BALTIC SEA ENVIRONMENT PROCEEDINGS

No. 9

SECOND BIOLOGICAL INTERCALIBRATION WORKSHOP

Marine Pollution Laboratory and
Marine Division of the National Agency
of Environmental Protection, Denmark

August 17-20, 1982
Rønne, Denmark

BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION
– HELSINKI COMMISSION –

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REPORT OF THE SECOND BIOLOGICAL INTERCALIBRATION WORKSHOP

1. INTRODUCTION

17-20 August, **1982,** the Marine Pollution Laboratory and the Marine Division of the National Agency of Environmental Protection, Denmark, arranged the 2nd Biological Intercalibration Workshop under the auspices of the Baltic Marine Environment Protection Commission (Helsinki Commission). The Workshop was held in Rønne, Bornholm.

The first Biological Intercalibration Workshop **was** held in Stralsund, GDR, in 1979, and many **good** results were achieved. In the preliminary report from that meeting it was stated:

> "The Workshop stressed the necessity of further intercalibrations of methods for biological monitoring parametres, and the Baltic Sea States should be encouraged to arrange such intercalibration exercises for the purpose of the Baltic Monitoring Programme."

At the 7th Meeting of the Scientific-Technological Working Group of the Helsinki Commission, Denmark offered to arrange a 2nd Biological Intercalibration Workshop in 1981. The meeting welcomed the invitation, but it was agreed to postpone the workshop until 1982 because cruises for the research vessels for 1981 were already planned. A Steering Group for the Biological Intercalibration Workshop was set up and met in Copenhagen 27-28 April 1981, where the programme for the workshop was discussed.

During the Workshop intercalibration excercises for biological determinants for the Baltic Monitoring Programme were accomplished. During the Workshop six working groups were established, and for each group the following conveners were nominated:

Primary production:	Dr. M. Korsak, Union of Soviet Socialist Republics
Chlorophyll-a:	Dr. R. Boje, Federal Republic of Germany
Phytoplankton:	Dr. L. Edler, Sweden
Zooplankton:	Dr. P. Ciszewski, Polish People's Republic
Macrozoobenthos:	Dr. F. Gosselck, German Democratic Republic
Nutrients:	Dr. F. Koroleff, Finland

Delegations from Denmark (DK), Finland,(SF), German Democratic Republic (GDR), Federal Republic of Germany (FRG), Polish People's Republic (PL), Sweden (S), and the Union of Soviet Socialist Republics (USSR) attended the workshop.

The following vessels took part in the Workshop:

DK:	GUNNAR THORSON
SF:	ARANDA
GDR:	A. v. HUMBOLDT
FRG:	ALKOR
PL:	HYDROMET
S:	ARGOS
USSR:	GEORGIJ USHAKOV

A timetable and the programme of the Workshop are given below in 1 .1.

Details with respect to the intercalibration programme as well as a complete list of participants are given in

"Report of the Meeting of the Biological Workshop 1982", National Agency of Environmental Protection, Copenhagen.

At a meeting in Copenhagen 26-28 April, 1983, the following Conveners and Members of the Steering Group met to agree upon the present final report of the 2nd Biological Intercalibration Workshop:

Steering Group Members	Conveners
K. Bender	R. Boje
K. Jensen	L. Edler
K. Jørgensen	F. Gosselck
J. Lassig	F. Koroleff
S. Schulz	M.N. Korsak
T. Willén	(G. Rasmussen)
G. Ærtebjerg	

The report has been edited by K. Jensen and G. Ærtebjerg, and the Working Group reports have been drafted by Conveners of corresponding groups.

1.1 Timetable and programme of the 2nd Biological Intercalibration Workshop

27-28 April 1981	Steering Group meeting in Copenhagen
17 August 1982	Research vessels meet in Rønne, Opening of the Workshop
17-20 August 1982	Working Group meetings in Rønne
19 August 1982	Sampling and experiments at sea, Station 55°16'5 N - 15°00'0 E.
20 August 1982	Report of the Meeting of the 2nd Biological Intercalibration Workshop, 1982
April 1983	Draft reports from the Working Groups

26-28 April 1983	Meeting of the Steering Group and conveners in Copenhagen. Completion of the final report.
Autumn 1983	Publishing of the final report in the Baltic Sea Environment Proceedings.

