Quality Assurance Panel
of the
German Marine Minitoring Programme
for the North Sea and Baltic
at the Federal Environmental Agency

1st macrozoobenthos ring test

Species identification
for selected
macrozoobenthos organisms

Final report

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organised by

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and the Working Group on Quality Assurance of the German Marine Monitoring Programme for the North Sea and Baltic (GMMP)

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1 Introduction

As part of the German Marine Monitoring Programme for the North Sea and Baltic (GMMP) the Quality Assurance Panel at the Federal Environmental Agency (Umweltbundesamt), working in conjunction with the Quality Assurance Working Group (AG QS), developed a concept for external quality assurance. For biological studies, this included proficiency comparisons in the form of ring tests designed to assess and document the comparability of the biological data collected in the GMMP and at the same time take into account international quality standards.

The aim of this 1st macrozoobenthos ring test to identify the species of selected macrozoobenthic organisms was:

- To establish the extent to which the laboratories involved in analyzing macrozoobenthos samples as part of the GMMP were able to correctly classify taxonomically the macrozoobenthic organisms from a broad range of taxonomic groups.
- At the same time to check the laboratories' sorting and counting accuracy.

The participating labs were given the remit of sorting the species within an artificially constituted sample, identifying the species and recording the number of individuals per species.

The aim of this ring test was to gain experience both in conducting this kind of ring test and in statistical analysis.

Table 1: Timetable for the 1st macrozoobenthos ring test

Time frame	**Activity**
Summer 1997 – March 1998	Ring test designed; lab commissioned to prepare samples
June 1998	Sample material made available
July 1998	Samples distributed
September 1998	Quality Assurance Panel receives analysis data
July 1999	Original data reviewed
October 1999	Ring test samples checked
September – November 1999	Statistical analysis and preparation of final report
February 2000	Report dispatched

13 institutes applied to take part in the ring test. Since sample material was available for only 11 participants, 2 institutions that collect marine/estuarine data, but are not directly part of GMMP,

were not included. Table 15 (Annex) contains an alphabetical list of the laboratories that took part in the ring test. Table 1 gives information about the timetable of the ring test.

2 Material and methods

2.1 Ring test material

The Quality Assurance Panel commissioned the company Aqua-Fact International Ltd. (Ireland) to prepare 11 identical samples for the ring test, observing the following parameters:

- Each sample should contain 25 common macrozoobenthos species from the major taxonomic groups Echinodermata, Crustacea, Mollusca and Polychaeta and have the same number of individuals per species.
- 2 - 5 adult animals per species, where possible of the same size and different sex, should be selected and prefixed in formaldehyde. They should be subsequently transported in alcohol.
- The animals should be in good condition and come from the North Sea, Wadden Sea and/or the Baltic.
- No other components, such as broken shells or plant particles or sediment residues, should be present in the samples.
- The samples should contain an overall total of 80 - 100 individuals.

The information on the composition of the macrozoobenthos samples provided by the company that prepared the test material (listed in Table 2) does not meet the requirements stipulated by the Quality Assurance Panel. The company stated that the samples contained only 24 species, although they actually contained 25 species (see section 3.2). Furthermore, the data supplied by the company on numbers of individuals was not always correct. Unfortunately, it was not possible to clarify these discrepancies with the company. This caused serious problems for the analysis and thus for the evaluation of the ring test.

In addition to this, the condition of the sample material was universally judged by all the ring test participants to be very poor. This made it very difficult to identify the species and count individuals and ultimately it was not possible to guarantee that all the ring test participants really were working under the same starting conditions to study the samples. In some cases, the shells were broken and the sharp edges of the shells had cut softer and thus more sensitive animals to

varying degrees, so that it was not always possible to carry out with certainty an exact identification of species or determine the precise number of individuals.

Table 2: Information provided by the supplier on the composition of the samples for the macrozoobenthos ring test

	Group	**Genus**	**Species**	**Family**	**Class (Echinodermata), otherwise order**	**No. of individuals specified by sample supplier**
01	Echinodermata	***Asterias***	***rubens***	Asteriidae	Asteroidea	**2**
02	Echinodermata	***Ophiura***	***ophiura***	Ophiuridae	Ophiuroidea	**2**
03	Crustacea	***Crangon***	***crangon***	Crangonidae	Decapoda	**4**
04	Crustacea	***Corophium***	***volutator***	Corophiidae	Amphipoda	**4**
05	Crustacea	***Pontocrates***	***altamarinus***	Oedicerotidae	Amphipoda	**4**
06	Mollusca	***Corbula***	***gibba***	Corbulidae	Myoida	**5**
07	Mollusca	***Donax***	***vittatus***	Donacidae	Veneroida	**2**
08	Mollusca	***Mactra***	***corallina***	Mactridae	Veneroida	**4**
09	Mollusca	***Cerastoderma***	***edule***	Cardiidae	Veneroida	**2**
10	Mollusca	***Mysella***	***bidentata***	Montacutidae	Veneroida	**3**
11	Mollusca	***Phaxas***	***pellucidus***	Pharidae	Veneroida	**4**
12	Mollusca	***Angulus***	***tenuis***	Tellinidae	Veneroida	**3**
13	Mollusca	***Tellina***	***fabula***	Tellinidae	Veneroida	**8**
14	Mollusca	***Venus***	***fasciata***	Veneridae	Veneroida	**3**
15	Mollusca	***Venus***	***gallina var. striatula***	Veneridae	Veneroida	**5**
16	Polychaeta	***Capitella***	***capitata***	Capitellidae	Capitellida	**5**
17	Polychaeta	***Arenicola***	***marina***	Arenicolidae	Capitellida	**2**
18	Polychaeta	***Magelona***	***mirabilis***	Magelonida	Magelonidae	**4**
19	Polychaeta	***Owenia***	***fusiformis***	Oweniidae	Oweniida	**4**
20	Polychaeta	***Nephtys***	***hombergii***	Nephtyidae	Phyllodocida	**2**
21	Polychaeta	***Nephtys***	***cirrosa***	Nephtyidae	Phyllodocida	**2**
22	Polychaeta	***Hediste***	***diversicolor***	Nereididae	Phyllodocida	**4**
23	Polychaeta	***Phyllodoce***	***maculata***	Phyllodocidae	Phyllodocida	**3**
24	Polychaeta	***Spiophanes***	***bombyx***	Spionidae	Spionida	**3**

The Quality Assurance Panel decided to evaluate the ring test nevertheless but not to carry out a final evaluation of the ring test participants. The main aim of the analysis of the ring test was to ascertain whether any comments could be made about major problem areas, for example in identifying particular species. A further aim was to draw conclusions for future macrozoobenthos ring tests.

2.2 Statistical analysis

In order to be able to carry out a comparative analysis, the individual lists of species submitted by the labs were combined into a unified list of species (Annex, Table 16 to

Table 19). In addition, the list of species was expanded to include details of the taxonomic classification, such as family and class or order.

Currently no commercially available analysis software has a standard procedure for analysing ring test data on the basis of categories. For that reason, the unified lists of species compiled (Table 16 to

Table 19 in the Annex) and the information given by the supplier of the samples (Table 2) were used to determine so-called successful hits. Several different approaches were used:

1. An exclusively qualitative approach, in which only the correct taxonomic classification of the species contained in the sample was of significance and
2. A qualitative/quantitative approach, in which the correct taxonomic classification and the number of individuals found were taken into account.
3. In a third approach, the logit model was used to take into consideration the correctness of the taxonomic classifications, taking into account the different degrees of difficulty.

2.2.1 Qualitative approach

This approach involves an exclusively qualitative examination of whether the ring test participants were able to find the species indicated by the supplier of the samples and to perform a correct taxonomic classification. The number of individuals found was of no significance here. On the whole, no attention was paid to cases where species were found that were not indicated by the supplier. Table 3 summarises the categories used for the qualitative evaluation.

Table 3: Success categories for the qualitative approach (1st approach)

Successful hits (hit rate)	Categorisation of hits
1	Genus and species named correctly
0.75	Genus correctly named and species not named
0.50	Genus correctly named and species named incorrectly
0.25	Genus and species named incorrectly, but classification in the correct taxonomic category immediately above
0	Genus and species incorrect or not found, incorrect classification to the taxonomic category immediately above

2.2.2 Qualitative/quantitative approach

This approach considered not only the qualitative aspect, but also whether the ring test participants were able to identify the correct number of individuals for each species. The successful hits used to do this are listed in Table 4. Species that were found but had not been indicated by the supplier of the samples were not taken into account, with one exception (***Bathyporeia sp.*** and ***B. pilosa***). ***Bathyporeia sp***. was taken into account because virtually all the ring test participants found this species in their samples. This might be the missing 25th species (cf. sections 2.1 and 3.2).

Table 4: Success categories for the qualitative/quantitative approach (2nd approach)

Successful hits (hit rate)	Categorisation of hits
1	Genus and species correct, all numbers of individuals found as indicated by the supplier of the samples.
0.75	Genus and species correct, more or fewer individuals found.
0.50	All individuals found exclusively in the correct higher taxonomic level.
0.25	More or fewer individuals found in the correct higher taxonomic level.
0	No individuals found, not even in the correct higher taxonomic level.

2.2.3 Statistical analysis using the logit model

To make a satisfactory statistical assessment of the success and failure of taxonomic classification it is necessary to take into account the different degrees of difficulty in identifying different taxonomic orders and species. This in turn requires an appropriate statistical model to be designed which views success and failure ultimately as the result of a random experiment whose probabilities are a function of the degree of difficulty of the taxonomic classification and the lab's level of experience.

The comments below basically assume that the taxonomic identification of a species takes place in the following sequence of steps:

- A: Identification of the higher taxonomic order
- B: Identification of the genus
- C: Identification of the species
- D: Counting individuals

Here it can be assumed that B is based on A, and C on B. The process of counting individuals is not directly connected to correct taxonomic classification. The primary aim of counting is to identify identical individuals; in other words D is not dependent on the steps A to C.

