NATIONAL MARINE BIOLOGICAL ANALYTICAL QUALITY CONTROL SCHEME

NMBAQC VIDEO RING TEST INTERIM REPORT: RESULTS OF TEST 3

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Report:

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Contents

1 Introduction

The third test for the development of a ring test for NMBAQC Video analysis has taken place and the results have been collected, collated and marked.

The third test considered the recommendations from tests 1 and 2 and the majority of the test was online/electronic which enabled all results to be returned electronically.

2 Aims of Test 3

The aims of Test 3 were to:

1. Improve the on-line version of the Ring Test by:
    a. refining data entry forms (see e.g. Appendices 7 and 8);
    b. providing a means of making the data entry compulsory;
    c. providing a 'Resolution Test Card' to enable participants to ensure they have an adequate resolution on the hardware/software system that they use for carrying out the Test.

2. Test the candidates':
    a. Substrate recognition skills;
    b. Substrate abundance assessment skills;
    c. Species ID skills;
    d. Species Abundance assessment skills.

3. Compare methods of assessing the abundance of organisms.

4. Refine the 'Analysis Tools' (*i.e.* the Rugosity Index and the SACFOR scale) and up-date the Reference list (38 entries for Test 3 compared with 34 for Test 2 and 15 for Test 1).

5. Refine the marking/assessment scheme.

3 Completion of Test

The third test was designed to be completed and submitted online via a purpose-built website which contained online and downloadable resources. The DVD containing video footage was circulated by post.

19 participants/organisations were sent Test 3 but only 10 returned fully completed test results. Several of these tests requested extensions to the deadlines which were approved.

This interim report will be edited and circulated to participants along with their participant ID so that they can assess their own performance in the Test. No participant IDs other than belonging to the candidate will be circulated to them.

4 Results

The results of Test 3 were assessed following the final workshop for the project. One of the main topics of discussion was the marking scheme used and the incorporation of local expertise and knowledge in that the results of users with local knowledge or data ownership should be give high value and that these answers should be considered correct. For Test 3 the owner or provider of the video footage was considered correct and participants' results were judged against these.

4.1 Video Analysis of Substrates

4.1.1 Marking Scheme

The scheme devised was based on an expert result and the value entered by the candidate was checked against this.

For each substrate the expert score was given a range of ±5% and if a candidate score fell within this bracket a correct result was given. This was carried out for each of the 8 substrate types and for each of the video clips used for this part of the Test, which gave a maximum possible score of 40. The percentage of correct answers was then calculated to give each candidate a score (Table 1).

A similar approach was taken for the marking of substrate features. Each candidate's response was compared to the expert response. If it matched, a score of 1 was given and, where no match occurred, a 0 score was given. Again, the percentage of correct answers for this part of the Test was calculated (Table 1).

An overall percentage mark was then calculated for the candidates' assessment of substrate abundance and the presence of substrate features combined (Table 1).

The 'Rugosity index' results were also marked on the basis of a comparison with the expert answer; if a candidate's response was ±1 index point different from the expert value then a score of 1 was given and, if the score was outside these values, a 0 score was given (Table 1).

4.1.2 Substrate Test Results

Table 1: Marks allocated for the identification of the physical substrates

ID	SUBSTRATE SCORE	SUBSTRATE PERCENTAGE	FEATURES SCORE	FEATURES PERCENTAGE	**OVERALL PERCENTAGE**	RUGOSITY SCORE
NT3A	25/40	63%	25/30	83%	**73%**	5/5
NTOO	22/40	55%	26/30	87%	**71%**	5/5
QAA	20/40	50%	25/30	83%	**67%**	5/5
QAC	25/40	63%	28/30	93%	**78%**	2/5
QAE	26/40	65%	24/30	80%	**73%**	5/5
QAI	27/40	68%	26/30	87%	**77%**	5/5
QAJ	22/40	55%	26/30	87%	**71%**	4/5
QAL	*40/40*	*100%*	*30/30*	*100%*	***100%***	*5/5*
QAM	25/40	63%	27/30	90%	**76%**	5/5
QAN	22/40	55%	21/30	70%	**63%**	3/5

4.1.3 Findings

Candidates show some agreement with the expert result when examining substrate types and their coverages but this is often lower than 60% agreement and no candidate scored over 70% agreement with the 'expert' score.