2. REPORT OF THE WORKING GROUP ON PHYTOPLANKTON PRIMARY PRODUCTION

2.1 Participating Laboratories:

DK Marine Pollution Laboratory, Charlottenlund (G. Aertebjerg)

SF Institute of Marine Research, Helsinki (J.-M. Leppänen)

GDR Institute für Meereskunde, Warnemünde (S. Schulz)

FRG Institut für Meereskunde, Kiel (R. Werner, B. Zeitzschel)

PL Sea Fisheries Institute, Gdynia (T. Stróżyk, S. Ochocki)

S National Board of Fisheries, Institute of Hydrographic Research (E.-G. Thelén)

USSR State Committee for Hydrometeorology and Control of Natural Environment, Laboratory of Monitoring, Moscow (M. Korsak (Convener), A. Vishensky, S. Yegorov)

2.2 Mixed sample exercise

During the Workshop three different experiments, A, B and C, were made with a natural mixed sample common for all laboratories.

In experiment A each laboratory used their normal ^{14}C-solution (cf. Table 2 .1) and counting procedure. The experiment included ten parallel light samples and two dark samples.

In experiment B each laboratory used their normal counting procedure but a ^{14}C-solution delivered by DK. The experiment included ten parallel light samples and .two dark samples.

In experiment C each laboratory used a ^{14}C-solution delivered by DK, and DK counted all the samples. The experiment included ten parallel light samples and two dark samples.

In experiments A, B and C each participating laboratory got one mixed sample from DK.

The temperature of the water in the incubators was about 18-19^{o}C. The irradiance in the incubators was measured by DK (Table 2.3). Before starting the experiments all bottles were filled with the same amount of water from the mixed sample. In the incubator experiment A the ^{14}C-solution, normally used by the laboratory, was added to 10 light bottles and 2 dark bottles, and to each of the other experimental bottles ^{14}C-solution delivered by DK was added (Experiment B and C).

The light source was put on at the agreed time for 120 minutes in all experiments. The experimental bottles were kept in the dark until filtration, which was started immediately. In each experiment A-C a dark bottle was filtrated as the first and the last bottle.

In the experiments A and B the filters were treated and the activity rates of the filters were determined using the normal procedure of the laboratory in question.

In experiment C the filters were exposed to formalin vapours for 5 minutes immediately after filtration and then to HCl vapours for another 5 minutes. The filters were marked with the country index and light or dark, and delivered to Denmark for the determination of activity together with 5 ampoules of the ^{14}C-solution normally used by the laboratory (see Table 2.2).

2.3 Natural sample

At an agreed time all laboratories collected samples from the obligatory depths (2, 5, 10, 15 and 20 m) and run an incubator experiment as described in the "Guidelines for the Baltic Monitoring Programme for the First Stage" using their normal equipment and procedures. Three light samples and one dark sample were incubated from each depth.

2.4 Additional experiments

For FRG, S and DK, experiments A, B and C were identical because they used ^{14}C from the Carbon-14-Agency, Denmark, and the activity of the filters was also determined at the same Agency. Therefore, it was agreed that representatives of these countries should only make experiments A and C.

S and DK laboratories carried out additional experiments with the mixed samples to study the relationship between the primary production rate and the irradiance in the incubator. All the data of primary production were calculated using the equation recommended in the "Guidelines for the Baltic Monitoring Programme for the First Stage" taking into consideration the uptake of ^{14}C in the dark. The primary production measured in the mixed sample in experiments A, B and C were recalculated using one and the same concentration of Total CO_2, 18.6 mg C/l. The production rates of the natural samples were calculated using one concentration of the Total CO_2 for each depth (Table 2.5).

