# NMBAQC

NE Atlantic Marine Biological Analytical Quality Control Scheme

# Fish Component Annual Report
# Scheme Operation 2020/2021 (Year 27)


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**FISH COMPONENT ANNUAL REPORT FROM APEM Ltd**

**SCHEME OPERATION – 2020/2021 (Year 27)**



**Linked Documents (hyperlinked in this report):**

Fish Reverse Ring Test Bulletin — RRT12

Fish Ring Test Bulletin — FRT14

Fish Reverse Ring Test Protocol

Fish Ring Test Protocol

## 1. Introduction

The twenty-seventh year of the NE Atlantic Marine Biological Analytical Quality Control (NMBAQC) Scheme (2020/2021) closely followed the format of the twenty-sixth year, with a ring test (RT) and a reverse ring test (RRT) being organised. The Fish Component of the Scheme is currently in its sixteenth year (start 2005/06). It involved the distribution of test specimens and images to participating laboratories and the centralised examination of returned data for the first exercise (RT), and re-analysis of fish specimens submitted by participants for the second exercise (RRT). The labelling and distribution procedures employed previously have been maintained. Specific details can now be found in the fish reverse ring test protocol and fish ring test protocol (FRRT Protocol and FRT Protocol).

Fourteen laboratories signed up for Scheme year 2020/2021 (with multiple participants from some organisations counted separately). Ten participants were government laboratories, two private consultancies, one university and one chartered laboratory. Although some fish are sampled under the Clean Seas Environment Monitoring Programme (CSEMP), the number of target species is relatively few. However, the requirement to monitor fish assemblages in transitional waters for the Water Framework Directive (WFD) provides a major impetus for the Fish Component exercise. As in previous years, some laboratories elected to be involved in either one or both exercises of the scheme.

### 1.1 Summary of Performance

This report presents the findings of the Fish component for year 2020/2021 (year 27) of the North East Atlantic Marine Biological Analytical Quality Control (NMBAQC) Scheme.

This component comprised two exercises:

- Fish Reverse Ring Test (FRRT) - re-identification by APEM Ltd. of a set of up to fifteen specimens supplied by participating laboratories;
- Fish Ring Test (FRT) - identification of fifteen fish specimens supplied with images.

The analytical procedures of the two exercises were the same as for previous years and are summarised in the protocol documents. 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.

**Fish Reverse Ring Test (FRRT)**: The identification of up to fifteen fish specimens selected and supplied by the nine participating laboratories (FRT12) was very accurate with only two taxonomic errors for 131 specimens submitted. Seven participants supplied collection dates

for specimens, these were all collected between November and December 2020. Most participants used this as a test for confirming voucher specimens; two participants included a problematic specimen in their submission, misidentification of a problematic specimen is not counted as a taxonomic error.

**Fish Ring Tests (FRT)**: Samples of 15 specimens were distributed (FRT14). The FRT was not a targeted ring test and most species included are commonly caught in routine monitoring surveys. Some specimens were relatively small but could still be expected to be caught using standard monitoring methods (e.g. seine netting).

For FRT14, the average numbers of differences per participating laboratory (for a total of 8 laboratories with 10 submissions) were 0.8 generic differences (5%) and 1.3 specific differences (9%). Three families (Gobiidae, Clupeidae and Ammodytidae) were responsible for 7 of the 8 generic errors and 12 of the 13 specific errors.

#### *1.1.1 Statement of Performance*

Each participating laboratory was supplied with a 'Statement of Performance', which included a summary of results for the FRT exercise and details of participation in the FRRT exercise, where appropriate. These statements were first circulated with the Year 5 annual report (1998/1999) for the purpose of providing evidence of Scheme participation and for ease of comparing year on year progress.

## 2. Summary of Fish Component

### 2.1 Introduction

There are two exercises within the Fish component: Fish Reverse Ring Test (FRRT) and Fish Ring Test (FRT) exercise

Each of these exercises is described in more detail below and in the supporting protocol documents (FRRT Protocol and FRT Protocol). A brief outline of the information obtained from each exercise is given, together with a description of the preparation of the necessary materials and brief details of the processing instructions given to each of the participating laboratories.

#### *2.1.1 Logistics*

The labelling and distribution procedures employed previously have been maintained. After the success of using more environmentally sustainable materials for the distribution and receipt of specimens last scheme year the same was used for year 27. This included the

replacement of polystyrene boxes with cardboard boxes and the use of reusable ice packs with natural wool insulation for the transportation of frozen material.

#### *2.1.2 Data Returns*

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, paper copies were also supplied. All returned data were converted to Excel 2010 format for storage and analysis. Reminders were distributed shortly before each exercise deadline.