The aim of the statistical analysis is to estimate the probability ***p*** of success, i.e. the probability of a particular species being correctly identified by a particular lab. This probability is a function both of the degree of difficulty of the task and of the level of competence of the lab. It has proven to be useful to use the following logit model for this connection:

$$\ln\left(p/(1-p)\right) = \text{degree of difficulty} + \text{level of competence} \qquad \textit{(equation 1)}$$

This means that the probability ***p*** of a particular task being successfully solved by a particular lab can be calculated by

$$p = \frac{\exp(\text{degree of difficulty} + \text{level of competence})}{1 + \exp(\text{degree of difficulty} + \text{level of competence})} \qquad \textit{(equation 2)}$$

The term ***p/(1-p)*** in the logit model describes the odds of success. Thus a probability of 0.5 corresponds to an odds ratio of 0.5 : 0.5 = 1, while a probability of 0.9 corresponds to an odds ratio of 0.9 : 0.1 = 9.

For a lab with average competence a level of competence of 0 is assumed, i.e. above-average proficiency results in a positive level of competence, below-average proficiency results in a negative level of competence. Thus given an average level of competence the odds of success (***p/(1-p)***) results in

$$p/(1-p) = \exp(\text{degree of difficulty}) \qquad \textit{(equation 3)}$$

whereas for the deviating level of competence, the odds of success are determined by

$$p/(1-p) = \exp(\text{degree of difficulty} + \text{level of competence}) \text{ or} \qquad \textit{(equation 4)}$$

$$= \exp(\text{degree of difficulty}) * \exp(\text{level of competence} \qquad \textit{(equation 5)}$$

Given average level of competence, the odds of success are dependent solely on the particular task. The second factor is also determined by the lab and can be interpreted as the relative level of competence of the lab, since multiplying this value by the odds of success, given average level of competence, results in the odds of a particular lab successfully completing the task.

The estimation of degree of difficulty on the one hand and level of competence on the other was carried out using the maximum likelihood method (McCullagh and Nelder 1989**)**.

To facilitate understanding, the most important statistical terms used have been listed and explained in Table 5.

Table 5: Summary of the most important statistical terms used

Probability ***p***	Probability of a correct identification /count ($0 \leq p \leq 1$)
Odds of success ***p/(1-p)***	Ratio of correct to incorrect identifications or counts
Degree of difficulty	Determined by the type of task. A degree of difficulty of 0 produces the odds of success for a lab of average competence exp(0)=1, i.e. the probability of success is 50%.
Relative degree of difficulty ***exp(degree of difficulty)***	The relative degree of difficulty corresponds to the odds of success of a lab of average competence
Level of competence	Determined by the skills and experience of the lab. Average competence is characterised by a level of competence of 0, greater competence corresponds to positive levels, lower competence to negative levels.
Relative level of competence ***exp(level of competence)***	If the lab has average competence the relative competence is 1, whereas greater (or lower) competence corresponds to greater (or lower) relative competence. Thus a relative competence of 2 means that for the lab in question the odds of success are twice as high as that of a lab of average competence.

If the ring test were repeated several times with different samples of a comparable degree of difficulty, there would be a random distribution of the levels of competence calculated around a true value. This value characterises the "true" level of competence but is unknown. Since random error follows an approximately normal distribution, significant difference in the competence of laboratories can be assumed only when there are clear deviations from normal distribution. To ascertain whether a lab is significantly better or worse than a hypothetical median lab, the standardised difference ***Z*** between the level of competence of the lab under review and the level of competence of the median lab is formed by:

$$Z = (\text{level of competence} - \text{Median})/s \qquad \textit{(equation 6)}$$

Here ***s*** stands for the standard deviation of the levels of competence. It is advisable that this standard deviation be empirically determined on the basis of the median of the absolute deviations from the median of all levels of competence (MAD: Median of Absolute Deviations, which is non-sensitive to outliers) or by using another robust estimation procedure to determine the standard deviation. The median lab is thus defined as a hypothetical lab whose level of competence corresponds to the median of the levels of competence of all labs.

The standardised difference ***Z*** follows an approximately standard normal distribution if the true level of competence of the lab in question corresponds to the level of competence of the median lab. In this case, there is a probability of approximately 95 % that ***Z*** is within an interval of – 2 to + 2. If the value + 2 is exceeded it can therefore be concluded that the lab in question is

"significantly" better than the median lab. By contrast, if the standardised difference ***Z*** is lower than the value of – 2 for a particular lab, it is very likely that it is "significantly" poorer.

3 Results and discussion

To improve clarity it proved to be advantageous to carry out a separate evaluation for each of the major taxonomic groups ***Echinodermata***, ***Crustacea***, ***Mollusca*** and ***Polychaeta***. The analysis data of the ring test participants and the results of the evaluation of success for both the qualitative and qualitative/semi-quantitative approach have been listed by taxonomic group in Tables 21 to 33 in the Annex (Echinodermata: Table 21 and Table 22; Crustacea: Table 23 to Table 25; Mollusca: Table 26 to Table 29 and Polychaeta: Table 30 to Table 33).

Due to inconsistencies with the information provided by the supplier, the individual samples given to the ring test participants were re-examined to establish species composition and number of individual in order to eliminate as far as possible any incorrect identifications or counts not caused by the laboratories. However, since processing and transportation conditions meant that all the animals in all the samples were not truly present in a reasonable condition, this was not possible in each case with a justifiable amount of effort.

The ring test participants took between 3 and 24 hours to process the samples; the average processing time was between 11 and 13 hours (Table 6).

Table 6: Time taken by the individual ring test participants to process the samples

Lab	Approx. processing time in hours
02	10
03	3
04	15
05	16 - 24
06	15
07	14
08	16
09	16 - 24
10	3
11	3
12	14 - 15

In the following comments on the individual groups, the names recorded in the first two columns of the unified lists of species (Table 16 to

Table 19 in the Annex) are used to describe the species.

In evaluating the "correctness" of identification and count, reference was made to the information provided by the supplier of the samples, although this information did not tally in each case with the actual content of the individual ring test samples. In cases of obvious discrepancies, the Quality Assurance Panel re-examined the samples and this is noted in the text.

3.1 Echinodermata

The Echinodermata are relatively large and easily noticeable animals, so that there were scarcely any problems here in identification and counting (Table 7). Two species, ***Asterias rubens*** and ***Ophiura ophiura***, which belong to different classes, were present. The classes and genera were correctly identified by all the labs. Only in the case of the species ***Ophiura ophiura*** did one lab reach a different result (***Ophiura albida***). When the sample of this lab was examined, it emerged that the lab had made an incorrect identification.

The determination of the number of individuals posed no difficulties; the counts recorded by all the labs were correct.

Table 7: Summarised evaluation of success in the identification of Echinodermata

Genus and species	Number of labs			Proportion of labs (%)		
	Class correctly identified	Genus correctly identified	Species correctly identified	Overall successful qualitative identification	Correctly counted with regard to class	Correctly counted with regard to species
Class Asteroidea						
Family Asteriidae						
Asterias rubens	11	11	11	100.0	100.0	100.0
Class Ophiuroidea						
Family Ophiuridae						
Ophiura ophiura	11	11	10	90.9	100.0	90.9

3.2 Crustacea

Table 8 gives a summarised overview of the results of the identification and count of Crustacea. An analysis of the data showed that 10 out of 11 labs found four species instead of the three indicated by the supplier of the samples (see Table 2). The additional species was ***Bathyporeia***

sp. or ***B. pilosa*** with 3 to 4 individuals. Since the supplier offered no clarification of this discrepancy, all the samples were re-examined. In this process a specimen of ***Bathyporeia sp.*** was found, including in the supplier's reference sample. Presumably, this species is the 25th species missing from the supplier's reference list (see section 2.1). Since 4 individuals of the species ***Bathyporeia pilosa*** were found in most of the samples of the ring test participants, this species was included in the evaluation with 4 individuals.

3.2.1 Order Decapoda

In the case of the order Decapoda (family Crangonidae) there were no problems in identifying order and family; they were correctly identified by all the labs. However, one lab concluded that the species ***Crangon crangon*** was ***Crangon aff. allmanni***, which is probably a misidentification, since a re-examination showed that the deep longitudinal ridges dorsal on both sides of the 6th pleon segment that is typical for the ***Crangon allmanni*** were not present (cf. Hayward and Ryland 1996).

Table 8: Summarised evaluation of success in identification of Crustacea

Genus and species	Number of labs			Proportion of labs (%)		
	Order correctly identified	Genus correctly identified	Species correctly identified	Overall successful qualitative identification	Correctly counted with regard to order	Correctly counted with regard to species
Order Decapoda						
Family Crangonidae						
Crangon crangon	11	11	10	90.9	90.9	81.8
Order Amphipoda						
Family Corophiidae						
Corophium volutator	11	11	11	100.0	90.9	90.9
Family Oedicerotidae						
Pontocrates altamarinus	11	10	10	90.9	81.8	72.7
Family Pontoporeidae (special case. Species not indicated by the supplier of the samples. Assumed reference = 4 individuals *Bathyporeia pilosa*)						
Bathyporeia pilosa	10	10	9	81.8	90.0	80.0

3.2.2 Order Amphipoda

Identification of the species belonging to the order Amphipoda was unproblematic for virtually all the labs.

The species ***Corophium volutator*** was correctly identified by all ring test participants and, with the exception of one lab, which found only 3 individuals, they were also correctly counted by all the labs.

The species ***Pontocrates altamarinus*** was found by 10 labs. One lab found the species ***Synchelidium maculatum*** instead. This species, like ***Pontocrates altamarinus,*** belongs to the family Oedicerotidae. With the exception of two labs, which found only 3 individuals, 4 individuals were counted by each lab. In one of the cases, the lower individual count was confirmed in a re-examination, while the sample of the other lab did contain the 4 individuals indicated by the supplier of the samples.

The genus ***Bathyporeia*** was found by 10 labs. An examination by the Quality Assurance Panel found that the sample of one lab did not in fact contain any individuals of the genus ***Bathyporeia***. One lab specified only the genus ***Bathyporeia sp.***, all the other labs identified the species ***Bathyporeia pilosa***. With the exception of one lab, which found only 3 individuals, 4 individuals were found by all the other ring test participants. However, when the sample of this lab was subsequently checked it was also found to contain 4 individuals.

3.3 Mollusca

The results for this group are very heterogeneous (Table 9). Identification of some species presented no problem whatsoever, whereas others proved more difficulties. Here the poor condition of the samples mentioned at the beginning (empty or broken shells, soft body detached from the shell) no doubt played an important part.

According to the supplier, the samples contained 10 species of bivalve with 2 to 8 individuals belonging to the orders Myoida and Veneroida. Most of the species belonged to the order Veneroida.