2.5 Results and discussion

2.5.1 Mixed sample

Experiment A

The data of the experiments A-C are included in table 4. The mean values of the primary production in experiment A determined by experts team different laboratories varied from 4.95 mg C/m^3h (FRG) to 8.47 mg C/m^3h (SF). The total mean value of the primary production in experiment A was 6.90 mg C/m^3h and SD and CV % 1.34 mg C/m^3h and 19 %.

The maximum values of primary production in the experiment A were measured by experts from Finland, which may be due to the maximum irradiance in their incubator (Tables 2.3 and 2.4).

FRG and PL used G.M. technique while all other laboratories used liquid scintillation technique for counting radio-activity of the phytoplankton on the filters.

Coefficients of variation (CV) of the primary production for values measured in this experiment varied from 8 % (DK) to 14 % (S). Uptake of ^{14}C in the dark varied from 4.4 % (DK) to 7.3 % (USSR) for the values of primary production.

The maximum deviation in the results of primary production for all data did not exceed 28 %. This result may be estimated as satisfactory taking into consideration the differencein solutions of ^{14}C used and the difference in counting procedures.

Experiment B

Only SF, GDR, PL and USSR took part in the experiment B. The maximum of primary production was measured by SF, 8.51 mg C/m^3h, and the minimum, 7.83 mg C/m^3h, by the USSR. The maximum deviation of primary production from the total average of 7.72 mg C/m^3h, did not exceed 12 %

and was very close to SD 10 %. The maximum ratio of the dark fixation of ^{14}C to the primary production was 8.9 % (USSR).

Differences between the values of primary production measured in the experiment B were much less than those in experiment A. This may be a result of the use by all participants of the same solutions of ^{14}C delivered by DK.

Experiment C

The mean values of the primary production in experiment C (Table 2.4) varied from 6.40 mg C/m^3h (FRG) to 8.70 mg C/m^3h (GDR). The total mean value was 7.55 mg C/m^3h; SD and CV were 0.81 mg C/m^3h and 11 %, respectively.

The percentages of the dark fixation of ^{14}C, excluding the results of the GDR, were very similar to the results obtained in experiments A and B. The value of the dark fixation of ^{14}C obtained by the GDR expert is very high and cannot be explained at present.

Taking into consideration the values of the dark fixation of ^{14}C the final data of primary production obtained by different participants were close to the total average. This may be explained by the fact that similar solutions of ^{14}C and the same counting procedures were used by all participants.

It is necessary to note that values of radioactivity of the filters were determined by liquid scintillation at the Carbon-14-Agency, DK. Since the filters used by SF, GDR and PL did not dissolve in the scintillation liquid the counting efficiencies of these samples have been determined by internal standard method. The counting efficiencies of the other samples were determined by the external standard channels ratio method.

2.5.2 Natural sample

The final data of this experiment are included in Table 2.5. The maximum values of the potential primary production at almost all depths were obtained by the SF Laboratory and the minimum by the FRG Laboratory. The maximum values of primary production measured by SF may be related to the high level of irradiance in the incubator (Table 2.3).

The mean values of the potential primary production measured by different laboratories at the same depths varied from 1.7 to 5.4 times. This fact can not be explained by differences in methods and counting procedures, because in experiments with the mixed sample such discrepancy in the results was not shown. It can propably be explained by a patchy distribution of phytoplankton in sampling area at the same depths. The percentages of the dark fixation of ^{14}C to the primary production at all depths for all laboratories were similar to the same values for the experiment with mixed sample.

During the experiments with natural samples Sechi disk measurements were carried out and the mean value of transparency was about 6.5 m.

Calculation of daily carbon incorporation at different depths from incubator experiments cannot be done without measurements of the relationship between the production and the irradiance, and the determination of attenuation of the irradiance in sea water at the sampling station.

The results of additional experiments which were carried out with mixed and natural samples in order to determine the relationship between photosynthetic rate and irradiance are included in Table 2.6. This data show a good agreement between experiments with mixed and natural samples.

2.6 Conclusions

1. The final results of primary production in experiment A-C with the mixed sample show a good agreement between the data obtained by different laboratories. The differences between the total average and the mean values obtained by different laboratories in experiment C did not exceed the SD values due to unification of the methodological procedures.