#### *2.1.3 Confidentiality*

In September 2020, each participant was given a confidential, randomly assigned 2020/2021 (Scheme year 27) LabCode. Codes are prefixed with the component initials (*i.e.* F for Fish component), the Scheme Year and a unique number (between 01 and 25); for example, laboratory number one in Scheme Year 2020/2021 (Year 27) was recorded as F_2701.

### 2.2 Fish Reverse Ring Test (**FRRT**) Exercise

#### *2.2.1 Description*

The Fish Reverse Ring Test is a training exercise which encourages laboratories to build reference collections to improve identification consistency, and to seek additional opinions for difficult specimens. The value of reference material in assisting identification cannot be over-emphasized; the creation and use of reference collections is viewed as best practice. This exercise can help participating laboratories to assess their ability to identify material from their own samples. Laboratories are also able to use this exercise to obtain second opinion identifications for difficult or problematic taxa of which they are unsure. This was the twelfth Fish Reverse Ring Test exercise (FRRT12). The participants were able to submit up to 15 specimens for re-examination by APEM Ltd.

#### *2.2.2 Selection of fauna*

Participants were asked to submit, wherever possible, specimens from WFD monitoring surveys and could include one unidentified or problematic taxon. It is the intention of the exercise for participants to have fish specimens from their own surveys and geographical region re-examined, accordingly a diverse number of species and regions are expected.

#### *2.2.3 Results*

##### *2.2.3.1 General comments*

Nine laboratories subscribed to the twelfth Fish Reverse Ring Test. Two participant submitted data and specimens very shortly after the deadline. Three participants submitted

less than the fifteen permitted specimens and two participants submitted a problematic specimen.

#### *2.2.3.2 Analysis of material from participating laboratories*

Fish Reverse Ring Test Bulletin FRRT12 presents a summary of the data sets and specimens received for analysis. The re-identification of the submitted specimens used a variety of identification literature and in-house reference material. Due to this exercise's emphasis upon training and due to the diversity of submissions, comparison of results is not applicable and, as such, no summary statistics are provided in this report.

A preliminary report with individual results was sent to each participant before the Fish Reverse Ring Test Bulletin (FRRT12) summarising the results of all participants was distributed. Table 1 of the bulletin summarises the species submitted by participants and Table 2 gives details on the taxonomic errors and discrepancies observed. Participants were given the option to request specimens returned following completion of the exercise. Participants were notified once the bulletin was available for download from the Scheme's website (www.nmbaqcs.org).

### *2.2.4 Discussion*

In almost all cases, the identifications made by APEM Ltd. agreed with those made by the participants, only two taxonomic errors from one hundred and thirty-one specimens were recorded. Four taxonomic discrepancies were recorded, two from the uses of synonyms, one for a specimen submitted without a species name and one for the intended specimen being misplaced. The submission of authorities for species names was optional and, therefore, such omissions were not included as taxonomic discrepancies.

## 2.3 Fish Ring Test (**FRT**) Exercise

### *2.3.1 Description*

The Fish Ring Test (FRT) is a training exercise which examines variation in participants' ability to identify different species and attempts to determine whether differences are the result of literature deficiencies, lack of reference material (e.g. growth series) or misinterpretation of identification resources.

A set of 15 fish specimens with accompanying images were distributed in November 2020. The FRT was not a targeted ring test but included some relatively small specimens that had been previously highlighted as problematic. Basic habitat and geographic details recorded when specimens were collected were provided to assist identification.

### 2.3.2 Preparation of the samples

The specimens distributed were obtained from a range of surveys from around the UK. Most specimens were collected by APEM Ltd., but a few specimens were sourced from a third party. Care was taken to provide specimens of similar size and condition for each laboratory. Each specimen was uniquely identifiable by means of a coded label and all material can been retained by participants for subsequent checking. Where possible, specimens were taken from samples within a single survey and, in most cases, they were from a single sample or trawl.

#### 2.3.2.1 Analysis Required

The participating laboratories were asked to identify each of the FRT specimens to species level and they were also asked to complete a 'confidence level' field to indicate whether they would ordinarily have left the specimen at a higher taxonomic level. Participants could also add brief notes and information detailing the literature used to determine their identifications. The implementation of this part of the Scheme was the same as in previous years. Participants were permitted to supply multiple returns (*i.e*. different sets of results from different analysts) to enhance the training value of the exercise, one laboratory chose to utilise this option. The protocols followed, particularly the method of counting differences, were the same as for previous circulations (FRT Protocol). Approximately two months were allowed for the analysis of specimens.