Recognising modifying features of habitats appears to be consistently accurate for candidates, with the lowest score being 21 out of 30 (70%) agreement with the 'expert' result and the remaining values showed over 80% agreement.

It appears the familiarity and clarification of the Rugosity score value enables the large majority of candidates to be in agreement and scores were consistently accurate.

4.1.4 Issues

Several issues were encountered with both the data collected and the 'marking' of the results:

- Percentage cover is an arbitrary scale;
- Expert response is considered correct;
- Confusion of substrates i.e. coarse sand and gravels;
- Each element is equally weighted for the overall result but a breakdown does show specific results for each element of the test.

4.1.5 Recommendations

- Marking scheme requires clarification and agreement

4.2 Video Analysis of Biota

4.2.1 Marking Scheme

The marking scheme attempted to use the local or data owner as the expert but as the majority of the video clips were provided by an organisation which was unable to complete test 3 no 'expert' results were available. The target organisms had be identified and selected prior to the test being issued and these identifications were given precedence and used as correct answers.

4.2.1.1 Marking scheme - Identification

This part of the scheme was set up to test candidates' abilities to accurately assign the organisms that they observe in benthic video to a particular taxon. The organisms labelled in the video clips for Test 3 (i.e. the 'Test organisms') were of known, pre-determined taxa. It was, therefore relatively straight forward to recognise the correct answers. The candidates were asked to provide the taxonomic level that they were able to identify the organism to, and additionally the organisms name at that level or at a more detailed level. This method, as with Test 2, produces responses which have a range of 'correctness'. For example, an organism such as *Asterias rubens* could be assigned to 'Class Asteroidea'. Clearly this is not an incorrect answer and it was felt that marks for this type of response should be built into the marking scheme. Similarly, if it is clearly impossible to identify an organism which appears in the video to the species level (either because of the video resolution or because it is only possible to identify certain organisms, for example, under the microscope (e.g. some of the hydroids or encrusting bryozoans) then the correct answer would be in a higher taxonomic category. Likewise, in certain cases, being less definite about identification is, in fact, more correct. This also needs to be built into the marking scheme. Marks were therefore allocated as follows:

- 3 marks for the correct taxon allocation, 2 marks for one taxonomic level away and 1 for two taxonomic levels away
- 3 marks for correct organism name at the appropriate taxonomic level, 2 marks were given for correct name but at an incorrect taxonomic level, 1 mark was given for a more detailed name which was unlikely to be identified consistently from video

The results from the taxonomic ID and the organisms name were then multiplied to give a final result. This method was used to take into account results when organisms were over or under identified. For example, identifying an organism at species level when genus level was more appropriate would give a lower score than correctly identifying the organism with genus name at genus level when this was the most appropriate identification. Additionally, this scheme allows for

uncertain results to be marked correctly but with a lower score, for example the most appropriate level of identification may have been to species level and name, whereas the candidate provided a correct name at genus or higher taxonomic level and selected this taxonomic level as the most appropriate level for their identification. This result would then score a correct mark but would be awarded a lower score due to the level of detail provided.

The marks for this part of the Test are presented in **Error! Reference source not found.**.

4.2.1.2 Marking Scheme – Counts and Percentage Cover

It has proved difficult to come up with an entirely satisfactory marking scheme for the counts and percentage cover for the different video samples. The counts allocated by the candidates varied considerably, particularly, as one would expect, when the organisms were more abundant.

The range of counts given for all the different Test Organisms are presented (see Appendix 3) to give an indication of the variability of the responses given by candidates, but probably the most useful indication of the 'right' count is the median, and marks are given on the basis of how close a candidate's count is to this. However, this does involve making the precarious assumption that 'the majority is right'.