3.3.1 Order Myoida

The species ***Corbula gibba***, which belongs to the family Corbulidae, posed no identification problems; it was correctly identified by all the labs. Of 11 labs 9 labs found 5 individuals in their

samples, two labs found only 4 individuals. The re-examination showed that the sample of one of those labs did, in fact, contain 5 individuals. In the case of the other lab, it was no longer possible to achieve an unequivocal individual count because the sample material was too severely damaged.

Table 9: Evaluation of success in identification of Mollusca

Genus and species	Number of labs			Proportion of labs (%)		
	Order correctly identified	Genus correctly identified	Species correctly identified	Overall successful qualitative identification	Correctly counted with regard to order	Correctly counted with regard to species
Order Myoida						
Family Corbulidae						
Corbula gibba	11	11	11	100.0	81.8	81.8
Order Veneroida						
Family Donacidae						
Donax vittatus	11	11	11	100.0	90.9	90.9
Family Mactridae						
Mactra corallina	10	10	10	90.9	20.0	20.0
Family Cardiidae						
Cerastoderma edule	10	10	9	81.8	0.0	0.0
Family Montacutidae						
Mysella bidentata	11	11	11	100.0	54.5	54.5
Family Pharidae						
Phaxas pellucidus	11	7	7	63.6	63.6	45.5
Family Tellinidae						
Angulus tenuis	11	11	11	100.0	27.3	27.3
Tellina fabula	11	11	11	100.0	0.0	0.0
Family Veneridae						
Venus fasciata	11	11	11	100.0	100.0	100.0
Venus gallina var. striatula	11	10	10	90.9	100.0	90.9

3.3.2 Order Veneroida

The species ***Donax vittatus,*** which belongs to the family Donacidae**,** similarly presented no difficulties in identification. All the ring test participants found this species in their samples.

With the exception of one lab, which counted only 1 individual in its sample, all the other labs found 2 individuals. When the samples were re-examined 2 specimens of ***Donax vittatus*** were found in the samples of all the labs.

The species ***Mactra corallina,*** which belongs to the family Mactridae**,** was found in the samples of all the labs except one; however, only 2 labs found the 4 individuals indicated by the supplier. Five labs found 3 individuals, two labs found 2 individuals and one lab found only 1 individual in its sample. Due to the poor condition of the sample material, it was not possible to check the number of individuals precisely. Only in the case of the lab that had not found this species was it possible to prove that there really were no individuals of the species ***Mactra corallina***.

The genus ***Cerastoderma*** (family Cardiidae) also posed no major difficulties. It was found by all but one of the labs, although they identified 3 individuals instead of the 2 indicated by the supplier of the samples. This information provided by the supplier proved to be incorrect. All the samples contained 3 individuals, including the sample of the lab that had not recorded this species. This provides a plausible explanation for the poor values in Table 9. Concerning species determination 10 labs agreed with the supplier in identifying ***Cerastoderma edule***; only one lab recorded the species ***Cerastoderma glaucum***, which was probably a misidentification (cf. Jagnow and Gosselck 1987).

The identification of the species ***Mysella bidentata*** (family Montacutidae) did not pose a problem for any of the labs; it was found in all the samples. Difficulties occurred only in the count. Only 6 labs found the 3 individuals indicated by the supplier. Four labs found 2 individuals and one lab found only 1 individual of this species. Since this species are very small fragile bivalves, whose condition was correspondingly poor, it was not possible to re-check the individual counts.

Greater problems occurred in identifying the species ***Phaxas pellucidus,*** which belongs to the family Pharidae. All the labs that did not record this species as being present in their samples specified instead the species ***Ensis americanus***. These two species, which belong to the same family, are obviously easily confused with one another. According to the supplier, the samples contained 4 individuals, which most labs confirmed. Four labs found only 3 individuals of the species ***Phaxas pellucidus*** or ***Ensis americanus***. In distinguishing between the two species the degree to which the front and rear end are rounded plays a central role (cf. Ziegelmeier 1974 and Cosel et al. 1982). This characteristic could no longer be recognised to an adequate degree on all the individuals due to damage during transportation, which is a possible reason for the high number of misidentifications.

The species ***Angulus tenuis*** and ***Tellina fabula,*** which belong to the family Tellinidae, were found by all the labs. The number of individuals for the species ***Angulus tenuis***, which, according to the supplier, should have been 3, was confirmed by only 3 labs. All the other labs found numbers ranging between 2 and 9 animals. The picture for the species ***Tellina fabula*** was similarly heterogeneous. Here none of the labs recorded a number of individuals of 8, which was the number given by the supplier of the samples. What made it more difficult was the fact that the individual count specified by the supplier exceeded the prescribed maximum individual count of 5 (see section 2.1). One lab found an additional species in its sample, ***Angulus donacinus***. Another lab did not specify a particular genus for the 5 individuals but simply categorised these animals as belonging to the family Tellinidae. There was obviously a great degree of uncertainty in species identification for this family.

By contrast with the species of the family Tellinidae, the identification and count for the species ***Venus fasciata*** and ***Venus gallina var. striatula,*** which belong to the family Veneridae***,*** presented no problems of any kind. The species ***Venus fasciata*** was found by all the labs as the supplier of the samples had stated and the count of 3 individuals was confirmed. The species ***Venus gallina var. striatula*** covered all the species such as ***Venus gallina, Venus striatula, Chamelea gallina***. Thus, 10 labs found 5 individuals of these species. Only one lab classified the 5 individuals as being of the species ***Circomphalus casina***, which also belongs to the family Veneridae.

3.4 Polychaeta

The condition of the Polychaeta material was generally judged to be very poor, which meant species identification for this relatively difficult group become even more difficult (Table 10). It also limited the extent to which the Quality Assurance Panel was able to re-check the material.

3.4.1 Order Capitellida

All but one of the labs found 4 or 5 specimens of the species ***Capitella capitata,*** which belongs to the family Capitellidae. The supplier had stated that the samples contained 5 specimens. One lab found instead of the species ***Capitella capitata*** 2 individuals of the species ***Capitomastus minimus*** and 2 individuals of the species ***Heteromastus filiformis***. Both species also belong to the Capitellidae. ***Heteromastus filiformis*** was probably a misidentification, since this species is

morphologically quite distinct from ***Capitella capitata*** and the re-examination was unable to find any individuals belonging to the species ***Heteromastus filiformis*** (cf. Hartmann-Schröder 1996).

In the case of the species ***Arenicola marina,*** which belongs to the family Arenicolidae, there were no difficulties in terms of species identification or count. Apart from one lab, which was able to record only 1 specimen in its sample, this species was found by all ring test participants in the numbers stated by the supplier (2 specimens).

3.4.2 Order Magelonida

The species ***Magelona mirabilis*** (family Magelonidae) was correctly identified by all the ring test participants. Three labs found only 3 specimens in their samples; all the others found 4 specimens, as indicated by the supplier. During the re-examination, markedly lower individual counts were found, which may be due to the poor condition of the material or the way it was handled by the institutions carrying out the studies. It was only possible to establish beyond doubt the presence of 4 individuals in the sample of one lab.

3.4.3 Order Oweniida

The ***Owenia fusiformis*** species, which belongs to the Oweniidae family, was identified by all the labs. However, the individual counts recorded showed major differences. According to the supplier, each sample should have contained 4 animals. However, two labs found only 2, one lab only 3 and two labs even 5 specimens. It was not possible to subsequently clarify these discrepancies because the number of damaged individuals and diverse fragments was too great.

3.4.4 Order Phyllodocida

Greater problems arose in the identification of the species ***Nephtys hombergii*** and ***Nephtys cirrosa***, which belong to the family Nephtydidae; the samples were meant to contain 2 specimens of each species. It was striking that 7 labs found a total of at least 5, 6 or even 7 animals belonging to the family Nephtydidae, although there were only supposed to be 4 animals.

Nephtys hombergii was found by only 3 ring test participants, who each identified 2 specimens. Seven other labs found 3, 4 or 5 specimens. In addition to that two labs also found one of specimen ***Nephtys kersivalensis***. Similarly, several labs also found 1 or 2 specimens of the

species ***Nephtys caeca*** in their samples. One lab found also one specimen of the species ***Sphaerodorum flavum*** in its sample.

All the labs that identified ***Nephtys cirrosa*** in their samples found 2 individuals of this species, as stated by the supplier. One lab did not specify a particular species, but merely named the genus ***Nephtys sp.***, of which it found 3 individuals.

Table 10: Summarised evaluation of success in identification of the Polychaeta

Genus and species	Number of labs			Proportion of labs (%)		
	Order correctly identified	Genus correctly identified	Species correctly identified	Overall successful qualitative identification	Correctly counted with regard to order	Correctly counted with regard to species
Order Capitellida						
Family Capitellidae						
Capitella capitata	11	10	10	90.9	72.7	72.7
Family Arenicolidae						
Arenicola marina	11	11	11	100.0	90.9	90.9
Order Magelonidae						
Family Magelonida						
Magelona mirabilis	11	11	11	100.0	72.7	72.7
Order Oweniida						
Family Oweniidae						
Owenia fusiformis	11	11	11	100.0	54.5	54.5
Phyllodocida Order						
Family Nephtyidae						
Nephtys hombergii	11	11	10	90.9	27.3	27.3
Nephtys cirrosa	10	10	5	45.5	80.0	50.0
Family Nereididae						
Hediste diversicolor	11	9	9	81.8	72.7	63.6
Family Phyllodocidae						
Phyllodoce maculata	11	11	8	72.7	81.8	63.6
Order Spionida						
Family Spionidae						
Spiophanes bombyx	8	6	6	54.5	50.0	37.5

The Quality Assurance Panel was not able to fully clarify the details of these discrepancies. The main point of criticism was probably in this case the preparation of the sample material. Firstly, the total number of individuals of the family Nephtydidae in the individual samples varied greatly and, secondly, the samples contained more than the two species stated by the supplier. The additional species not mentioned by the supplier was probably ***Nephtys caeca*** (cf. also Böggemann 1997).