2. The significant discrepancy between mean values of potential primary production measured by different laboratories in the experiment with natural samples may result from a patchy distribution of phytoplankton in sampling area.

3. In order to calculate the actual values of the daily primary production during future intercalibrations it is recommended to measure the relationship between photosynthetic rate and irradiance as well as the attenuation of the irradiance in the sea water.

Table 2.1

Activities of the ^{14}C-solution used by the different laboratories in the experiments A, B and C.

SD: Standard deviation. CV: Coefficient of variation. N: Number of ampoules

Laboratory	Mean DPM/ml	DPM/ampoule	SD DPM/ml	CV %	N
DK	44 491 000	44 522 000	133 589	0.30	4
SF	46 455 000	-	961 015	2.07	4
GDR	61 713 000	-	752 854	1.22	3
FRG	8 050 000	8 056 000	22 679	0.28	4
PL	13 525 000	-	103 646	0.76	4
S	9 419 000	9 418 000	23 815	0.30	4
USSR	9 034 000	-	7 097	0.08	4

Table 2.2

Mean volume and standard deviation (4 measurements) of the syringes used by the different laboratories in experiment C

Laboratory	Mean, ul	SD, ul
DK	99.67	0.35
SF	99.91	0.36
GDR	100.35	0.42
FRG	99.48	0.43
PL	200.17	0.59
S	100.72	0.31
USSR	100.44	0.31

Table 2.3

Irradiances in the incubators. Mean of measurements at the top, bottom, right and left side of the incubators.

Laboratory	10^{18}q m^{-2} s^{-1}
DK	240
SF	274
GDR	160 and 154
FRG	261
S	186
USSR	204

Table 2.4

PHYTOPLANKTON PRIMARY PRODUCTION
Mixed sample in experiments A, B, C

Primary *) production / Laboratory	A	B	C
DK	$\frac{7.57 \pm 0.61}{0.33}$		$\frac{7.64 \pm 0.31}{0.44}$
SF	$\frac{8.47 \pm 1.12}{0.26}$	$\frac{8.51 \pm 0.68}{0.24}$	$\frac{8.42 \pm 1.24}{0.30}$
GDR		$\frac{6.83 \pm 0.58}{0.56}$	$\frac{8.7 \pm 1.36}{6.3}$
FRG	$\frac{4.95 \pm 0.58}{0.32}$		$\frac{6.40 \pm 0.32}{0.42}$
PL	$\frac{6.61 \pm 0.24}{0.27}$	$\frac{7.18 \pm 0.21}{0.25}$	$\frac{7.00 \pm 0.14}{0.38}$
S	$\frac{7.17 \pm 1.03}{0.43}$		$\frac{7.10 \pm 0.48}{0.24}$
USSR	$\frac{6.33 \pm 0.64}{0.46}$	$\frac{7.83 \pm 0.84}{0.70}$	$\frac{7.61 \pm 1.60}{0.77}$

*) All data calculated as mg C/m^3h

$$\text{Primary production} = \frac{(\text{mean value} \pm \text{SD})}{\text{dark fixation}}$$

For all samples total CO_2 was calculated to be 18.60 mg C/l

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TABLE 2.5

PHYTOPLANKTON PRIMARY PRODUCTION *

Natural sample

Depth \ Laboratory	DK	SF	GDR	FRG	PL	S	USSR	Total CO_2
2	16.2±0.5 / 0.25	17.2±1.60 / 0.09	15.2±0.87 / 0.65	10.4±1.8 / 0.21	17.5±2.5 / 0.39	17.6±1.4 / 0.21	11.2±1.7 / 0.28	17.86
5	14.5±3.8 / 0.50	20.7±0.77 / 0.12	7.20±0.32 / 0.86	7.0021 .1 / 0.17	18.5** / 0.15	15.3±0.78 / 0.22	10.3±2.1 / 0.33	17.86
10	12.6±4.2 / 0.40	16.4±0.64 / 0.15	6.20±0.42 / 0.68	7.30±1.8 / 0.28	12.0±0.9 / 0.25	10.6±1.6 / 0.23	7.40±0.71 / 0.38	17.86
15	9.20±0.35 / 0.45	13.4±1.2 / 0.14	8.40±0.22 / 0.63	2.50±0.26 / 0.13	4.47io.15 / 0.18	12.5±0.50 / 0.21	5.40±0.46 / 0.34	18.25
20	6.00±0.23 / 0.29	4.90±0.16 / 0.10	3.90±0.27 / 0.63	1.50±0.3 / 0.12	11 .1±0.8 / 0.35	3.60±0.25 / 0.20	3.50±0.18 / 0.24	19.08