One mark was allocated to those respondents who gave a score equivalent to the median (the 50 percentile or within 1 standard deviation of it). Percentage cover estimates were marked in the same way.

4.2.2 Biota Test Results

The responses given for the identification of the labelled Test organisms are given in Appendix 1: The results of the substrate analysis provide by the candidates

Organisation Code	TAKE	BEDROCK	BOULDER	COBBLE	PEBBLE	GRAVEL	SAND	MUD	SHELL	TOTAL	RUGOSITY	MOUNDS	BURROWS	TUBES	ALGALMAT	SANDWAVES	RIPPLES
NT3A	1			40	25	20	10		5	0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	1		10	13	25	40	5	5	2	0	1	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAA	1	0	10	16	31	16	21	0	6	0	2	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAC	1			20	25	25	30			0	3	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAE	1			25	41	25	7		2	0	2	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAI	1	0	0	30	25	25	20	0	0	0	1	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAJ	1	0	1	33	15	10	40	0	1	0	2	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
QAL	1		1	15	20	32	20	2	10	0	1	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
QAM	1	0	1	15	20	33	15	15	1	0	1	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAN	1		5	20	30	25	5	10	5	0	3	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE
NT3A	2	45	45	1	1	5	1		2	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	2	10	85			5				0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAA	2	25	56	9	2	2	4	0	2	0	3	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
QAC	2	85	5	5			5			0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAE	2	55	25	15	2	1	1		1	0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAI	2	60	20	10	5	5	0	0	0	0	3	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAJ	2	74	22	0	0	2	2			0	3	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAL	2	50	14	14	14	5	3			0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAM	2	60	30	0	8	2	0	0	0	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAN	2	60	30					5	5	0	4	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
NT3A	3			70	25		5			0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	3		50	30	18	2				0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE

Organisation Code	TAKE	BEDROCK	BOULDER	COBBLE	PEBBLE	GRAVEL	SAND	MUD	SHELL	TOTAL	RUGOSITY	MOUNDS	BURROWS	TUBES	ALGALMAT	SANDWAVES	RIPPLES
QAA	3	2	17	41	19	12	6	0	3	0	2	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE
QAC	3			40	55	5				0	3	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
QAD	3											FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAE	3			62	31	5	2			0	2	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAI	3	0	0	50	50	0	0	0	0	0	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAJ	3	0	1	89	3	1	5	1	0	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAL	3			55	40	3	2			0	2	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
QAM	3	0	1	75	22	1	1	0	0	0	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAN	3			40	45	10	5			0	3	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
NT3A	4	90	7	3						0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	4	20	60	15	5					0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAA	4	13	26	12	18	10	13	0	8	0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAC	4	60	30	5	5					0		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAE	4	25	15	20	20	10	10			0	3	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAI	4	75	15	5	0	0	5	0	0	0	3	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAJ	4	0	2	89	4	0	4	1	0	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAL	4	14	43	19	18	3	2		1	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAM	4	10	70	10	4	5	0	1	0	0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAN	4	50	10	10	5	5		20		0	4	FALSE	TRUE	TRUE	TRUE	FALSE	FALSE
NT3A	5		1	45	35	10	8		1	0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	5		40	40	15	5				0	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAA	5	2	9	33	22	14	15	1	4	0	2	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAC	5		5	50	30	15				0	3	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAE	5		3	29	40	15	10		3	0	2	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAI	5	0	1	30	50	4	15	0	0	0	1	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAJ	5	0	2	69	5	3	20	0	1	0	3	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
QAL	5		1	25	48	20	5		1	0	1	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAM	5	0	1	23	30	10	20	15	1	0	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAN	5		5	20	35	5	5	25	5	0	3	FALSE	TRUE	TRUE	TRUE	FALSE	FALSE

Appendix 2. The associated marks allocated are presented below (**Error! Reference source not found.**). Note organism 13 was removed from the test result due to inconsistencies in candidate returns attributed to an error in labelling on the video footage. The results for organisms 13 are still included in the appendices.

