassiosira punctigera* (Castracane) Hasle.
- Collaboration between the Marine Institute in Ireland and the IOC UNESCO Centre for Science and Communication of Harmful algae in Denmark on the Bequalm intercomparison exercise commenced in 2011. This collaboration involves the use of algal cultures from the Scandinavian Culture Collection of Algae and Protozoa in Copenhagen, cultures isolated from field samples and from the Marine Institute culture collection. This collaboration also includes the elaboration of a marine phytoplankton taxonomy quiz using an online platform called 'Ocean Teacher'. This online Harmful Algal Bloom (HAB) quiz was designed by Jacob Larsen (IOC) and Rafael Salas (MI).
- This year, 64 analysts from 40 laboratories took part in this intercomparison. All analysts returned sample and online HAB quiz results. A laboratory from New Zealand participated in this exercise for the first time.
- Most laboratories are based in Europe (32): Ireland (3), Northern Ireland (1), Scotland (3), England (5), France (12), Netherlands (2), Sweden (1), Spain (2), Croatia (1) and Greece (1). Laboratories outside Europe (9): Morocco (6), Tunisia (1), New Zealand (1) and Peru (1).
- Also, as part of this intercomparison exercise, a training workshop is held annually to discuss the results of the intercomparison exercise and to provide

training in some areas of interest on phytoplankton taxonomy to the participants. This workshop has been held in various places over the years and it has taken the format of a 2 ½ days training workshop with at least 1 ½ days dedicated to lectures on algal groups in rooms equipped with microscopes and using live cultures. This workshop has become an important forum for scientists working on phytoplankton monitoring programmes from around the world to convene and be able to discuss taxonomical matters related to monitoring, new advances and finds, taxonomical nomenclature changes, looking at samples from different geographical areas and listen to relevant stories from other laboratories about issues with harmful algal events in their regions and of high ecological importance. (The workshop programme is shown in Appendix 4)

5.2 Summary of 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.
- The homogeneity test was passed for 4 out 6 measurands and the stability test passed for four out 6 measurands. *R.setigera* and *H.triquetra* failed the homogeneity test and *H.triquetra* and *P.sulcata* failed the stability test.
- The assigned values standard uncertainty was found to be negligible for all test items. The comparison of the assigned value appear not to be negligible, however, the comparison is not equal between the homogeneity test and the analysts results as the volume analysed is different.
- Z-scores show four warning signals for the *C.diadema* count for analysts 16, 28, 57 and not identified by 60, five warning signals for the *H.triquetra* count, one for analyst 43 and not identified by analysts 16, 34, 56 and 57. Six warning (analysts 21, 27, 31, 32, 33, 45) and two action signals (analysts 38, 54) for *P.australis*. Two warning (55, 57) and two action signals (37, 56) for P.sulcata count. Six warning (23, 31, 34, 37, 45, and 54) and two action signals (43, 56) for *R.setigera* and five warning (15, 19, 27, 31, and 32) and two action signals (16, 50) for the *T.punctigera* count.
- Mandel's h shows that analysts 16, 37 and 56 exhibit significantly higher or lower mean values across all measurands compared to the rest. This may suggest some source of bias. Mandel's k statistics shows that analyst; 7, 33, 43 and 50, exhibit poorer repeatability precision across all measurands.
- RLP versus RSZ plot indicates significant systematic underestimation deviations of the measurement values of several analysts. Analysts 56, 37 and 57 shows systematic underestimation on all test items and poor mean deviation suggesting some kind of methodology bias.
- The repeatability standard deviation plots show poor repeatability for *P.australis*, *R.setigera* and *T.punctigera* cell counts. There is good correlation, however with *C.diadema, H.triquetra* and *P.sulcata* counts for most analysts.
- The diatoms *P.sulcata* and *R.setigera* appear to be the easiest species to identify in the samples.