* All data calculated as mg C/m^{3}h

** Only one light sample

$$\text{Primary production (P.P)} = \left(\frac{\text{P.P.} \pm \text{SD}}{\text{dark fixation}}\right)$$

Table 2.6

Production – Irradiance curves

P.P. Laboratory	Irradiance in % of the normal irradiance in incubator						
	5 %	10 %	15 %	25 %	50 %	100 %	175 %
DK natural sample	0.57	1.53	2.83	5.65	9.87	11.41	11.3
DK mixed sample	0.57	1.60	2.58	4.31	6.66	7.88	8.03
S natural sample	0.53	1.31	1.74	3.13	5.13	5.67	7.88
S mixed sample	0.82	1.07	1.78	2.59	4.66	5.80	4.69

All data calculated as mg C/m^3h

3. REPORT OF THE WORKING GROUP ON CHLOROPHYLL-A

3.1 Participating laboratories

DK Marine Pollution Laboratory, Charlottenlund (M. Nyberg)
SF Institute of Marine Research, Helsinki (L. Grönlund)
GDR Institut für Meereskunde, Warnemünde (G. Breuel)
FRG Institut für Meereskunde, Kiel (R. Boje (convener), P. Fritsche)
PL Institute for Environmental Development, Branch of Gdansk (J. Wiktor)
S National Board of Fisheries, Institute of Hydrographic Research, Göteborg (J. Szaron)

3.2 Introduction

The aim of the intercalibration was to compare the methods used in the BMP for the determination of chlorophyll-a and phaeopigment. For this purpose measurements were made on a prepared extract (produced from a batch culture of Dunaliella sp. from the Marine Pollution Laboratory, Charlottenlund from the mixed sample delivered by Denmark, and natural samples collected by all research vessels at the intercalibration station at the same depth and time.

Further details of the procedure, the reporting formats and a preliminary report are contained in "Report of the Meeting of the Biological Workshop 1982" issued by NAEP, DK.

3.3 Results

Information on the measurement procedure used by the participating laboratories is given in Table 3.1. All laboratories used their methods. GDR and S used $MgCO_3$ for frozen but not for fresh samples.

For the calculation of the results different equations have been used (compare with the "Guidelines for the Baltic Monitoring Programme for the First Stage"):

Equ.	1	Chl-a	photometric	(Jeffrey/Humphrey eq.)
"	2	Chl-a	"	(Lorenzen eq., acid method)
"	3	Pheo	"	(" " " ")
"	4	Chl-a	fluorometric	(Jeffrey/Humphrey eq.)
"	5	Chl-a	"	(Lorenzen eq., acid method)
"	6	Pheo	"	(" " " ")

In the following presentation of the results (Tables 3.2 to 3.18) "grand mean", "grand s" and "grand CV" have been determined from all data with CV 20 %.

The fluorometric values of chlorophyll-a obtained by SF are included in the tables in the following way: eq. 4 together with eq. 1 and eq. 5 together with eq. 2. Thus acid and non-acid techniques are separated from each other.

Tables 3.12 and 3.13 show combined results of the BMP-methods used by the different countries. Here fresh samples taken by SF, have to be used together with frozen samples taken by other laboratories and a better fit of the data is achieved by combining eq. 1 and 5.