Table 2: Marks allocated for the identification of the labelled Test organisms

	Test Organism Number															
Organisation Code	1	2	3	4	5	6	7	8	9	10	11	12	14	15	Total Mark	% Mark
QAJ	9	1	1	9	9	9	2	6	9	6	9	9	9	0	88	70%
NT3A	9	9	9	9	9	9	1	6	6	6	9	9	9	0	100	79%
QAL	9	2	2	9	9	9	9	9	6	0	0	0	0	0	64	51%
QAC	9	9	9	9	9	9	1	6	6	6	9	0	9	0	91	72%
QAN	9	6	6	9	9	9	6	6	0	6	9	0	9	0	84	67%
QAA	4	2	2	9	9	9	1	6	9	3	9	0	9	0	72	57%
QAI	9	6	6	9	9	1	6	0	9	9	1	9	0	0	74	59%
QAM	9	6	6	9	9	1	6	9	6	9	9	9	0	0	88	70%
NTOO	9	9	9	9	9	1	6	9	9	9	0	1	0	0	80	63%
QAE	9	0	0	9	9	9	9	6	6	9	9	9	0	0	84	67%

The Abundance estimates given by candidates on the basis of 'Counts' and 'Percentage cover' are given in Appendices 3 and 4 respectively. The associated marks allocated are presented below (**Error! Reference source not found.**).

Table 3: Marks allocated for Counts and Percentage Cover assessment

	Test Organism Number																													
Organisation Code	**1**		**2**		**3**		**4**		**5**		**6**		**7**		**8**		**9**		**10**		**11**		**12**		**14**		**15**			
	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	Count	%Cover	**Count Mark**	**Cover Mark**
QAJ	0	0	0	1	0	1	1	1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1	1	1	0	1	**4**	**11**
NT3A	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	1	0	0	0	0	1	**8**	**11**
QAL	1	0	0	1	0	1	1	1	0	0	1	1	1	1	1	0	1	1	1	0	1	0	1	1	0	1	0	0	**9**	**8**
QAC	1	1	1	1	0	0	1	0	1	0	1	1	1	1	1	1	1	1	1	0	1	0	0	1	0	1	0	0	**10**	**8**
QAN	0	0	1	0	0	1	1	1	0	0	1	0	1	0	1	0	0	0	0	0	1	1	1	1	0	1	0	1	**7**	**6**
QAA	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	0	1	1	1	0	1	0	**13**	**8**
QAI	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	0	0	0	0	0	**11**	**8**
QAM	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	**13**	**13**
NTOO	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	1	1	0	1	1	1	1	**11**	**11**
QAE	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	0	0	0	1	1	**10**	**11**

Table 4: Summary of marks allocated for the different components of the BIOTA ANALYSIS part of Test 3

Organisation Code	Total % Mark for ID	Total % Mark for Count & %Cover	Total % Mark for Biota Section of Test
QAJ	70%	54%	**62%**
NT3A	79%	68%	**74%**
QAL	51%	61%	**56%**
QAC	72%	64%	**68%**
QAN	67%	46%	**57%**
QAA	57%	75%	**66%**
QAI	59%	68%	**63%**
QAM	70%	93%	**81%**
NTOO	63%	79%	**71%**
QAE	67%	75%	**71%**

4.2.3 Findings

4.2.3.1 Identification

Candidates appear to be able to identify organisms to a suitable taxonomic level from video. Most low scores appear either due to no response being given, or the response that was given was identified at an unsuitable taxonomic level. This can be seen in the appendices when cryptic species such as a red algae or a sponge was attempted to be identified to a species level when it was considered more appropriate to identify the organism at class or phylum level.

4.2.3.2 Counts and Percentage Cover

Percentage cover and counts of organisms showed some agreement. Where organisms had high numbers the count was highly variable, and where it was more appropriate to estimate percentage cover rather than counts, counts were variable and often in accurate.

Again some low scores can be accounted for due to a lack of response rather than an incorrect response. Candidates were requested and required to provide a complete set of results.