- *H.triquetra* was also easy to identify. Four analysts did not identify the species in the sample, possibly because it had the lowest cell density in the samples of all the measurands. *C.diadema* gave the widest variability of answers of all the measurands at species level. All participants, identified correctly to genus level except for one 'not id'. Most analysts identified *Pseudo-nitzschia* to genus level only as 'seriata complex'. *Thalassiosira* appeared to be the most difficult species to identify in the samples even at genus level.
- The Ocean teacher online HAB quiz results suggests a high rate of proficiency. 32 analysts (50%) scored above the 90% mark, 18 analysts (29%) scored above the 80% mark, 6 analysts (10%) over 70% and the rest (7 analysts (11%)) below 70% needing improvement. Overall, 88% was the mean overall grade for all analysts.
- The video question was the worst answered. Short answer questions created problems and analysts committed some spelling and grammar errors which cost them some points. There was consensus on numerical questions indicating that we all have a similar approach to enumeration. Theoretical knowledge of algal groups doesn't seem to translate into better answers to identification questions on the same algal groups, as with *Pseudo-nitzschia* and *Protoperidinium* questions.

5.3 Reports

This intercomparison exercise has been coded in accordance with defined protocols in the Marine Institute,for the purposes of quality traceability and auditing. The code assigned to the current study is PHY-ICN-14- MI1. PHY standing for phytoplankton, ICN for intercomparison, 14 refers to the year 2014, MI refers to the Marine Institute and 1 is a sequential number of intercomparisons for the year. So, 1 indicates the first intercomparison for the year 2014. The full report is available from the NMBAQC website via the following link:

Phytoplankton Enumeration And Identification Ring Test, 2014

Salas, R.G., Larsen, J., 2014. BEQUALM Phytoplankton proficiency test in the abundance and composition of marine microalgae 2014 report. PHY-ICN-14-MI1 VR 1.0. 98pp.

6 Macroalgae component

Contract Manager: Clare Scanlan, Scottish Environment Protection Agency.
Component Administrator: Emma Wells, Wells Marine.

6.1 Summary of activities

The Macroalgae component of the scheme commenced in its 2005/06 (Year 12). The 2014/15 format for Year 21 followed the previous year.

The component consisted of three modules:

- **Rocky Shore Macroalgae Ring Test (RM - RT)**: - Identification of twenty macroalgae species based on a series of images.

- **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.

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

6.1.1 Rocky shore Macroalgae Ring Test (RM-RT09)

Seven laboratories subscribed to the macroalgae ring test with six laboratories submitting results with an overall total of fifteen participants. One laboratory failed to submit results due to time restrictions. Five of the submitting laboratories were government organisations and two private consultancies.

6.1.2 Opportunistic Macroalgae Biomass - Ring Test (OMB-RT06)

The format followed that of previous years of the test (OMB RT01 – RT05 - see NMBAQC website). Nine laboratories were issued with test material. All nine laboratories completed the macroalgae biomass module with a single laboratory submitting two sets of results. All of the participating laboratories were government; no private consultancy took part.

6.1.3 Opportunistic Macroalgae/Seagrass Cover - Ring Test (OMC-RT06)

This module included a single exercise for macroalgae and one for seagrass both of which had three test options based on individual laboratories' methodologies. The format followed that of previous years (OMC RT01 – OMC RT05). Thirteen laboratories were issued test material. All laboratories completed the % cover macroalgae/seagrass module with a total of 38 participants. Participation in each test option varied. All laboratories submitting results were government organisations.

6.2 *Summary of exercise results*

6.2.1 Rocky shore Macroalgae Ring Test (RM-RT09)

There was an excellent level of agreement through all participants. At the generic level there were a total of fourteen differences (4.7%). At the specific level there were a total of thirty two differences (10.7%). These differences were mostly attributed to four taxa. A total of 35% of all errors were from one species (*Helminthocladia calvadosii*) contributing to 57% of all generic differences and 25% of all specific differences. *Ulva prolifera, Cladophora sericea* and *Ulva flexuosa* contributed to a further 13%, 22% and 30%, respectively, of differences. Therefore a total of 65% of incorrect identifications were attributed solely to the Chlorophyta division most of which were incorrectly identified at the species level (80%). All other specimens were identified correctly.

There were a number of incorrect spellings mainly attributed to changes in nomenclature such as *Polyides sp.* which was previous named as *P. rotundus* but is now

recorded within algaebase as *P. rotunda* and *Pilayella littoralis* now recorded as *Pylaiella littoralis.* However, both current names and synonyms were accepted for the ring test.