The species ***Hediste diversicolor,*** which belongs to the family Nereididae, of which the samples were supposed to contain 4 specimens, did not present the same degree of difficulty as the species in the family Nephtydidae. Two labs found only 3 specimens, one lab identified 5 instead of 4 specimens of the species ***Nereis sp*** (= ***Hediste sp.*** ?) and one lab identified 4 specimens of the species ***Neanthes succinea***. Since the corresponding sample material was not fully available or only one animal was present, it was not possible to investigate these deviations more closely.

The genus ***Phyllodoce,*** which belongs to the family Phyllodocidae***,*** was detected by all the ring test participants. One lab specified only the genus ***Phyllodoce sp.***, two labs identified the species ***Phyllodoce mucosa***. One lab found only 2 animals, all the other labs found 3 animals of the species ***Phyllodoce maculata,*** as stated by the supplier of the samples.

3.4.5 Order Spionida

There were also some problems with the species ***Spiophanes bombyx,*** which belongs to the family Spionidae. 3 labs found no representative of this order at all in their samples. Two other labs would not be more specific than recording Spionidae indet. Three labs found only 2 animals. Only three labs found in their samples 3 animals as indicated by the supplier. Since, in the re-examination the animals could not be found in over half of the samples, it is not possible to make any unequivocal statements about the reasons for these poor results.

3.5 Statistical analysis of the accuracy of the taxonomic identifications, taking into account differing degrees of difficulty using the logit model

For each of the 25 species, 4 sub-tasks A to D (cf. Section 2.2.3) had to be carried out, which meant that a total of 100 tasks had to be performed.

Since, due to problems in preparing and transporting the samples, some species had suffered more than others, it was not possible to take into consideration the counts for the Mollusca species ***Mactra corallina, Mysella bidentata, Angulus tenuis, Tellina fabula*** and the Polychaeta

species ***Nephtys hombergii, Nephtys cirrosa, Spiophanes bombyx***. Of the remaining 93 sub-tasks a total of 62 were successfully carried out by all labs without exception. It is basically not possible to carry out a meaningful statistical evaluation for these successfully performed sub-tasks. Thus from a statistical point of view no decision can be taken for these sub-tasks as to whether the identification task is “infinitely” simple (this would be the case for example if for a correct identification of the higher order it were already clear which genus has to be present), or whether it is a task that might well present difficulties and in which only “by chance” all 11 labs have “guessed” correctly.

It is therefore only possible to include the remaining 31 sub-tasks in the statistical evaluation, of which at least one lab made an error in each. Table 11 gives an overview of these sub-tasks and their codes.

Table 11: Summary of the sub-tasks in which at least one lab made an error

	Genus	Species	Higher taxonomic level	Identification of genus	Identification of species	Count
Echinodermata	***Asterias***	***rubens***				
Echinodermata	***Ophiura***	***ophiura***			T12	
Crustacea	***Crangon***	***crangon***			T13	T19
Crustacea	***Corophium***	***volutator***				T20
Crustacea	***Pontocrates***	***altamarinus***		T6		T21
Crustacea	***Bathyporeia***	***pilosa***	T1		T14	T22
Mollusca	***Corbula***	***gibba***				T23
Mollusca	***Donax***	***vittatus***				T24
Mollusca	***Mactra***	***corallina***	T2			
Mollusca	***Cerastoderma***	***edule***	T3		T15	
Mollusca	***Mysella***	***bidentata***				
Mollusca	***Phaxas***	***pellucidus***		T7		T25
Mollusca	***Angulus***	***tenuis***				
Mollusca	***Tellina***	***fabula***				
Mollusca	***Venus***	***fasciata***				
Mollusca	***Venus***	***gallina var. striatula***		T8		
Polychaeta	***Capitella***	***capitata***		T9		T26
Polychaeta	***Arenicola***	***marina***				T27
Polychaeta	***Magelona***	***mirabilis***				T28
Polychaeta	***Owenia***	***fusiformis***				T29
Polychaeta	***Nephtys***	***hombergii***			T16	
Polychaeta	***Nephtys***	***cirrosa***	T4		T17	
Polychaeta	***Hediste***	***diversicolor***		T10		T30
Polychaeta	***Phyllodoce***	***maculata***			T18	T31
Polychaeta	***Spiophanes***	***bombyx***	T5	T11		

Each of the 11 laboratories had to carry out these 31 sub-tasks, making a total of 341=31*11 identifications. However, with regard to their evaluation, it is important to note that successful performance of task C presupposes the successful performance of task B, so that the inclusion of task C into the evaluation of a lab is meaningful only if that lab has already successfully carried out task B (consequential errors are not counted). If, for example, a particular lab has correctly determined the higher taxonomic level for a particular species, but has incorrectly identified the genus, this lab's identification of the species is not taken into account. During the 341 identifications, this problem occurred 7 times in total, so that 334 identifications remained that were included in the statistical evaluation. Each of these 334 identifications was either successful and coded with the value 1 or was not successful and was coded with 0. In other words, each of these identifications leads to a result Y, which either has the value 0 or 1. The aim of the statistical analysis is ultimately to estimate the probability of a value 1, i.e. of success. Since this probability depends both on the degree of difficulty of the sub-task and on the level of competence of the lab, the logit model was used for this connection (cf. Section 2.2.3).

This algorithm produces the results presented in Table 12 for the various degrees of difficulty. At a probability of success of less than 80 % (given average level of competence) it indicates the following key problem areas:

- When identifying the higher taxonomic level the identification of ***Spiophanes bombyx*** proved particularly difficult (T5).
- For the species ***Phaxas pellucidus*** (T7) and ***Spiophanes bombyx*** (T11) identification of the genus was relatively problematic.
- In the identification of species there were major problems with ***Nephtys cirrosa*** (T17) and ***Phyllodoce maculata*** (T18). In particular with ***Nephtys cirrosa*** the probability of success was only 50 % for a lab of average competence.
- The task of counting individuals proved problematic in the case of the following species: ***Phaxas pellucidus*** (T25), ***Capitella capitata*** (T26), ***Magelona mirabilis*** (T28), ***Owenia fusiformis*** (T29) and ***Hediste diversicolor*** (T30).

For the evaluation of the degrees of difficulty it must, however, be noted that only those sub-tasks where at least one misidentification had occurred were taken into account. Thus, for example, sub-tasks T1 to T4, which are characterised by a high probability of success, are not necessarily the easiest tasks but merely those where precisely one misidentification occurred.

Table 12: Degrees of difficulty of the 31 sub-tasks

Sub-task	Degree of difficulty	Odds of success given average level of competence	Probability of success given average level of competence
Correct classification in a higher taxonomic level			
T1	2.63	13.83	0.93
T2	2.63	13.83	0.93
T3	2.63	13.83	0.93
T4	2.63	13.83	0.93
T5	1.14	3.12	0.76
Identification of the genus			
T6	2.63	13.83	0.93
T7	0.65	1.91	0.66
T8	2.63	13.83	0.93
T9	2.63	13.83	0.93
T10	1.74	5.70	0.85
T11	0.93	2.53	0.72
Identification of the species			
T12	2.63	13.83	0.93
T13	2.63	13.83	0.93
T14	2.55	12.79	0.93
T15	2.46	11.66	0.92
T16	2.63	13.83	0.93
T17	0.00	1.00	0.50
T18	1.14	3.12	0.76
Number of individuals			
T19	2.63	13.83	0.93
T20	2.63	13.83	0.93
T21	1.74	5.70	0.85
T22	2.55	12.79	0.93
T23	1.74	5.70	0.85
T24	2.63	13.83	0.93
T25	0.65	1.91	0.66
T26	1.14	3.12	0.76
T27	2.63	13.83	0.93
T28	1.14	3.12	0.76
T29	0.21	1.23	0.55
T30	1.14	3.12	0.76
T31	1.74	5.70	0.85

The arithmetic mean of all degrees of difficulty is 1.9167 (mean value of all sub-tasks), so that for the odds of success (p/(1-p)) given a randomly selected task performed by a lab of average competence the value 6.8 = exp(1.9167) results, which corresponds to a probability of p = 0.87 = 6.8/(1+6.8).

Table 13: Levels of competence of the 11 laboratories

Lab code	Level of competence	Relative competence	Odds of success given average degree of difficulty	Probability of success given average degree of difficulty
02	-0.03	0.97	6.61	0.87
03	-1.83	0.16	1.09	**0.52**
04	-0.74	0.48	3.25	0.76
05	0.26	1.30	8.83	0.90
06	1.84	6.31	42.89	0.98
07	-0.99	0.37	2.53	0.72
08	0.26	1.30	8.83	0.90
09	0.08	1.09	7.38	0.88
10	0.62	1.86	12.66	0.93
11	0.54	1.72	11.69	0.92
12	-0.03	0.97	6.61	0.87

The values calculated for the levels of competence of the 11 laboratories are listed in The arithmetic mean of all degrees of difficulty is 1.9167 (mean value of all sub-tasks), so that for the odds of success (p/(1-p)) given a randomly selected task performed by a lab of average competence the value 6.8 = exp(1.9167) results, which corresponds to a probability of p = 0.87 = 6.8/(1+6.8).

Table 13. Apart from level of competence, the odds of success for a lab given a sub-task of average degree of difficulty were also calculated. For lab 06, for example, the odds are 43 to 1, which correspond to a probability of approx. 98 %. For five other labs, the probability of success given an average degree of difficulty was also at least 90 %. By contrast, lab 03 achieved odds of success of only about 1 to 1, which is in this case the probability of a correct identification was only approx. 52 %. That means that this lab successfully performed only every second sub-task of average degree of difficulty; however, it should be noted that, due to the problems already mentioned, it may have received a sample that was in particularly poor condition.

The levels of competence can be used to carry out not only an absolute, but also a relative evaluation, i.e. an evaluation that makes reference to the results of the other laboratories, for which the so-called median lab can be used as a reference value (see section 2.2.3). The value for

the level of competence of median lab is in this case 0.08. In order to determine whether one lab is significantly better or worse than the hypothetical median lab, take the standardized difference (Z) between the level of competence of the lab under review and the level of competence of the median lab. In this case is s the standard deviation of the levels of competence of the individual labs and can be empirically determined so that

$$s = MAD/0.67449$$
$$= 0.46/0.6745$$
$$= 0.682$$

results. The factor 0.6745 is used here as a consistency factor to permit a comparison between the estimated value and the empirical standard deviation.

Table 14 lists the values for the standardized difference (***Z***) for all 11 laboratories.