4.2.3.3 Final Marks for the BIOTA ANALYSIS part of Test 3

The summary of marks given for the BIOTA ANALYSIS part of TEST 3 is given in **Error! Reference source not found.**. It is to be noted that the weightings for the different components of the Test are equal. However, it may be more appropriate to give different weightings to the different components. The weightings to be used need to be agreed for future tests.

The overall % marks (using equally weighted components) ranged between 56% and 81%. On the basis of a 50% pass mark, no candidate would have 'failed' the Test.

Candidates will be able to get an idea of their performance relative to others from **Error! Reference source not found.**; they will also be able to discover where their relative strengths and weaknesses are in relation to the different aspects of the analysis of benthic video biota. It is important to supply marks for the different components of the Test so that candidates can identify any parts of the video analysis process which might require remedial training.

4.2.4 Issues

- The issues raised in previous tests regarding estimates of abundance either in terms of percentage covers or count was attempted by candidates submitting values for both, and the results show that depending upon on the form of the organism being identified both measures of abundance are appropriate for different organisms. Future tests should attempt to clarify which estimate of abundance is most appropriate for each organism.

- 'Expert' type answers were used for this assessment and this does seem to give sensible results but the validity of the 'expert' should be investigated further and candidates' feedback should be sought on how they performed against the 'expert' results.
- The marking scheme was discussed during the final workshop but there is still ambiguity around the weighting scheme, and whether the marking schemes employed are suitable and acceptable. This should be considered and agreed by the NMBAQC committee prior to any further tests.

5 Appendices

Appendix 1: The results of the substrate analysis provide by the candidates

Organisation Code	TAKE	BEDROCK	BOULDER	COBBLE	PEBBLE	GRAVEL	SAND	MUD	SHELL	TOTAL	RUGOSITY	MOUNDS	BURROWS	TUBES	ALGALMAT	SANDWAVES	RIPPLES
NT3A	1			40	25	20	10		5	0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	1		10	13	25	40	5	5	2	0	1	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAA	1	0	10	16	31	16	21	0	6	0	2	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAC	1			20	25	25	30			0	3	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAE	1			25	41	25	7		2	0	2	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAI	1	0	0	30	25	25	20	0	0	0	1	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAJ	1	0	1	33	15	10	40	0	1	0	2	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
QAL	1		1	15	20	32	20	2	10	0	1	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
QAM	1	0	1	15	20	33	15	15	1	0	1	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAN	1		5	20	30	25	5	10	5	0	3	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE
NT3A	2	45	45	1	1	5	1		2	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	2	10	85			5				0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAA	2	25	56	9	2	2	4	0	2	0	3	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
QAC	2	85	5	5			5			0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAE	2	55	25	15	2	1	1		1	0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAI	2	60	20	10	5	5	0	0	0	0	3	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAJ	2	74	22	0	0	2	2			0	3	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAL	2	50	14	14	14	5	3			0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAM	2	60	30	0	8	2	0	0	0	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAN	2	60	30					5	5	0	4	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
NT3A	3			70	25		5			0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	3		50	30	18	2				0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAA	3	2	17	41	19	12	6	0	3	0	2	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE
QAC	3			40	55	5				0	3	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
QAD	3											FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAE	3			62	31	5	2			0	2	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAI	3	0	0	50	50	0	0	0	0	0	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAJ	3	0	1	89	3	1	5	1	0	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAL	3			55	40	3	2			0	2	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE

Organisation Code	TAKE	BEDROCK	BOULDER	COBBLE	PEBBLE	GRAVEL	SAND	MUD	SHELL	TOTAL	RUGOSITY	MOUNDS	BURROWS	TUBES	ALGALMAT	SANDWAVES	RIPPLES
QAM	3	0	1	75	22	1	1	0	0	0	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAN	3			40	45	10	5			0	3	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
NT3A	4	90	7	3						0	4	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	4	20	60	15	5					0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAA	4	13	26	12	18	10	13	0	8	0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAC	4	60	30	5	5					0		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAE	4	25	15	20	20	10	10			0	3	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE
QAI	4	75	15	5	0	0	5	0	0	0	3	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAJ	4	0	2	89	4	0	4	1	0	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAL	4	14	43	19	18	3	2		1	0	3	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAM	4	10	70	10	4	5	0	1	0	0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAN	4	50	10	10	5	5		20		0	4	FALSE	TRUE	TRUE	TRUE	FALSE	FALSE
NT3A	5		1	45	35	10	8		1	0	2	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
NTOO	5		40	40	15	5				0	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAA	5	2	9	33	22	14	15	1	4	0	2	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAC	5		5	50	30	15				0	3	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAE	5		3	29	40	15	10		3	0	2	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE
QAI	5	0	1	30	50	4	15	0	0	0	1	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAJ	5	0	2	69	5	3	20	0	1	0	3	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
QAL	5		1	25	48	20	5		1	0	1	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
QAM	5	0	1	23	30	10	20	15	1	0	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
QAN	5		5	20	35	5	5	25	5	0	3	FALSE	TRUE	TRUE	TRUE	FALSE	FALSE

Appendix 2: The identification given to the 15 labelled Test organisms by the candidates

	Test Specimen Number						
Organisation Code	**1**	**2**	**3**	**4**	**5**	**6**	**7**
QAJ	*Suberites carnosus*	*Ophiocomina nigra*	*Protanthea simplex*	*Suberites ficus*	*Alcyonium digitatum*	*Pentapora fascilis*	*Virgularia mirabilis*
NT3A	*Metridium senile*	*Ophiocomina nigra*	*Protanthea simplex*	*Phylum: Porifera (possibly Suberites ficus)*	*Alcyonium digitatum*	*Pentapora foliacea*	*Virgularia mirabilis*
QAL	*Metridium senile*	*Ophiocomina nigra*	*Protanthea simplex*	*Suberites sp.*	*Alcyonium digitatum*	*Pentapora foliacea*	*Virgularia mirabilis*
QAC	*Metridium senile*	*Ophiocomina nigra*	*Protanthea simplex*	*Kingdom Animalia*	*Alcyonium digitatum*	*Pentapora foliacea*	*Virgularia mirabilis*
QAN	*Metridium senile*	*Ophiocomina nigra*	*anemone (Zoantharia?)*	*Suberites ficus*	*Alcyonium digitatum*	*Pentapora foliacea*	*Virgularia mirabilis*
QAA	*Metridium senile*	*Ophiocomina nigra*	*Protanthea simplex*	*Suberites*	*Alcyonium digitatum*	*Pentapora foliacea*	*Virgularia mirabilis*
QAI	*Metridium senile*	*Ophiocomina nigra*	Order: ACTINIARIA	Phylum: PORIFERA	*Alcyonium digitatum*	*Pentapora foliacea*	*Virgularia mirabilis*
QAM	*Metridim senile*	*Ophiocomina nigra*	*Protanthea simplex*	*Alcyonium sp.*	*Alcyonium digitatum*	*Pentapora foliacea*	*Virgularia mirabilis*
NTOO	*Metridium senile*	*Ophiocomina nigra*	*Protanthea simplex*	*Porifera indet. 1 (Suberites ?)*	*Alcyonium digitatum*	*Pentapora fascialis*	*Virgularia mirabilis*
QAE	*Metridium senile*	*Class; Ophiuroidea*	*Class: Hexacorallia*	*Unidentified indet*	*Alcyonium digitatum*	*Pentapora foliacea*	*Virgularia mirabilis*