6.2.2 Opportunistic Macroalgae Biomass - Ring Test (OMB-RT06)

There was a wide range of both wet and dry weights which was greatest for the algae mass of the largest weight from both dry and wet weights. This is consistent with all previous OMB tests. For wet weight the range of results was 270.29 – 405.15 (Sample A), 177.81 – 311.16 (Sample B) and 56.97 – 81.11 (Sample C). This clearly indicates a degree of variation in data and lack of consistency between laboratories during the rinsing and squeezing of the samples particularly within the larger sample sizes (Samples A and B). The large degree of variation in wet weight results are primarily a result of the non-specific method of squeezing and rinsing.

The dry weights results displayed a couple of large outliers. These indicate some problems during the processing of the samples. This may be due to inadequate rinsing or incomplete drying. The average wet weights suggests the samples were not dried fully prior to weighing. However, in contrast, sample C was much more comparable in terms of wet weight and dry weight, indicating the correct procedures were being used. Sample C was the smallest sample size and as seen in previous tests had the most consistent set of results.

The range of results for both the dry and wet weights could generally be considered acceptable. Two results were flagged as 'Fail', when using Z-scores based on sample mean of wet weights for Laboratories with a Z-score of 2.02 for sample B and a Z-score of -2.1 for sample C. Two additional 'Fails' were flagged for the comparison of dry weight against the sample mean with a Z-score of 2.347 (sample A) and 2.183 (sample C). In general a Z-score of <2 is considered satisfactory, one >2 and <3 indicates "questionable" performance and generates a warning signal and a Z-score of >3 indicates "unsatisfactory" performance. This means that no results were actually "unsatisfactory" but performance should be investigated. A second Z-score based on deviation from the actual known dry weight resulted in a total of four 'Fails'. The largest anomalies were a z-score of 3.029 (sample A), 2.899 (sample B) and 3.365 (sample C).

6.2.3 Opportunistic Macroalgae/Seagrass Cover - Ring Test (OMC-RT06)

Z-scores were used for either the mean % cover per quadrat or the % cover as calculated by ImageJ. The results could then be compared between participants, and between method of cover estimation for both macroalgae and seagrass. The results generally show a higher level of consistency between participants when comparing with the population mean. This was apparent across all tests for both macroalgae and seagrass. In conjunction with this there were a greater number of Z-scores failures when comparing the image analysis % cover with the population mean of the quadrats. This is consistent with previous years. This indicates either a lack of accuracy in % cover estimations or inaccurate % cover results produced using ImageJ.

The overall range of results submitted is still highly variable with some quadrats having estimated ranges in excess of 50% indicating a high degree of participant error. The level of success rate for individuals was not completely consistent between tests with the greatest number of 'Fails' for each test being attributed to different people, however some people regularly produced a higher deviation from the mean and ImageJ results than others. As with previous years this provides some evidence that different methods of % cover estimation provide varying levels of success for the different participants, making it difficult to conclude which method is the best in terms of producing the most accurate result. It seems this is highly dependent upon the participant.

The degree of deviation from the image analysis % cover value depended significantly upon the quadrat. Some quadrats were more problematic than others; this was consistent with the range of % cover and could be partly attributed to the more patchy coverage of opportunist algae, and particularly seagrass, in some quadrats which is much harder to estimate accurately.

In general the pass rate using Z-scores against image analysis showed a much higher number of 'Fails', in total this amounted to 188 and 183 within the macroalgae and seagrass tests respectively. This was significantly higher than when results were compared against the sample mean producing a total of 47 and 48 'Fails' for the macroalgae and seagrass respectively. This number of 'Fails' is also higher than for previous years suggesting a difficult test in terms of % cover ranges. This trend is also apparent across all years with image analysis z-scores consistently resulting in a higher number of 'Fails' compared with z-scores from the mean with the greatest number of 'Fails' consistently being recorded from test C (9 x 9 cross hairs).

6.3 *Issues and recommendations*

General

Participants have not all followed instructions correctly, which presented problems for the contractor. This included miss-spelling of taxon names (not checked properly); not including authority for taxon name; not completing spreadsheets properly; including information in email and formats other than the specified one. Participants will be reminded for future exercises that they must return information in the correct formats, otherwise data may not be accepted.

Participants were previously consulted on the timing of exercises and the great majority of respondents preferred early in the year. Consequently all exercises were sent out at the start of January, with a six week period for return of results. Reports will then be available in good time for the start of the sampling season, so that key training areas can be addressed.