3.3.1 Chlorophyll-a

Variability between single measurements is lowest for all laboratories for the prepared extract (CV = 0.1 - 4.7), and higher for the mixed and natural samples (with the tendency of highest values for natural samples).
Values of chlorophyll-a determined according to eq. 2 are about 90 % of those calculated from eq. 1.
The results included in Table 3.3 (prepared extract) indicate that the photometers and the SF fluorometer seem to be of sufficient accuracy. The error caused by differences in the acidification technique (eq. 2/5) is of minor importance.

3.3.2 Phaeopigment

The spectrophotometric measurement of phaeopigment concentrations gives uncomparable results as shown in Tables 3.14 to 3.18. High variability can be seen when comparing the absolute values as well as the deviations between single measurements (see CV for laboratories). The same results have already been obtained at the 1st Biological Workshop in Stralsund but have not been stated.

The CV for the fluorometric method used by SF is acceptable.

3.4 Recommendations

1. If an appropriate spectrophotometer is available it is recommended to determine chlorophyll-a by using the equations of Jeffrey and Humphrey (eq. 1). The measurement of phaeopigment by the spectrophotometric method should be discontinued because results are not comparable.

2. When a fluorometer is used, chlorophyll-a and phaeopigment can be determined. Chlorophyll-a should be calibrated frequently against the spectrophotometric method (eq. 1).

Table 3.1

Monitoring procedures of the different laboratories used for the determination of chlorophyll-a and phaeopigment

	DK	SF	GDR	FRG	PL	S
filter	GF/C	GF/F	GF/C	GF/C	GF/C	GF/C
∅ cm (active)	3.6	1.6	4.2	2.0	5	3.5
filt. vol. e	4	0.1	2	1	2	1.8
storage (deep-frozen)	yes	no	yes	yes	yes	yes
acetone ml	10	10	10	11,5	6	10
homogenizer	teflon grinding	vibration	-	vibration	-	teflon grinding
measur.instr.	Perkin-Elmer 554	Turner 110	Zeiss vsu 2 Beckman	Zeiss PMQ 3	Zeiss vsu 2P Beckman	Varian Tech-tronic 634
bandwidth nm	2		1	1	1	2
extraction min	150	3	60	3	120	60-120
$MgCO_3$			+		+	-
cell cm	1	1	5	5	2	5
equation	2-3	4-6	l-3	l-3	1-3	l-3

Table 3.2

CHLOROPHYLL-A
Prepared extract, eq. 1/4

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	3597	23	0.6	1
SF	10	3625	29	0.8	4
FRG	10	3592	5	0.1	1
GDR	10	3522	27	0.8	1
PL	10	3679	73	2.0	1
S	10	3550	7	0.2	1

grand mean: 3594 mg=m^3 grand s: 61 grand CV(%): 1.7

Table 3.3

CHLOROPHYLL-A
Prepared extract, eq. 2/5

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	3265	92	2.8	2
SF	10	2879	54	1.9	5
FRG	6	3509	10	0.3	2
GDR	10	3299	61	1.8	2
PL	10	3404	160	4.7	2
S					

grand mean: 3251 mg=m^3 grand s: 231 grand CV(%): 7.1

Table 3.4

CHLOROPHYLL-A
Mixed samples, fresh, eq. 1/4

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	2.94	0.07	2.4	1
SF	10	2.90	0.05	1.7	4
GDR	10	2.38	0.13	5.5	1
FRG	10	2.59	0.08	3.1	1
PL	9	2.42	0.48	19.8	1
S	10	2.74	0.05	1.8	1

grand mean: 2.66 mg/m^3 (2.71 ") grand s: 0,29 (0.22) grand CV(%): 10.9 (8.1)

() values without PL

Table 3.5

CHLOROPHYLL-A
Mixed samples, fresh, eq. 2/5

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	2.70	0.15	5.6	2
SF	10	2.48	0.06	2.4	5
GDR	10	2.18	0.13	6.0	2
FRG	10	2.48	0.08	3.2	2
PL	9	2.34	0.57	24.4	2
S	10	2.56	0.06	2.3	2

grand mean: 2.48 mg/m^3 (2.46 ") grand s: 0.20 (0.28) grand CV(%): 8.1 (11.4)