### 2.3.3 Results

#### 2.3.3.1 General Comments

Many laboratories use ring tests for training purposes and select them preferentially over other similar exercises. The results are not used to assign 'Pass' or 'Fail' flags. In total, eight laboratories subscribed to FRT14 with a total of ten individual data sets. All participants submitted data before the deadline.

#### 2.3.3.2 Returns from Participating Laboratories

Identifications made by the participating laboratories were compared with those made by APEM Ltd. to determine the numbers of differences. Where identifications deviated from the APEM Ltd. identification due to the use of synonyms, or incorrect spellings of the name, the difference was ignored for the purpose of calculating the total number of differences.

Identifications made by each of the participating laboratories for the fifteen specimens, arranged with laboratories as rows and specimens in columns is given in Table 2 of the Fish Ring Test Bulletin FRT14. For clarity, the participant's identification is given only where the

name given by the laboratory differed from the APEM Ltd. identification. Where it was considered that the name referred to the same species as the APEM Ltd. identification, but differed for one of the reasons indicated above, the name is presented in brackets: "[name]". A dash, "-", in the tables indicates that the name of the genus (and / or species) given by the laboratory was the same as the APEM Ltd. identification.

#### *2.3.3.3 Counting Result differences*

For each laboratory, a count was made of each difference between their identification and the APEM Ltd. identification (*i.e*. for each instance where text other than a dash or a bracketed name appears in the appropriate column in Tables 2). Separate counts were maintained for differences at genus and species level.

#### *2.3.3.4 Ring Test Results*

The intention of this training exercise is to discover where difficulties lie in the identification of certain taxa. Results for Scheme Year 2020/2021 were presented in Fish Ring Test Bulletin FRT14 along with the reasons for each identification discrepancy. This bulletin contains images of the test material and of all available taxa that were named as alternative identifications by participants. Participating laboratories were advised to retain ring test specimens after receiving their results, in order that they could review their identifications, if necessary. Participants are encouraged to question APEM Ltd. identifications if they still believed their original identifications to be correct. On completion of the exercise specimens can be incorporated into participants in-house reference collections.

#### *2.3.3.5 Taxonomic differences observed*

The results discussed below are given in Table 2 of Fish Ring Test Bulletin FRT14, which displays the data arranged with columns for species to enable quick reference to the range of answers received.

The agreement at generic level was very good; 8 differences (5% of all genus identifications received from participants) were recorded in the 10 data sets received from 8 participating laboratories. There was slightly less agreement at species level, with 13 differences recorded (9% of all species identifications received from participants).

Three families (Gobiidae, Clupeidae and Ammodytidae) were responsible for 7 of the 8 generic errors and 12 of the 13 specific errors. These were *Pomatoschistus microps*, *Pomatoschistus minutus, Sprattus sprattus, Clupea harengus* and *Ammodytes tobianus*. The only other specimen circulated with an error was *Trisopterus luscus*.

Further details and analysis of results can be found in the Fish Ring Test Bulletin FRT14. The bulletin was circulated to each laboratory that supplied results for this exercise and was also posted on the Scheme's website (www.nmbaqcs.org).

#### *2.3.3.6 Differences between Participating Laboratories*

Differences recorded at genus and species level for each of the participating laboratories are summarised in Figure 1 and Table 2 in the Fish Ring Test Bulletin FRT14. The laboratories are ordered by increasing number of differences at species level followed by genus level. The division of laboratories into three bands (Low, Mid and High) based on the number of differences at species level is also shown.

Five participants correctly identified all specimens and only two participants submitted results with more than two difference at species level.

### *2.3.4 Discussion*

The results were broadly comparable with those from previous exercises. However, the number of differences were lower than generally seen in the past (especially compared to the smaller specimens distributed in FRT13). The lower number of differences are indicative of possibly fewer challenging specimens having been distributed, and the current results should not be used as a direct comparison with previous fish ring tests results.

In FRT14, the number of differences observed were mostly related to three problematic groups (juvenile clupeids, gobies and sand eels). Seven participants submitted comments relating to damaged specimens, some of the differences could possibly be attributed to specimens being too damaged for identification. Due to these factors the results from the exercise are not intended to make a comparison with participants identifications in routine fish monitoring surveys.

The main literature used to identify most specimens was consistent with past exercises (Maitland & Herdson 2009 and Wheeler 1969).

Production of the Fish Ring Test Bulletin FRT14 was on schedule and distributed in March. In keeping with recent bulletins, summaries of features used for problematic species highlighted by the ring test were included.