6.4.1 Marine algae identification

The most problematic species was *Helminthocladia calvadosii* which may be considered relatively difficult to identify due to the occurrence of morphologically similar species such as *Dumontia contorta*. Another issue arose with *Gracilaria gracilis*. This is a fairly common species, but with limited distribution and highly variable morphology. Similar species have overlapping characteristics, and it was considered that this overlap between *Gracilaria gracilis and Gracilariopsis longissima* was sufficient to justify accepting both names on this occasion. Keying out the two species shows very little difference except for some basic morphological differences, or at the microscopic level which was not fully evident through the photos provided. This problem highlights the need for more definitive photos, specimens and descriptions to be provided in future exercises so as to save confusion. However, it is not always possible to obtain specimens showing certain features if they are not in the correct reproductive phase. In this instance it was also unclear which keys or guides were used by all individuals to identify the species making them impossible to compare.

6.4.2 Opportunistic macroalgal biomass

There is now a general agreement that the use of artificial material to mimic algae is an acceptable surrogate for the test. It was noted by some labs that there was a limited representation of small, finer, low biomass algae, such as *Cladophora*. It may be possible in subsequent tests to incorporate alternative materials more representative of the texture of opportunist algae.

Some participants still question the necessity to incorporate both dry and weights within the ring test. The dry weight of algal samples is included 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 definitive 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. The dry weights are also now being used to calculate an expected wet weight from which to compare results.

Most laboratories submitted dry weight values that were considered well within an acceptable limit of the actual biomass; however wet weight still remains highly variable. Therefore the level of squeezing still remains an issue. In addition, some laboratories only measure the dry weight. Therefore, for such an exercise to be appropriate this measure of biomass needs to remain within the test.

It was suggested that the mud added to the sample, to enable a more realistic comparison with field procedures, should include a variety of debris such as *Hydrobia* shells.

It is evident that the larger samples create a greater margin of error with far less consistency between laboratories. However, these samples are more representive of

natural conditions. Future tests will be aimed at including a good range of weights but focusing on some much larger biomass weights.

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.

6.4.3 Percentage (%) cover of opportunistic macroalgae and seagrass

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.

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. This will be investigated using all data in the future.

Image analysis should be 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.

During field sampling it may be possible to estimate % cover of opportunist algae with a higher degree of 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. Sometimes it is difficult to accurately count algal cover when obscured under cross hairs, this would not be an issue in the field, but cannot be prevented within the test, therefore it remains important to include the open quadrat test method for a full view of the quadrat. However attempts will be made for subsequent ring tests to make the grids opaque to increase the level of visibility under the cross hairs

As many laboratories take quadrat photos whilst estimating % cover for in house quality control, it has been suggested that a reverse ring test could be included in the % cover component. This would enable laboratories to submit their own quadrat photos for analysis. This still remains to be discussed for inclusion in future ring tests

6.4 Taxonomic literature & reports

RM RT09 Final report April 2015

Wells, E., 2015. National Marine Biological Analytical Quality Control Scheme-Macroalgae Identification Component Report -RM RT09 2015 Year 21. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

RM RT09 Preliminary report March 2015

Wells, E., 2015. National Marine Biological Analytical Quality Control Scheme- Ring Test Bulletin -RM RT09 2015 Year 21. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

OMC Macroalgae & Seagrass RT06 Final Results Bulletin April 2015

Wells, E., 2015. National Marine Biological Analytical Quality Control Scheme- Macroalgae and Seagrass % Cover Module Report - OMC RT06 2015. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

OMC Macroalgae RT06 Preliminary Results Bulletin March 2015

Wells, E., 2015. National Marine Biological Analytical Quality Control Scheme- Ring Test Bulletin - Macroalgae OMC RT06 2015. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

OMC Seagrass RT06 Preliminary Results Bulletin March 2015

Wells, E., 2015. National Marine Biological Analytical Quality Control Scheme- Ring Test Bulletin - Seagrass OMC RT06 2015. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

OMB RT06 Final Report April 2015

Wells, E., 2015. National Marine Biological Analytical Quality Control Scheme- Macroalgae Biomass Module Report -OMB RT06 2015. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

OMB RT06 - Preliminary Report March 2015

Wells, E., 2015. National Marine Biological Analytical Quality Control Scheme- Ring Test Bulletin - Macroalgae Biomass-OMB RT06 2015. Report to the NMBAQC Scheme participants. Wells Marine Surveys.

7 Epibiota component

Component Administrator: Dan Bayley (until Sept 2014) and Emma Verling (Sept 2014 onwards), JNCC.