() all values

Table 3.6

CHLOROPHYLL-A
Mixed samples, frozen, eq. 1

	n	$\bar{x}$ (mg/m^3)	x	CV(%)	Eq.
DK	10	2.67	0.05	1.9	1
SF					
GDR	10	2.12	0.10	4.7	1
FRG	10	2.55	0.07	2.7	1
PL	7	2.69	0.09	3.3	1
S	10	2.74	0.08	2.9	1

grand mean: 2.55 mg/m^3 grand s: 0.25 grand CV(%): 9.8

Table 3.7

CHLOROPHYLL-A
Mixed samples, frozen, eq. 2

	n	$\bar{x}$ (mg/m^3)	x	CV(%)	Eq.
DK	10	2.30	0.11	4.8	2
SF					
GDR	10	1.94	0.13	6.7	2
FRG	10	2.42	0.07	2.9	2
PL	7	0.60	0.32	53.3	2
S	10	2.54	0.08	3.1	2

grand mean: 2.30 mg/m^3 grand s: 0.25 grand CV(%): 10.9

Table 3.8

CHLOROPHYLL-A
Natural samples, fresh, eq. 1/4

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK					
SF	8	3.05	0.10	3.3	4
GDR	10	2.05	0.08	3.9	1
FRG					
PL					
S					

grand mean: 2.49 mg/m^3 grand s: 0.52 grand CV(%): 20.9

Table 3.9

CHLOROPHYLL-A
Natural samples, fresh, eq. 2/5

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK					
SF	8	2.43	0.06	2.5	5
GDR	10	1.86	0.13	7.0	2
FRG					
PL					
S					

mg/md mean: 2.11 ^{3} grand s: 0.31 grand CV(%): 14.7

Table 3.10

CHLOROPHYLL-A
Natural samples, frozen, eq. 1

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	2.52	0.19	7.5	1
SF					
GDR	10	2.21	0.11	5.0	1
FRG	10	2.54	0.10	3.9	1
PL					
S	10	2.90	0.14	4.8	1

grand mean: 2.54 mg/m^3 grand s: 0.28 grand CV(%): 11.0

Table 3.11

CHLOROPHYLL-A
Natural samples, frozen, eq. 2

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	2.21	0.24	10.9	2
SF					
GDR	10	1.86	0.10	5.4	2
FRG	IO	2.43	0.09	3.7	2
PL					
S	10	2.62	0.18	6.9	2

grand mean: 2.28 mg/m^3 grand s: 0.33 grand CV(%): 14.5

Table 3.12

CHLOROPHYLL-A (MONITORING PROGRAMME)
Mixed samples

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	2.67	0.05	1.9	1
SF	10	2.48	0.06	2.4	5
GDR	10	2.12	0.10	4.7	1
FRG	10	2.55	0.07	2.7	1
PL	7	2.69	0.09	3.3	1
S	10	2.74	0.08	2.9	1

grand mean: 2.54 mg/m^3 grand s: 0.23 grand CV(%): 9.1

Table 3.13

CHLOROPHYLL-A (MONITORING PROGRAMME)
Natural samples

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	2.52	0.19	7.5	1
SF	8	2.43	0.06	2.5	5
GDR	10	2.21	0.11	5.0	1
FRG	10	2.54	0.10	3.9	1
PL					
S	10	2.90	0.14	4.8	1

grand mean: 2.52 mg/m^3 grand s: 0.26 grand CV(%): 10.3

Table 3.14

PHAEOPIGMENT
Prepared extract, eq. 3/6

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	413	120	29.1	3
SF	10	1342	66	4.9	6
GDR	10	212	101	47.6	3
FRG	6	39	13	33.3	3
PL	8	326	275	84.4	3
S					

Table 3.15

PHAEOPIGMENT
Mixed samples, fresh, eq. 3/6

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	0.24	0.13	54.2	3
SF	10	0.76	0.03	3.9	6
GDR	IO	0.20	0.08	40.0	3
FRG	10	0.08	0.02	25.0	3
PL	6	0.19	0.11	43.8	3
S	10	0.16	0.07	43.8	3