The FRT exercise is intended to be a valuable training tool and can be an indicator of problem groups. It can highlight possible taxa for further 'targeted' ring test exercises or for inclusion at taxonomic workshops. The allowance of multiple submissions per laboratory and the inclusion of images in the Ring Test Bulletins help to enhance the training value of this

component. All participating laboratories have been made aware of the problems identified by these ring tests via the Fish Ring Test Bulletins, which also included literature citations and detailed discussions of the problem taxa highlighted by the exercise.

## 3. Conclusions and Recommendations

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

1. The latest Fish Reverse Ring Test (FRRT12) and Fish Ring Test (FRT14) were successfully implemented and their format can be continued in the next scheme year. **Participants are encouraged to provide feedback to enable protocols and implementation to be improved where possible.**

2. Most participating laboratories submitted data / specimens in accordance with the Scheme's timetable. There were only two slightly late submissions, although they did not delay initial analysis and distribution of interim reports. **Participants should endeavour to supply data / specimens according to the exercise deadlines to ensure timely summary reporting.**

3. Some identification differences might be the results of inadequate literature. Participants are encouraged to collate fish identification literature for problematic groups or juvenile specimens and follow the most recent taxonomy. **Participants are encouraged to review the bibliography of taxonomic literature available on the NMBAQC website (Section 3 in Worsfold *et al.* 2020 and past bulletins) and give details of additions where possible. Reference to online databases for the validity of scientific names (FishBase, WoRMS and Eschmeyer's Catalog of Fishes) is also recommended.**

4. The maintenance of a comprehensive reference collection has numerous benefits for improving identification ability, maintaining consistency of identification between surveys and access to growth series material. The FRRT exercise can be used as a means of verifying reference specimens. Laboratories are strongly recommended to **implement and expand in-house reference collections of fish; these should include**

**images alongside physical specimens**. The inclusion of juvenile material is useful for certain groups, *e.g.* clupeids. Ideally **all surveys should include a photographic reference of all species encountered as a minimum.**

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

**6.** Since the beginning of the scheme, continual improvement to the learning structure of the Scheme reports has been crucial. For the FRRT and FRT detailed results have been forwarded as **individual exercise interim reports** to each participating laboratory as soon after the exercise deadlines as practicable. The results and subsequent differences raised in both exercises should **benefit all scheme participants**. A bulletin was circulated after each exercise, reviewing the literature used, detailing the accepted identification of the taxa received or circulated, including images of relevant specimens and discussing problematic species. Participants are encouraged to review all exercise reports and **provide feedback concerning content and format** wherever appropriate.

**7.** Despite being raised as a problematic group in the past gobies and clupeids continued to be groups with a high number of differences recorded. Future Fish Ring Test exercises are expected to target taxa that were highlighted as potentially problematic in FRT14 and FRRT12. **Participants are encouraged to provide feedback on problem taxa that could be included in future exercise and are invited to submit specimens for use in future exercises** (approximately 20 specimens of similar size and condition).

**8.** The distribution and analysis of an 'Image only' FRT in scheme year 2019/2020 provided lots of feedback and helped raise potential difficulties that would need to be overcome for the use of images to replace specimens in an exercise. However, the use of 'image only' specimens remain a potentially useful option for the inclusion of

species of conservation interest, larger-bodied species, or scarce species that would otherwise be impractical to circulate. **Participants are encouraged to provide feedback on the use of 'image only' specimens in future exercises.**

**9.** After the distribution of preserved specimens in the previous Fish Ring Test (FRT13) some participants requested fresh specimens. For FRT14 all specimens were distributed frozen. Once thawed some of the smaller specimens were very fragile and easily damaged, potentially by larger still frozen specimens. **Any relatively small or fragile specimens distributed in future exercise will be packaged separately to avoid damage in transit.**

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

**11.** Protocol documents for each exercise of the Fish Component have been produced. **Participants are encouraged to review the protocols and provide feedback and suggestion to improve exercises.**

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

## 4. References


CEFAS (ed.), 2012. *Clean Seas Environment Monitoring Programme*. Green Book. July 2012.

Fricke, R., Eschmeyer, W. N. & Van der Laan, R. (eds) 2020. Eschmeyer's Catalog of Fishes: Genera, Species, References.

(http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp).

Maitland, P.S. & Herderson D., 2009. *Key to the Marine and Freshwater Fishes of Britain and Ireland*. Environment Agency, 480 pp.

Wheeler, A., 1969. *The fishes of the British Isles and North West Europe*. Macmillan, London, 380 pp.

WoRMS Editorial Board 2020. World Register of Marine Species. Available from http://www.marinespecies.org at VLIZ.