Table 14: Levels of competence and test statistics for the 11 laboratories

Lab code	Level of competence	Absolute deviation from the median (MAD)	Standardized difference Z
02	-0.03	0.11	-0.16
03	-1.83	1.91	-2.80
04	-0.74	0.82	-1.20
05	0.26	0.18	0.26
06	1.84	1.76	2.58
07	-0.99	1.07	-1.57
08	0.26	0.18	0.26
09	0.08	0	0
10	0.62	0.54	0.79
11	0.54	0.46	0.67
12	-0.03	0.11	-0.16

Figure 1 shows a graphic depiction of these links. ***Z*** has an approximately standard normal distribution if the true level of competence of the lab in question corresponds to the level of competence of the median lab. If the value + 2 is exceeded it can therefore be concluded that the lab in question is “significantly” better than the median lab. This condition was obviously fulfilled by lab 06. The proficiency of this lab must thus be regarded as markedly better than the median lab. If, by contrast, as is the case with lab 03, the test value is less than the value – 2, there is a great likelihood that the lab is “significantly” worse. However, in this case the reason for the poor result may be lie in the poor condition of the ring test samples this lab received.

Figure 1: Standardized differences of the 11 laboratories from the median lab

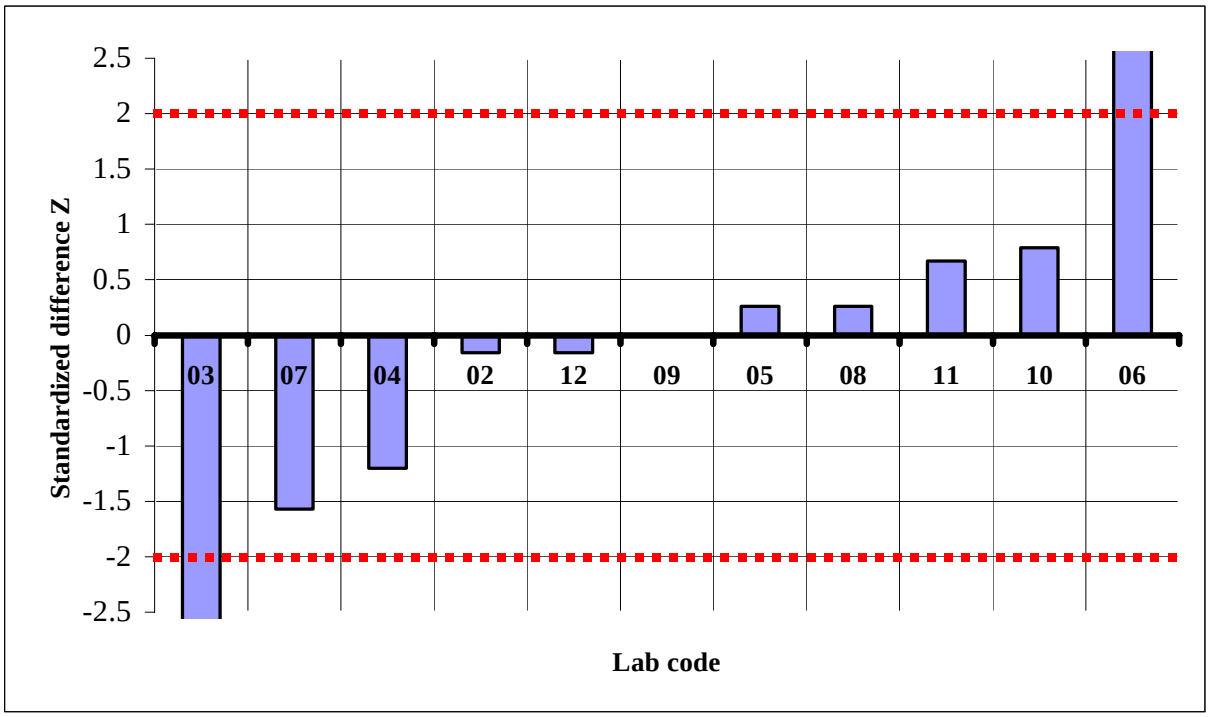
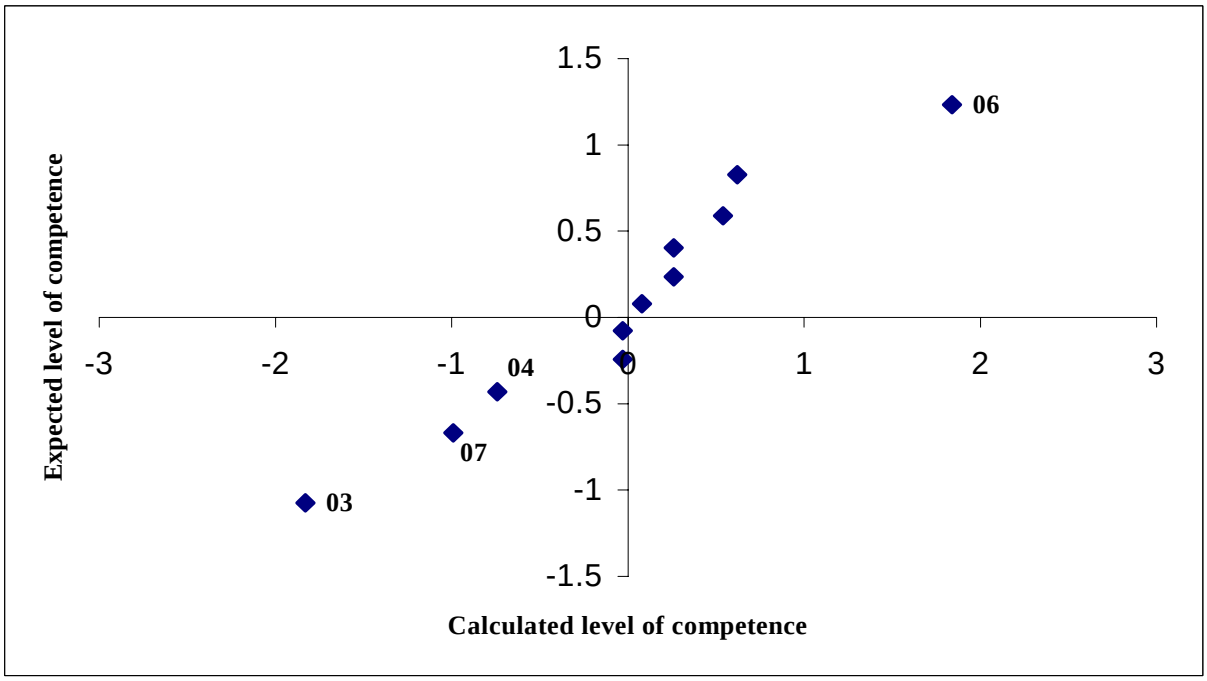


Figure 2: Normal distribution plot



A review of the homogeneity of the levels of competence can be carried out graphically using a normal distribution plot. Since the empirical levels of competence have an approximately normal distribution, if the true levels of competence of the laboratories are the same then the empirical

levels of competence in a normal distribution plot will be approximately on a straight line. However, the normal plot of the levels of competence depicted in Figure 2 demonstrates that there are striking deviations from the straight line, so that the assumption of normality does not appear to be reliable, particularly in the marginal areas of the distribution. Lab 06 seems clearly superior to the other labs, while in particular lab 03, but also labs 04 and 07, had noticeably poorer values. By contrast, all the other labs are on a straight line, so that here it can be assumed that the fluctuations observed are only random. However, we must point out again that the low levels of competence of labs 03, 04 and 07 may have been caused by the poor condition of the samples. Thus nothing speaks against the assumption that the competence of the labs was generally of a satisfactory standard.

4 Summary and conclusions

Overall it can be concluded that all the labs were able to reliably identify most of the species. There were major problems with some species of Bivalvia and Polychaeta. Counting errors occurred more frequently for these groups.

If we compare the exclusively qualitative approach (1st approach) with the qualitative/quantitative approach (2nd approach), it can be seen very clearly which species presented predominantly problems of identification and which species or groups also posed counting difficulties and also where both tasks were problematic. For the Echinodermata there was an identification problem in only one case, but no counting difficulties at all (cf. Table 22). With the Crustacea identification problems occurred in 4 cases and counting problems in 6 cases (cf. Table 25). With the Mollusca there were more serious problems of identification with the species ***Phaxas pellucidus***. There were difficulties in counting for all the Mollusca species with the exception of the species ***Venus fasciata*** (cf. Table 29). The greatest number of identification problems occurred with the Polychaeta (cf. Table 33). The only species to be identified without difficulty were ***Arenicola marina***, ***Magelona mirabilis*** and ***Owenia fusiformis***. The only species for which there were no counting problems was ***Arenicola marina.***

The statistical approach used is well suited for acquiring information about the degree of difficulty in identifying individual species and the competence of the labs.

Working with the material was made particularly difficult by errors in preparation of the samples and in transportation, so that in some cases an exact diagnosis of the species or determination of

the individual counts was not possible. Since all the animals were in one container, the more delicate animals were in some cases severely damaged by the larger, more robust animals. Consequently, some of the samples were in a very poor condition. That affected particularly those groups where the majority of difficulties in identification and counting occurred. The condition of the small fragile bivalve species was particularly defective. The shells of these animals were broken and in some cases the body of the mollusca had become detached from the shell. Sometimes the hinge teeth had even broken off.

In the case of the Polychaeta, a number of important distinguishing features had also been damaged or were no longer present. For example, bristles had sometimes broken off and parapodia were “frayed”. Some individuals of the ***Spiophanes*** species, for example, were present only as fragments. Other animals had completely lost their colouring (pigmentation in the ***Phyllodoce***). Since the condition of the sample material in the individual ring test samples varied enormously the principle of equality of opportunity for all the participating labs was violated. For this reason, the proficiency of the individual labs that took part in this ring test will not be conclusively evaluated.

The highly defective condition of the sample material also made it impossible in many cases for the Quality Assurance Panel to effectively check the samples. For example, the Quality Assurance Panel was not always able to reconstruct the individual counts recorded by the ring test participants, because in some cases even fewer individuals than recorded by the labs could be found.