	Test Specimen Number							
Organisation Code	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
QAJ	*Steligera stuposa*	*Esperiopsis furcorum*	*Pectin maximus*	*Antedon*	*Serpula vermicularis*	*Ascidia mentula*	*Red folise alga*	*Halidrys siliquosa*
NT3A	*Haliclona oculata*	*Esperiopsis fucorum*	*Aequipecten opercularis*	Family: Antedonidae	*Serpula vermicularis*	Class: Ascidiacea *(possibly Pyura microcosmos)*	Phylum: Rhodophycota (possibly *Heterosiphonia plumosa)*	*Ascophyllum nodosum*
QAL	*Haliclona oculata*	*Amphilectus fucorum*	*Aequipecten opercularis*	*Antedon sp.*	*Serpula vermicularis*	*Pyura microcosmus*	*Heterosiphonia plumosa*	*Halidrys siliquosa*
QAC	*Arborescent sponge*	*Arborescent sponge*	Family Pectinidae	Class Crinoidea	*Serpula vermicularis*	*Family Ascidiidae*	Class RHODOPHYCEAE	*Halidrys siliquosa*
QAN	*Alcyonidium diaphanum*	*Esperiopsis fucorum*	*Aequipecten opercularis*	*Antedon bifida*	*Serpula vermicularis*	*ascidian*	*Ceramium sp.*	*Halidrys siliquosa*
QAA	*Axinella dissimilis*	*Esperiopsis fucorum*	Family; Pectinidae	Family; Antedonidae	*Serpula vermicularis*	Class: Ascidiacea	*Heterosiphonia plumosa*	*Halidrys siliquosa*
QAI	Phylum: PORIFERA	Phylum: PORIFERA	Family: Pectinidae					
QAM	*Haliclona oculata*	*Amphilectus fucorum*	Family: Pectinidae	Family: Antedonidae	*Serpula vermicularis*	missing	*Heterosiphonia plumosa*	*Halidrys siliquosa*
NTOO	*Porifera indet. 2 (Haliclona oculata ?)*	*Amphilectus fucorum*	*Pecten maximus*	*Antedon bifida*	*Serpula vermicularis*	N/A	*Rhodophyta indet.1 (Heterosiphonia plumosa?)*	*Halidrys siliquosa*
QAE	*Haliclona oculata*	*Esperiopsis fucorum*	*Aequipecten opercularis*	*Class: Crinoidea*	*Serpula vermicularis*	Does not exist on disc	Division: Rhodophycota	*Halidrys siliquosa*

Appendix 3: The 'Counts' allocated by the candidates for each of the 15 Test Organisms

	Test Specimen Number														
Organisation Code	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
QAJ	1	5	15	0.5	3	2	5	10	5		10	100	2	2	0.5
NT3A	55	200	150	30	8	10	22	35	70	8	13	400	11	16	5
QAL	50			1	13	12	25	31	14	12	9		10		
QAC	45	200	500	1	10	10	30	40	40	14	10	1000	10	1	1
QAN	65	200	400	1	13	12	28	40		20	6		12		
QAA	40	100	100	3	7	8	28	37	40	14	10	250	10	11	3
QAI	40	150	80	3	10	12	22	35	20	18					
QAM	41	200	190	2	9	9	38	31	32	17	7	9		6	3
NTOO	45	240	200	1	9	10	28	22	13	1	5	4		9	2
QAE	43	300	250	3	10	8	30	50	50	12	3	300			4

Appendix 4: Percentage Cover scores allocated by candidates for each of the 12 Test organisms

	Test Specimen Number														
Organisation Code	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
NT3A	5	10	5	1	1	2	5	5	5	1	1	10	1	15	1
NTOO	1	10	5	1	2	4	5	3	1	1	1	30		2	1
QAA	6	20	15	1	5	5	5	10	15	5	5	70	7	10	5
QAC	5	5	40	5	5	5	5	10	5	5	5	80	10	5	5
QAE	5	60	17	1	3	3	3	7	7	3	3	30		15	3
QAI	1	5	1	1	1	5	1	5	1	1					
QAJ	0.1	10	12	0.1	1	10	1	10	10			80	0.5	5	2
QAL												60		5	5
QAM	2	10	7.5	1	1	1	2	10	5	2	1	30		5	1
QAN	10	80	10	1	5	30	30	20	20	5	2	70	5	5	2