7.1 Summary of activities

JNCC have been working on a draft of the Epibiota Guidelines and comments from the NMBAQC Committee, NMBAQC participants and other interested parties were welcomed and included. It was decided to break the guidance down into two sections, an 'operational guidelines' section and an 'interpretation guidelines' section. The operational guidelines are in the final revision stage and JNCC is currently working on producing a draft of the Interpretation Guidelines.

7.2 Summary of results

The operational guidelines are close to be finalised and to be ready for implementation, as part of the revised Marine Monitoring Handbook, which is currently being updated. The results from Natural England's epibiota workshop became available this year. These are available for download from the NMBAQC web site.

7.3 Taxonomic literature & reports

Epibiota Video Workshop Summary Recommendations, 2014
Epibiota Video Workshop: Summary Recommendations. Version 4. Compiled by Sue Ware. July 2014

8 Zooplankton component

Component Administrator: David Johns & Astrid Fischer, SAHFOS.

8.1 Summary of activities

In January 2013 SAHFOS on behalf of NMBAQC sent out a questionnaire to organisations known to be involved in zooplankton research. The questionnaire was aimed at gauging current quality control mechanisms, as well as identifying possible interest in a zooplankton ring test, similar to the other NMBAQC components. Zooplankton are an MSFD indicator group, however, there are no current standards for their sampling. As such a quality control mechanism for the correct identification was identified by the Healthy and Biodiverse Seas Evidence Group (HBDSEG) to be one of the areas that NMBAQC should investigate.

SAHFOS prepared a UK Zooplankton trial ring test, which was a follow-on from the questionnaire, to assess current identification levels and to determine the best way forward. A ring test containing 10 actual zooplankton specimens from the North Sea and 10 written questions were sent out in November 2014 to twelve participants from six UK laboratories. Participants were given 8 weeks to complete their test, and results were consequently judged by one of SAHFOS' senior taxonomists.

8.2 Summary of results

The zooplankton trial ring test was deemed a success. It showed that the level of zooplankton identification in the UK is overall very good, and that it was a useful training exercise. The competent monitoring agencies all achieved a level of at least 80% in both tests.

For the specimen test, the most difficult to ID proved to be *Clausocalanus* spp. and *Branchiostoma* spp. For the written test the most difficult question was to specify what specifics characterise the identification of *Calanus* P5 and especially that of a male *Calanus helgolandicus*.

The participants enjoyed the test, saying that it challenged them and that it was gauged at the right level of expertise. Going forward, everyone was in agreement that we should have further ring tests and that these should also include some form of enumeration component.

8.3 Taxonomic literature & reports

Zooplankton UK Trial Ring Test 2014/2015, Astrid Fischer, Marianne Wootton and David Johns, SAHFOS, 2015.
http://www.nmbaqcs.org/media/1606/zooplankton-trial-ring-test-2015-report.pdf

Appendix 1 - NMBAQC Co-ordinating Committee – Year 21 - 2014/2015

Name	Organisation	Position
David Johns	Sir Alister Hardy Foundation for Ocean Science (SAHFOS)	Chair
Tim Mackie	Environment & Heritage Service, NI	CMA Representative
Amanda Prior	Environment Agency	Finance Manager
Myles O'Reilly	Scottish Environment Protection Agency	Invertebrate Contract Manager
Joe Silke/ Rafael Salas	Marine Institute, Ireland	Phytoplankton Contract Manager
Clare Scanlan	Scottish Environment Protection Agency	Macroalgae Contract Manager
Grant Rowe	Fugro EMU Ltd	Contractors' Representative
Dan Bayley/ Emma Verling	Joint Nature Conservation Committee	Epibiota Contract Manager
Jim Ellis	Centre for Environment, Fisheries & Aquaculture Science (Cefas)	Fish Contract Manager
Claire Mason	Cefas	PSA Contract Manager
Keith Cooper	Cefas	CMA Representative
Matthew Green	Natural Resources Wales	CMA Representative
Astrid Fischer	SAHFOS	Technical Secretary