Another point to be criticised is that the information given by supplier of the samples on the numbers of individuals per species to be expected was incorrect (e.g. for the ***Tellina fabula***). Sometimes, contrary to the stipulations, individuals were used that were too young. According to the decision taken at the Workshop (1st taxonomic workshop on macrozoobenthos in the GMMP on the topic of Polychaeta of 23.-26.03.1998 in Neubroderstorf) no juvenile animals should be used (in the case of ***Nephtys*** < 2 cm), because GMMP has decided not to identify them.

Other points to be criticised included the use of screw-top containers that leaked and were not filled to the rim with liquid, and the preservation of animals in alcohol. The preservation in alcohol caused the loss of colour and contraction of the animals mentioned above, which therefore no longer had their accustomed appearance. It is possible that the supplier of the samples did not carry out the initial preservation of the test material with formol as required. At least the Polychaeta should in future always be fixed with formalin. There is also uncertainty about the fact that the samples contained a high rate of broken shells components.

The fact that mixed samples from different sea areas/habitats were prepared was also criticised. Information on the origin of the samples and where they were found (depth of water, salt content, type of sediment, geographical region) are helpful for the identification process. The sample was supposed to have been taken from a single community and the individual species were to have been dispatched in separate containers for identification. To facilitate a check of the sorting accuracy, it is probably better to use samples with sediment.

The following conclusions can be drawn for any macrozoobenthos ring tests to be carried out in the future:

- Great care must be taken when preparing the samples; information on the samples must be correct and as detailed as possible.
- It must be guaranteed that no animals are damaged in transportation. Fragile and sensitive animals should in future be dispatched separately as should large and small animals.
- From the point of view of the Quality Assurance Panel, an up-to-date list of species macrozoobenthos (complete list) should be sent out with synonyms for the analysis, on which the labs would enter their results. That would avoid ambiguities in nomenclature.
- The idea of sending the analysed ring test samples back to the Quality Assurance Panel proved helpful for the evaluation and should be retained.
- Future ring tests should concentrate on the following groups of organisms: Amphipoda**,** Polychaeta and small Bivalvia.

5 Bibliography

Armonies, W.; Reise, K. (1999):

On the population development of the introduced razor clam Ensis americanus near the island of Sylt (North Sea). - Helgoländer Meeresuntersuchungen 52 (291-300).

Lab:03

Bick, A.; Gosselck, F. (1985):

Arbeitsschlüssel zur Bestimmung der Polychaeten der Ostsee. - Mitt. Zool. Mus. Berlin 61, 2 (171-272).

Lab:08, 09, 11

Bondesen, P. (1984):

Havmuslinger. - Natur og Museum 23, 2 (1-32).

Lab:11

Bondesen, P. (1994):

Danske Havmuslinger. - Natur og Museum 33, 2(1-32).

Lab:11

Böggemann 1997

Polychaeten aus der Deutschen Bucht – Taxonomische Bearbeitung und Dokumentation der vom Forschungsinstitut Senckenberg hauptsächlich in der Deutschen Bucht gesammelten Polychaeten. – Courier Forschungsinstitut Senckenberg 202, 1 – 315.

Cosel, v. R.; Dörjes, J.; Mühlenhardt-Siegel, U. (1982):

Die amerikanische. Schwertmuschel Ensis directus (Conrad) in der Deutschen Bucht. I.Zoogeographie und Taxonomie im Vergleich mit den einheimischen Arten. - Senckenbergiana Marit. 14, ¾ (147-173).

Lab:05, 12

de Boer, T.W.; de Bruyne, R.H. (1991):

Schelpen van de Friese Waddeneilanden.

Lab:03

Hartmann, O. (1947):

Polychaetous annelids, Part 7: Capitellidae. - Allan Hancock Pacific Exp. 10, 4 (391-418).

Lab:02

Hartmann-Schröder, G. (1971):

Annelida, Borstenwürmer, Polychaeta. In: Dahl, M., Peus, F. (Eds.): Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und ihrer Lebensweise, Part 58.

Lab:03

Hartmann-Schröder, G. (1996):

Annelida, Borstenwürmer, Polychaeta. In: Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und ihrer Lebensweise, Part 58, (1-648)- 2nd revised edition, Gustav Fischer Verlag Jena, Stuttgart, Lübeck, Ulm.

Lab:02, 04, 05, 06, 07, 08, 09, 10, 11, 12

Hyward, P. J., Ryland, J. S. (1990):

The Marine Fauna of the British Isles and North-West Europe, Volume 1: Introduction and Protozoans to Arthropods.- Oxford Science.

Lab:03, 04, 07, 09

Hyward, P. J., Ryland, J. S. (1990):

The Marine Fauna of the British Isles and North-West Europe, Volume 2: Molluscs to Chordates. - Oxford Science.

Lab:02, 03, 04, 07, 08, 09

Hyward, P. J., Ryland, J. S. (1995):

Handbook of the Marine Fauna of North-West Europe. - Oxford University Press, Oxford.

Lab:12

Hyward, P. J., Ryland, J. S. (1996):

Handbook of the Marine Fauna of North-West Europe. - 2nd revised edition, Oxford University Press, Oxford.

Lab:05, 06, 11

Jagnow, B.; Gosselck, F. (1987):

Bestimmungsschlüssel für die Gehäuseschnecken und Muscheln der Ostsee - Mitt. Zool. Mus. Berlin 63, 2 (191-268).

Lab:06, 08, 09, 11

Köhn, J.; Gosselck, F. (1989):

Bestimmungsschlüssel der Malakostraken der Ostsee. - Mitt. Zool. Mus. Berlin 65, 1 (3-114).

Lab:06, 08, 09, 11

Lieberkind, I. (1928):
Echinodermata, Stachelhäuter oder Echinodermen. - In. Dahl, F.: Die Tierwelt Deutschlands und der angrenzenden Meeresteile, Part 4 (264—329). Gustav Fischer Verlag Jena.

Lab:02, 06

Lincoln R. J. (1979):
British Marine Amphipoda: Gammaridea. - British museum (Natural History) London (1-658). - Richard Clay (The Chaucer Press) Ltd., Bungay, Suffolk.

Lab:02, 03, 04, 06, 07, 08, 09, 10, 12

McCullagh, P.; Nelder, J. A. (1989):
Generalized Linear Models. London.

Pleijel, F. (1988):
Phyllodoce (Polychaeta, Phyllodocidae) from Northern Europe. - Zoologica Scripta 17, 2 (141-153).

Lab:02, 10

Rainer, S. F. (1991):
The genus Nephtys (Polychaeta: Phyllodocidae) of northern Europe: a review of species, including the description of N. pulchra sp. n. and a key to the Nephtyidae. - Helgoländer Meeresuntersuchungen 45 (65-96).

Lab:07, 08, 11

Rasmussen, E (1973):
Systematics and Ecology of the Isefjord Marine Fauna, Reprinted from OPHELIA, Vol.11.

Lab:12

Schellenberg, A. (1942): Krebstiere oder Crustacea - IV: Flohkrebse oder Amphipoda, In: Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und ihrer Lebensweise, Part 40. Gustav Fischer Verlag Jena.

Lab:06, 11

Schönborn, C.; Arndt, E.; Gosselck, F. (1989):
Bestimmungsschlüssel der benthischen Hydrozoen der Ostsee. Mitt. Zool. Mus. Berlin 69, 2, (201-253).

Lab:08

Smaldon, G. (1979):

British Coastal Shrimps and Prawns. Synopses of the British Fauna 15 (New Series).

Lab:02

Streesemann, E. (1992):

Exkursionsfauna von Deutschland, Band 1 - Wirbellose (ohne Insekten). Volk und Wissen Verlag GmbH, Berlin.

Lab:07, 11

Tebble, N. (1966):

British Bivalve Seashells - A Handbook for Identification. Trustees of the British Museum (Natural History) London. HM Stationary Office, Edinburgh.

Lab:02, 04, 10, 12

Tebble, N. (1976):

British Bivalve Seashells - A Handbook for Identification. Royal Scottish Museum.

Lab:11

Willmann, R. (1989):

Muscheln und Schnecken der Nord- und Ostsee. JNN Naturführer, Verlag J.Neumann-Neudamm, Melsungen.

Lab:03, 12

Ziegelmeier, E. (1957):

Die Muscheln (Bivalvia) der deutschen Meeresgebiete. Helgoländer wiss. Meeresunters. 6 (1-64), Hamburg.

Lab:02, 03, 04, 06, 07, 10

Ziegelmeier, E. (1957, veränderter Nachdruck 1974):

Die Muscheln (Bivalvia) der deutschen Meeresgebiete.- Hamburg. Helgoländer wissenschaftliche Meeresuntersuchungen 6 (1-59).

Labor. 08, 11, 12

Ziegelmeier, E. (1966, veränderter Nachdruck 1973):

Die Schnecken (Gastropoda, Prosobranchia) der deutschen Meeresgebiete und brackigen Küstengewässer. Helgoländer wissenschaftliche Meeresuntersuchungen 13 (1-61).

Lab:11

6 Annex (tables)

Table 15: Alphabetical list of ring test participants

Institution	Participants	Address
Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI)	Rachor, Eike; Barwich, Elke	27568 Bremerhaven Columbusstr.
Aquamarin	Grotjahn, Michael	26506 Norden Rheinstraße 13
BIOCONSULT, Umweltplanung und Gewässerkunde	Zeiß, Bernd	28759 Bremen Lesumstraße 10
Biologische Anstalt Helgoland i. d. Stiftung Alfred-Wegner-Institut für Polar- und Meeres-forschung, Wattenmeerstation Sylt	Herre, Elisabeth	25992 List/Sylt Hafenstraße 43
Forschungsinstitut Senckenberg Hamburg, Arbeitsgruppe Systemökologie	Fock, Heiko	22607 Hamburg Notkestraße 31
Institut für Angewandte Ökologie GmbH (IFAÖ)	Bönsch, Regine	18184 Neu-Broderstorf Lindenweg 2
Institut für Ostseeforschung Warnemünde (IOW) an der Universität Rostock	Zettler, Michael; Peters, Christine; Bick, Andreas	18119 Rostock-Warnemünde Seestraße 15
Landesamt für Natur und Umwelt des Landes Schleswig-Holstein (LANU)	Schroeren, Volker	24220 Flintbek Hamburger Chaussee 25
MARILIM	Reincke, Torsten	24148 Kiel Wischhofstraße 1-3, Geb. 11
Niedersächsiches Landesamt für Ökologie (NLÖ), Forschungsstelle Küste	Obert, Bernd	26548 Norderney An der Mühle 5
	Schaefer, Ragnar	24220 Schönhorst Barkauer Straße 26

Table 16: Unified list of all the Echinodermata species named by the ring test participants

Echinodermata				
Genus	**Species**	**Family**	**Class**	**Synonyms**
Asterias	***rubens***	Asteriidae	Asteroidea	
Ophiura	***albida***	Ophiuridae	Ophiuroidea	
Ophiura	***ophiura***	Ophiuridae	Ophiuroidea	*Ophiura texturata*

Table 17: Unified list of all the Crustacea species named by the ring test participants

Crustacea				
Genus	**Species**	**Family**	**Order**	**Synonyms**
Crangon	***crangon***	Crangonidae	Decapoda	*Cancer crangon, Crangon vulgaris*
Crangon	***aff. allmanni***	Crangonidae	Decapoda	
Corophium	***volutator***	Corophiidae	Amphipoda	*Oniscus volutator, Corophium grossipes, Corophium longicorne*
Pontocrates	***altamarinus***	Oedicerotidae	Amphipoda	
Synchelidium	***maculatum***	Oedicerotidae	Amphipoda	
Bathyporeia	***pilosa***	Pontoporeidae	Amphipoda	
Bathyporeia	***sp.***	Pontoporeidae	Amphipoda	*Tersitis* sp.