## 5. Relevant NMBAQC reports


Duncombe-Smith, S. & Hall, D. (2020) *NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test Bulletin: FRRT11*. Report to the NMBAQC Scheme participants. APEM Report NMBAQCFRRT11, 29pp, Jan 2020.

Duncombe-Smith, S. & Hall, D. (2020) *NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: FRT#13*. Report to the NMBAQC Scheme participants. APEM Report NMBAQCFRT#13, 43pp, April 2020.

Duncombe-Smith, S. & Hall, D. (2021) NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test Bulletin: FRRT12. Report to the NMBAQC Scheme participants. APEM Report NMBAQC FRRT12, 25pp, Jan 2021.

Duncombe-Smith, S. & Hall, D. (2021) NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: FRT#14. Report to the NMBAQC Scheme participants. APEM Report NMBAQC FRTB#14, 24pp, March 2021.

Duncombe-Smith, S. & Hall, D. (2021) Fish Component Reverse Ring Test Protocol. Report to the NMBAQC Scheme participants. 6pp, March 2021.

Duncombe-Smith, S. & Hall, D. (2021) Fish Component Ring Test Protocol. Report to the NMBAQC Scheme participants. 7pp, March 2021.

Hall, D. J. (2008) *National Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB33 (F_RT03).* Report to the NMBAQC Scheme participants. Unicomarine report NMBAQCrtb33, 24 pp, January 2008.

Hall, D. J. & Dyson, J. (2006) *National Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB28 (F_RT01).* Report to the NMBAQC Scheme participants. Unicomarine report NMBAQCrtb28, 8pp, May 2006.

Hall, D. J. & Worsfold, T. M. (2007) *National Marine Biological Analytical Quality Control Scheme. Ring Test Bulletin: RTB31 (F_RT02).* Report to the NMBAQC Scheme participants. Unicomarine report NMBAQCrtb31, 18pp, May 2007.

Hussey, S. (2013) *National Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: F_RT06.* Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb06, 19pp, July 2013.

Hussey, S. (2013) *National Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test: F_RRT04.* Final report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrrt04, 19pp, July 2013.

Hussey, S. (2014) *National Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test: F_RRT05.* Final report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrrt05, 34pp, March 2014.

Hussey, S. (2014) *National Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: F_RT07.* Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb07, 15pp, May 2014.

Hussey, S. (2015) *National Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: F_RT08.* Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb08, 20pp, April 2015.

Hussey, S. (2015*)* *National Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test Bulletin: F_RRT06.* Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrrt06, 33pp, April 2015.

Hussey, S. (2016) *National Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test Bulletin: F_RRT07.* Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrrt07, 34pp, March 2016.

Hussey, S. (2016) *National Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: F_RT09*. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrt09, 20pp, April 2016.

Jakobsen, K. (2017) *NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: F_RT10*. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb10, 20pp, March 2017.

Jakobsen, K. (2017) *NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test: F_RRT08*. Final report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrrt08, 11pp, March 2017.

Seaby, R. & Barnich, R. (2018) *NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: F_RT11*. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb11, 32pp, Feb 2018.

Seaby, R. & Barnich, R. (2018) *NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test: F_RRT09*. Final report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrrt09, 9pp, March 2018.

Seaby, R. & Barnich, R. (2019) *NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test: F_RRT10*. Final report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrrt10, 9pp, March 2019.

Seaby, R. & Barnich, R. (2019) *NE Atlantic Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: F_RT12*. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb12, 26 pp, May 2019.

Taylor, J. G. & Hall, D. J. (2009) *National Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test Bulletin: F_RRT01*. Report to the NMBAQC Scheme participants. Unicomarine Report NMBAQCfrrt01, 22pp, December 2009.

Taylor, J. G. & Hall, D. J. (2011) *National Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test Bulletin: F_RRT02*. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrrt02, 22pp, January 2011.

Taylor, J. G & Hall, D. J. (2011) *National Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: F_RT04*. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb04, 14pp, June 2011.

Taylor, J. G & Hall, D. J. (2012) *National Marine Biological Analytical Quality Control Scheme. Fish Reverse Ring Test Bulletin: F_RRT03*. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrrt03, 29pp, February 2012.

Taylor, J. G & Hall, D. J. (2012) *National Marine Biological Analytical Quality Control Scheme. Fish Ring Test Bulletin: F_RT05*. Report to the NMBAQC Scheme participants. Thomson Unicomarine Report NMBAQCfrtb05, 15pp, June 2012.

Worsfold, T., Hall, D. & O'Reilly, M. (2020) *Bibliography of taxonomic literature for marine and brackish water Fauna and Flora of the North East Atlantic*. NMBAQC Scheme, 248 pp., May 2020.