Appendix 2 - NMBAQC scheme participation for Year 21 2014/2015

ORGANISATION	BENTHIC INVERTS	PARTICLE SIZE	FISH	MACROALGAE	PHYTO
Agri Food Biosciences Institute (AFBI)	✔	✔	✔	✔	✔
Ahern Ecology			✔		
APEM Ltd	✔	✔	✔	✔	✔
Benthic Solutions Limited	✔	✔			
Biotikos Limited	✔				
Cawthron Insitute					✔
Cefas Lowestoft Benthic Laboratory	✔	✔	✔		✔
Centre régional de l'INRH (Institut National de Recherche Halieutique)					✔
Certificaciones Del Peru					✔
CLS Rosmuc, Carna					✔
CMACS Ltd	✔	✔			
Cyfoeth Naturiol Cymru/ Natural Resources Wales	✔	✔	✔	✔	
eCoast BVBA	✔				
Ecospan Environmental Ltd	✔				
Environment Agency	✔		✔	✔	
Estonian Marine Institute				✔	
Fish Vet Group (NMBAQ Lab Code LB1914)	✔	✔			
Fugro Emu Limited	✔	✔	✔	✔	
Gardline Environmental Ltd		✔			
Grontmij Nederland B.V., Team Ecologie	✔				
HEBOG Environmental Limited	✔				
Hunter Biological and Sue Hamilton	✔				
IFREMER					✔
ILVO (Institute for Agricultural and Fisheries Research) - ANIMALAB	✔				
IMARES Wageningen UR benthos team	✔				✔
Institut National des sciences et Technologies de la Mer					✔
Institute of Estuarine & Coastal Studies	✔	✔	✔		
Institute of Oceanography and Fisheries, Croatia					✔
IRTA					✔
Jacobs UK					✔
Kenneth Pye Associates Ltd					
Koeman en Bijkerk bv	✔				✔

ORGANISATION	BENTHIC INVERTS	PARTICLE SIZE	FISH	MACROALGAE	PHYTO
Laboratorio de Control de Calidad de los Recursos Pesqueros					✔
Laboratory Unit of Harmful Marine Microalgae, Aristotle University of Thessaloniki					✔
Marine Ecological Surveys Ltd	✔				
Marine Farm Services, Shetland Seafood Quality Control (SSQC)	✔				
Marine Institute Bantry Learhies pier					✔
Marine Institute Lalway Rinville, Oranmore					✔
Marine Invertebrate Ecological Services	✔				
Marine Scotland Laboratory		✔			
Marine Scotland Science					✔
Monitor Taskforce, Royal Netherlands Institue for Sea Research	✔				
Myriad Taxonomy		✔			
National Laboratory Services (EA)		✔			
Natural England	✔	✔			
Neidersachsischer Landesbetrieb fur Wasserwirtschaft, Kusten-und Naturschutz (NLWKN)				✔	
NIEA - (DOE (NI) and Marine group division)	✔	✔	✔	✔	
ORSA					✔
Precision Marine Survey Ltd	✔	✔	✔		
SAHFOS					✔
SAMS					✔
Seastar Survey Ltd	✔				
SEPA	✔	✔	✔	✔	✔
SMHI					✔
Thomson Unicomarine Ltd	✔	✔	✔		
UMR					✔
UMS 3113 Observatoire Marin	✔				

Appendix 3 - Invertebrate Taxonomic Workshop Programme

NMBAQC Scheme Taxonomic Workshop 10th-14th November 2014, Dove Marine Laboratory, Cullercoats.