Table 18: Unified list of all the Mollusca species named by the ring test participants

Mollusca				
Genus	**Species**	**Family**	**Order**	**Synonyms**
Corbula	***gibba***	Corbulidae	Myoida	*Aloides gibba, Variocorbula gibba*
Donax	***vittatus***	Donacidae	Veneroida	
Mactra	***corallina***	Mactridae	Veneroida	*Mactra stultorum, Trigonella stultorum*
Cerastoderma	***edule***	Cardiidae	Veneroida	*Cardium edule*
Cerastoderma	***glaucum***	Cardiidae	Veneroida	*Cerastoderma lamarcki, Cardium glaucum, Cardium lamarcki*
Mysella	***bidentata***	Montacutidae	Veneroida	*Montacuta bidentata*
Tellimya	***ferruginosa***	Montacutidae	Veneroida	*Montacuta ferruginosa, Tellimya ferruginosa cf.*
Phaxas	***pellucidus***	Pharidae	Veneroida	*Cultellus pellucidus*
Ensis	***americanus***	Pharidae	Veneroida	*Ensis directus*
Angulus	***tenuis***	Tellinidae	Veneroida	*Tellina tenuis*
Tellina	***fabula***	Tellinidae	Veneroida	*Angulus fabula, Fabulina fabula*
Angulus	***donacinus***	Tellinidae	Veneroida	
Tellinidae		Tellinidae	Veneroida	
Venus	***fasciata***	Veneridae	Veneroida	*Clausinella fasciata*
Venus	***gallina var. striatula***	Veneridae	Veneroida	*Venus gallina, Venus striatula, Chamelea gallina*
Circomphalus	***casina***	Veneridae	Veneroida	
Scrobicularia	***plana***	Semelidae	Veneroida	
Bivalvia	***indet.***			

Table 19: Unified list of all the Polychaeta species named by the ring test participants

Polychaeta				
Genus	**Species**	**Family**	**Order**	**Synonyms**
Capitella	***capitata***	Capitellidae	Capitellida	
Capitomastus	***minimus***	Capitellidae	Capitellida	*Capitella minima*
Heteromastus	***filiformis***	Capitellidae	Capitellida	
Arenicola	***marina***	Arenicolidae	Capitellida	*Lumbricus marinus*
Magelona	***mirabilis***	Magelonida	Magelonidae	*Magelona papillicornis*
Owenia	***fusiformis***	Oweniidae	Oweniida	
Nephtys	***aff. assimilis***	Nephtyidae	Phyllodocida	
Nephtys	***caeca***	Nephtyidae	Phyllodocida	
Nephtys	***hombergii***	Nephtyidae	Phyllodocida	
Nephtys	***kersivalensis***	Nephtyidae	Phyllodocida	
Nephtys	***cirrosa***	Nephtyidae	Phyllodocida	
Nephtys	**sp.**	Nephtyidae	Phyllodocida	
Sphaerodorum	***flavum***	Nephtyidae	Phyllodocida	
Hediste	***diversicolor***	Nereididae	Phyllodocida	*Nereis diversicolor*
Neanthes	***succinea***	Nereididae	Phyllodocida	*Nereis succinea*
Nereis	**sp.**	Nereididae	Phyllodocida	
Phyllodoce	***maculata***	Phyllodocidae	Phyllodocida	*Anaitides maculata*
Phyllodoce	***mucosa***	Phyllodocidae	Phyllodocida	*Anaitides mucosa*
Phyllodoce	**sp.**	Phyllodocidae	Phyllodocida	
Spiophanes	***bombyx***	Spionidae	Spionida	
Scolelepis	***bonnieri***	Spionidae	Spionida	
indet		**Spionidae**		
indet		**Maldanidae**		

Table 20: List of other species named by the ring test participants

Phylum	**Class**	**Genus**	**Species**	**Synonyms**
Annelida	**Clitellata**	***Tubificoides***	***benedii***	*Tubificoides benedeni*
Cnidaria	**Hydrozoa**	***Lovenella***	***clausa***	
Nemathelminthes	**Nematoda**			

Table 21: Analysis data of the ring test participants for the Echinodermata group (species and individual counts)

Class	**Asteroidea**	**Ophiuroidea**		**Total**	**Total**
Family	**Asteriidae**	**Ophiuridae**		**Ophiuridae**	**Echinodermata**
Genus and species	***Asterias rubens***	***Ophiura ophiura***	***Ophiura albida***		
Lab code					
Reference	***2***	***2***	***0***	***2***	***4***
02	2	2	0	2	4
03	2	2	0	2	4
04	2	2	0	2	4
05	2	2	0	2	4
06	2	2	0	2	4
07	2	2	0	2	4
08	2	0	2	2	4
09	2	2	0	2	4
10	2	2	0	2	4
11	2	2	0	2	4
12	2	2	0	2	4

Table 22: Success data for Echinodermata (successful hits)

	Qualitative approach (1st approach)		**Qualitative/semi-quantitative approach (2nd approach)**	
Class	**Asteroidea**	**Ophiuroidea**	**Asteroidea**	**Ophiuroidea**
Family	**Asteriidae**	**Ophiuridae**	**Asteriidae**	**Ophiuridae**
Genus and species	***Asterias rubens***	***Ophiura ophiura***	***Asterias rubens***	***Ophiura ophiura***
Lab code				
02	1	1	1	1
03	1	1	1	1
04	1	1	1	1
05	1	1	1	1
06	1	1	1	1
07	1	1	1	1
08	1	0.5	1	0.5
09	1	1	1	1
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1

Table 23: Analysis data of the ring test participants for the Crustacea group (species and individual counts, part 1)

Order	**Decapoda**		**Amphipoda**				
Family	**Crangonidae**		**Corophiidae**	**Oedicerotidae**		**Pontoporeidae**	
Genus and species	***Crangon crangon***	***Crangon* aff. *allmanni***	***Corophium volutator***	***Pontocrates altamarinus***	***Synchelidium maculatum***	***Bathyporeia pilosa***	***Bathyporeia* sp.**
Lab code							
Reference	***4***	***0***	***4***	***4***	***0***	***0***	***0***
02	0	4	4	4	0	4	0
03	4	0	4	0	4	0	4
04	4	0	4	3	0	4	0
05	4	0	3	4	0	4	0
06	4	0	4	4	0	4	0
07	3	0	4	3	0	3	0
08	4	0	4	4	0	4	0
09	4	0	4	4	0	0	0
10	4	0	4	4	0	4	0
11	4	0	4	4	0	4	0
12	4	0	4	4	0	4	0

Table 24: Analysis data of the ring test participants for the Crustacea group (continued, part 2)

Lab code	**Total Crangonidae**	**Total Oedicerotidae**	**Total Pontoporeidae**	**Total Amphipoda not including Pontoporeidae**	**Total Amphipoda including Pontoporeidae**	**Total Crustacea not including Pontoporeidae**	**Total Crustacea including Pontoporeidae**
Reference	***4***	***4***	***0***	***8***	***8***	***12***	***12***
02	4	4	4	8	12	12	16
03	4	4	4	8	12	12	16
04	4	3	4	7	11	11	15
05	4	4	4	7	11	11	15
06	4	4	4	8	12	12	16
07	3	3	3	7	10	10	13
08	4	4	4	8	12	12	16
09	4	4	0	8	8	12	12
10	4	4	4	8	12	12	16
11	4	4	4	8	12	12	16
12	4	4	4	8	12	12	16

Table 25: Success data for Crustacea (successful hits)

Order	**Decapoda**	**Amphipoda**	**Amphipoda**	**Amphipoda**
Family	**Crangonidae**	**Corophiidae**	**Oedicerotidae**	**Pontoporeidae**
Genus and species	***Crangon crangon***	***Corophium volutator***	***Pontocrates altamarinus***	***Bathyporeia pilosa***
Lab code	Success in the qualitative approach (1st approach)			
02	0.5	1	1	1
03	1	1	0.25	0.75
04	1	1	1	1
05	1	1	1	1
06	1	1	1	1
07	1	1	1	1
08	1	1	1	1
09	1	1	1	0
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1
Lab code	Qualitative/semi-quantitative approach (2nd approach)			
02	0.5	1	1	1
03	1	1	0.5	0.5
04	1	1	0.75	1
05	1	0.75	1	1
06	1	1	1	1
07	0.75	1	0.75	0.75
08	1	1	1	1
09	1	1	1	0
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1

Table 26: Analysis data of the ring test participants for the Mollusca group (species and individual counts, part 1)