Day	Session	Discussion / Demonstration / Practical	Aims	Session Leader
Monday 10th Nov. 2014	8:00 AM	Arrival. Registration. Laboratory set-up.	Register participants. Laboratory setup.	David Hall & Carol Milner (APEM Ltd.)
	10:00 AM	Introduction. General information.	Welcome participants. Q&A session regarding workshop. Outline timetable.	David Hall & Carol Milner (APEM Ltd.)
	10:15 AM	Introduction — The Dove Marine Laboratory. Brief details. Local information. Lab. rules (H&S issues).	To give brief history of Dove Marine Lab. and facilities. Areas of local interest. Pub & food guide.	Jane Delany (Dove Marine Laboratory)
	10:30 AM	Discussion / Demonstration - Introduction to selected Opisthobranchia. Literature. Problem areas. Identification techniques.	To introduce the major features / terminology used for identification of Opisthobranchia	Bastian Brenzinger (Bavarian State Collection of Zoology)
	1:00 PM	Buffet lunch.		
	PM	Practical - Examination & identification of range of Opisthobranchia taxa from reference material.	To obtain identification experience. View / verify reference material.	Bastian Brenzinger (Bavarian State Collection of Zoology)
Tuesday 11th Nov. 2014	9:00 AM	Introduction / Discussion / Demonstration – Sabellidae & Fabriciidae. Literature. Problem areas. Identification techniques.	To introduce the major features / terminology used for identification of Sabellidae & Fabriciidae.	Adriana Giangrande (Universita' del Salento, Lecce)
	AM	Practical - Examination & identification of range of Sabellidae & Fabriciidae taxa from reference material.	To obtain identification experience. View / verify reference material.	Adriana Giangrande (Universita' del Salento)
	1:00 PM	Buffet lunch.		
	PM	Discussion / Demonstration – Sabellidae & Fabriciidae. Literature. Problem areas. Identification techniques.	To introduce the major features / terminology used for identification of Sabellidae & Fabriciidae.	Adriana Giangrande (Universita' del Salento)
	PM	Practical - Examination & identification of range of Sabellidae & Fabriciidae taxa from reference material.	To obtain identification experience. View / verify reference material.	Adriana Giangrande (Universita' del Salento)
	4:00 PM	Blue Reef Aquarium group trip.		
Wednesday 12th Nov. 2014	9:00 AM	Discussion / Demonstration – Sabellidae & Fabriciidae. Literature. Problem areas. Identification techniques.	To introduce the major features / terminology used for identification of Sabellidae & Fabriciidae.	Adriana Giangrande (Universita' del Salento)
	AM	Discussion / Demonstration – Sabellidae & Fabriciidae. Literature. Problem areas. Identification techniques.	To obtain identification experience. View / verify reference material.	Adriana Giangrande (Universita' del Salento)
	1:00 PM	Buffet lunch.		
	PM	Discussion / Demonstration – Sabellidae & Fabriciidae. Literature. Problem areas. Identification techniques.	To obtain identification experience. View / verify reference material.	Adriana Giangrande (Universita' del Salento)
	PM	Practical - Examination & identification of range of Sabellidae & Fabriciidae taxa from reference material.	To obtain identification experience. View / verify reference material.	Adriana Giangrande (Universita' del Salento)
Thursday 13th Nov.2014	9:00 AM	Discussion / Demonstration – Sabellidae & Fabriciidae. Literature. Problem areas. Identification techniques.	To introduce the major features / terminology used for identification of Sabellidae & Fabriciidae.	Adriana Giangrande (Universita' del Salento)
	AM	Practical - Examination & identification of range of Sabellidae & Fabriciidae taxa from reference material.	To obtain identification experience. View / verify reference material.	Adriana Giangrande (Universita' del Salento)
	1:00 PM	Buffet lunch.		
	PM	Practical continued.	To introduce the major features / terminology used for identification of Sabellidae & Fabriciidae.	Adriana Giangrande (Universita' del Salento)
	7:30 PM	Workshop Dinner - Spanish restaurant, El Torero, Newcastle.		
Friday 14th Nov. 2014	9:00 AM	Workshop feedback. Equipment pack up.	Distribute / collect workshop feedback forms. Pack up equipment & prepare for departure	Carol Milner (APEM Ltd.)
	9:00 AM	Tea & coffee; Departure	-	-

Appendix 4 - BEQUALM/NMBAQC Scheme Taxonomic Workshop

Agenda Bequalm Phytoplankton Intercomparison workshop

Danhostel, Hillerød, Denmark, 1-3 Dec 2014.

Monday 1 –Wednesday 3 Dec. 2014

	Morning 9.00-12.00pm	**Afternoon 13.30-17.00**
Monday, 1 Dec	Intercomparison exercise results Enumeration and identification exercise results. Ocean teacher online HABs quiz exercise results. Prolab plus database (Rafael Salas) Discussion of exercise and ideas for 2015 (All)	"Seek and you shall find: A case study of an *Alexandrium ostenfeldii* bloom in the Netherlands." (Anneke van den Oever) Harmful algae, toxins and fish kills (P.J Hansen, Univ. of Copenhagen)
Tuesday, 2 Dec	Lecture and microscope demonstration: Ichthyotoxic flagellates (J.Larsen) 'Which Lugol's is the best 'solution'?' (Oliver Williams)	Lecture and microscope demonstration: Ichthyotoxic flagellates, continued (J.Larsen)
Wednesday 3 Dec	Field samples from participants (microscopy and identification) All	Departure