Order	**Veneroida**											
Family	**Donacidae**	**Mactridae**	**Cardiidae**		**Montacutidae**		**Pharidae**		**Tellinidae**			
Genus and species	***Donax vittatus***	***Mactra corallina***	***Cerasto-derma edule***	***Cerasto-derma glaucum***	***Mysella bidentata***	***Tellimya ferruginosa***	***Phaxas pellucidus***	***Ensis americanus***	***Angulus tenuis***	***Tellina fabula***	***Angulus donacinus***	**Tellinidae**
Lab code												
Reference	***2***	***4***	***2***	***0***	***3***	***0***	***4***	***0***	***3***	***8***	***0***	***0***
02	2	2	3	0	2	0	3	0	3	7	0	0
03	2	3	3	0	2	0	0	3	4	4	0	0
04	1	2	0	0	1	0	3	0	4	5	0	0
05	2	3	3	0	3	0	4	0	5	5	0	0
06	2	4	3	0	3	0	4	0	3	5	0	0
07	2	0	3	0	3	2	0	3	8	2	0	0
08	2	4	3	0	3	0	0	4	9	5	0	0
09	2	3	0	3	2	0	4	0	8	5	0	0
10	2	3	3	0	2	0	4	0	9	3	0	0
11	2	3	3	0	3	0	4	0	3	2	0	5
12	2	1	3	0	3	0	0	4	2	5	5	0

Table 27: Analysis data of the ring test participants for the Mollusca group (species and individual counts, continued, part 2)

Order	**Myoida**						
Family	**Corbulidae**	**Veneridae**			**Semelidae**		
Genus and species	***Corbula gibba***	***Venus fasciata***	***Venus gallina var. striatula***	***Circomphalus casina***	***Scrobicularia plana***	***Bivalvia indet***	**Bivalves**
Lab code							
Reference	***5***	***3***	***5***	***0***	***0***	***0***	***0***
02	5	3	5	0	0	0	0
03	5	3	5	0	4	0	0
04	5	3	5	0	0	1	0
05	5	3	5	0	0	0	0
06	5	3	5	0	0	0	0
07	5	3	5	0	0	0	0
08	5	3	5	0	0	0	0
09	5	3	0	5	0	0	0
10	5	3	5	0	0	0	0
11	4	3	5	0	0	0	1
12	4	3	5	0	0	0	0

Table 28: Analysis data of the ring test participants for the Mollusca group (continued, part 3)

Lab code	**Total Cardiidae**	**Total Montacutidae**	**Total Pharidae**	**Total Tellinidae**	**Total Veneridae**	**Total Mollusca**
Reference	***2***	***3***	***4***	***11***	***8***	***39***
02	3	2	3	10	8	35
03	3	2	3	8	8	38
04	0	1	3	9	8	30
05	3	3	4	10	8	38
06	3	3	4	8	8	37
07	3	5	3	10	8	36
08	3	3	4	14	8	43
09	3	2	4	13	8	40
10	3	2	4	12	8	39
11	3	3	4	10	8	38
12	3	3	4	12	8	37

Table 29: Success data for Mollusca (successful hits)

Order	**Myoida**	**Veneroida**								
Family	**Corbulidae**	**Donacidae**	**Mactridae**	**Cardiidae**	**Montacutidae**	**Pharidae**	**Tellinidae**		**Veneridae**	
Genus and species	***Corbula gibba***	***Donax vittatus***	***Mactra corallina***	***Cerastoderma edule***	***Mysella bidentata***	***Phaxas pellucidus***	***Angulus tenuis***	***Tellina fabula***	***Venus fasciata***	***Venus gallina var. striatula***
Lab code	Success in the qualitative approach (1st approach)									
02	1	1	1	1	1	1	1	1	1	1
03	1	1	1	1	1	0.25	1	1	1	1
04	1	1	1	0	1	1	1	1	1	1
05	1	1	1	1	1	1	1	1	1	1
06	1	1	1	1	1	1	1	1	1	1
07	1	1	0	1	1	0.25	1	1	1	1
08	1	1	1	1	1	0.25	1	1	1	1
09	1	1	1	0.5	1	1	1	1	1	0.25
10	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	0.25	1	1	1	1
Lab code	Success in the qualitative/semi-quantitative approach (2nd approach)									
02	1	1	0.75	0.75	0.75	0.75	1	0.75	1	1
03	1	1	0.75	0.75	0.75	0.25	0.75	0.75	1	1
04	1	0.75	0.75	0	0.75	0.75	0.75	0.75	1	1
05	1	1	0.75	0.75	1	1	0.75	0.75	1	
06	1	1	1	0.75	1	1	1	0.75	1	1
07	1	1	0	0.75	1	0.25	0.75	0.75	1	1
08	1	1	1	0.75	1	0.5	0.75	0.75	1	1
09	1	1	0.75	0.25	0.75	1	0.75	0.75	1	1
10	1	1	0.75	0.75	0.75	1	0.75	0.75	1	0.5
11	0.75	1	0.75	0.75	1	1	1	0.75	1	1
12	0.75	1	0.75	0.75	1	0.5	0.75	0.75	1	1

Table 30: Analysis data of the ring test participants for the Polychaeta group (part 1)

Order	**Capitellida**				**Magelonida**	**Oweniida**	**Spionida**			**Phyllodocida**		
Family	**Capitellidae**			**Arenicolidae**	**Magelonidae**	**Oweniidae**	**Spionidae**			**Phyllodocidae**		
Genus and species	***Capitella capitata***	***Capito-mastus minimus***	***Heteromastus filiformis***	***Arenicola marina***	***Magelona mirabilis***	***Owenia fusiformis***	***Spiophanes bombyx***	***Scolelepis bonnieri***	***Spionidae* indet.**	***Phyllodoce maculata***	***Phyllodoce mucosa***	***Phyllodoce* sp.**
Lab code												
Reference	***5***	***0***	***0***	***2***	***4***	***4***	***3***	***0***	***0***	***3***	***0***	***0***
02	5	0	0	1	4	4	3	2	0	2	0	0
03	0	2	2	2	4	2	0	0	0	0	0	3
04	4	0	0	2	3	4	0	0	2	3	0	0
05	4	0	0	2	3	3	2	0	0	3	0	0
06	5	0	0	2	4	2	2	0	0	3	0	0
07	5	0	0	2	4	5	0	0	0	3	0	0
08	5	0	0	2	4	4	2	0	0	0	3	0
09	5	0	0	2	4	4	3	0	0	3	0	0
10	5	0	0	2	4	5	3	0	0	0	3	0
11	5	0	0	2	4	4	0	0	0	3	0	0
12	5	0	0	2	3	4	0	0	3	3	0	0

Table 31: Analysis data of the ring test participants for the Polychaeta group (continued, part 2)

Order	**Phyllodocida**									
Family	**Nephtyidae**							**Nereididae**		
Genus and species	***Nephtys* aff. *assimilis***	***Nephtys caeca***	***Nephtys hombergii***	***Nephtys kersivalensis***	***Nephtys cirrosa***	***Nephtys* sp.**	***Sphaero-dorum flavum***	***Hediste diversicolor***	***Neanthes succinea***	***Nereis* sp.**
Lab code										
Reference	***0***	***0***	***2***	***0***	***2***	***0***	***0***	***4***	***0***	***0***
02	1	0	2	0	2	0	0	3	0	0
03	0	0		0	0	3	0	0	0	5
04	0	0	3	0	2	0	0	0	4	0
05	0	0	2	0	2	0	0	4	0	0
06	0	0	2	1	2	0	0	4	0	0
07	0	2	3	0	0	0	0	4	0	0
08	0	2	3	0	0	0	0	4	0	0
09	0	0	5	0	0	0	0	4	0	0
10	0	0	4	1	0	0	1	4	0	0
11	0	1	4	0	0	2	0	4	0	0
12	0	0	3	0	2	0	0	3	0	0

Table 32: Analysis data of the ring test participants for the Polychaeta group (continued, part 3)

Lab code	Total Capitelli-dae	Total Nephtyidae	Total Nereididae	Total Phyllo-docidae	Total Spionidae	Total Capitellida	Total Phyllo-docida	Total Polychaeta
Reference	***5***	***4***	***4***	***3***	***3***	***7***	***11***	***29***
02	5	5	3	2	5	6	10	29
03	4	3	5	3	0	6	11	23
04	4	5	4	3	2	6	12	27
05	4	4	4	3	2	6	11	25
06	5	5	4	3	2	7	12	27
07	5	5	4	3	0	7	12	28
08	5	5	4	3	2	7	12	29
09	5	5	4	3	3	7	12	30
10	5	6	4	3	3	7	13	32
11	5	7	4	3	0	7	14	29
12	5	5	3	3	3	7	11	28

Table 33: Success data for Polychaeta (successful hits)

Order	**Capitellida**	**Capitellida**	**Magelonida**	**Oweniida**	**Phyllodocida**				**Spionida**
Family	**Capitellidae**	**Arenicolidae**	**Magelonidae**	**Oweniidae**	**Nephtyidae**		**Nereididae**	**Phyllodocidae**	**Spionidae**
Genus and species	***Capitella capitata***	***Arenicola marina***	***Magelona mirabilis***	***Owenia fusiformis***	***Nephtys hombergii***	***Nephtys cirrosa***	***Rediste diversicolor***	***Phyllodoce maculata***	***Spiophanes bombyx***
Lab code	Success in the qualitative approach (1st approach)								
02	1	1	1	1	1	1	1	1	1
03	0.25	1	1	1	0.75	0.75	0.25	0.75	0
04	1	1	1	1	1	1	0.25	1	0.25
05	1	1	1	1	1	1	1	1	1
06	1	1	1	1	1	1	1	1	1
07	1	1	1	1	1	0.5	1	1	0
08	1	1	1	1	1	0.5	1	0.5	1
09	1	1	1	1	1	0	1	1	1
10	1	1	1	1	1	0.5	1	0.5	1
11	1	1	1	1	1	0.75	1	1	0
12	1	1	1	1	1	1	1	1	0.25
Lab code	Success in the qualitative/semi-quantitative approach (2nd approach)								
02	1	0.75	1	1	1	1	0.75	0.75	1
03	0.25	1	1	0.75	0.25	0.25	0.25	0	0
04	0.75	1	0.75	1	0.75	1	0.5	1	0.25
05	0.75	1	0.75	0.75	1	1	1	1	0.75
06	1	1	1	0.75	1	1	1	1	0.75
07	1	1	1	0.75	0.75	0.5	1	1	0
08	1	1	1	1	0.75	0.5	1	0.5	0.75
09	1	1	1	1	0.75	0	1	1	1
10	1	1	1	0.75	0.75	0.25	1	0.5	1
11	1	1	1	1	0.75	0.5	1	1	0
12	1	1	0.75	1	0.75	1	0.75	1	0.5

7 List of tables

8 List of figures