Table 3.16

PH'AEOPIGMENT
Mixed samples, frozen, eq. 3

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	0.47	0.15	31.9	3
SF					
GDR	10	0.24	0.11	45.8	3
FRG	10	0.12	0.03	25.0	3
PL	7	3.44	0.42	12.2	3
S	10	0.22	0.04	18.2	3

Table 3.17

PHAEOPIGMENT
Natural samples, fresh, eq. 3/6

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK			-		
SF	8	1.12	0.16	14.3	6
GDR	10	0.22	0.11	50.0	3
FRG					
PL					
S					

Table 3.18

PHAEOPIGMENT
Natural samples, frozen, eq. 3

	n	$\bar{x}$ (mg/m^3)	s	CV(%)	Eq.
DK	10	0.40	0.19	47.5	3
SF					
GDR	10	0.53	0.07	13.2	3
FRG	10	0.08	0.04	50.0	3
PL					
S	10	0.37	0.12	32.4	3

4. REPORT OF THE PHYTOPLANKTON COUNTING WORKING GROUP

4.1 Participating laboratories

DK Marine Pollution Laboratory, Charlottenlund (S.M. Pedersen)

SF Institute of Marine Research, Helsinki (M. Huttunen, K. Kononen)
National Board of Waters, Helsinki (L. Lepistö)

GDR Wilhelm-Pieck-Universität Rostock, Sektion Biologie, Rostock (E. Kühner)

FRG Institut für Meereskunde, Kiel (E. Bauerfeind, C. Stienen)

PL Institut for Environmental Development, Branch of Gdansk (L. Kruk-Dowgiałło)

S National Swedish Environment Protection Board, Uppsala (T. Willén, M. Tirén)
Department of Marine Botany, University of Lund (L. Edler (convener)).

4.2 Introduction

The goal of the work was:

- to investigate the agreement of phytoplankton counts made by different laboratories
- to investigate the agreement of phytoplankton species determination made by different laboratories
- to give recommendations for improvement of phytoplankton analysis, in order to arrive at comparable results in the future.

4.3 Samples

4.3.1 Culture sample

A culture sample was delivered to all laboratories. It was agreed that it should be analyzed as follows:

10 subsamples of 50 ml each are sedimented.
Sedimentation time 24 hrs
5 subsamples are counted according to the procedure normally used by the laboratory in the BMP-work
5 subsamples are counted according to the method described below for the mixed sample.

4.3.2 Mixed natural sample

A mixed natural sample was delivered to all participants. It was agreed that analyses should be made as follows:

5 samples of 50 ml each are sedimented for 24 hrs. and counted
1 of the sedimented samples is counted five times within 2 days
Results should be reported on provided data sheets.
It is important that all requested data are given.
All species found should be listed, but only the most abundant should be counted. Normally 6-10 species account up to 90 % of the biomass. A total of about 400 units/cells should be counted.
When counting, different size classes of the same species should be used if possible. This differentiation should also be given in the results.
The group of unidentified organisms should be reported in the size classes: < 3 urn, 3-7 um and > 7 urn.
Results should be given as cell counts and as biomass in carbon.
As the counting procedure to be used here differs from those given in the Guidelines for the Baltic Monitoring Programme for the First Stage and will be proposed for the future Guidelines, it is recommended that comments on the new procedure should be given.

4.4 Results

Results were obtained from all countries except USSR.

Due to lacking or inaccurate reporting from some laboratories of different size classes of the organisms and of biomass as carbon, these results were not evaluated.

4.4.1 Culture sample

Counts of 5 or 10 subsamples

The culture sample contained five species of flagellates. They were counted by all participants, although the species determination differed or lacked in many cases (Table 4.1). Counting results are given in Table 4.2. Except for the small flagellate Isochrysis sp. (4 urn), the grand CV was kept in the range of 15-19 %, which is acceptable. CV of individual counts, however, was in many cases much larger. This may be due to disruption of organisms.

Parallel counts of the same chamber bottom

This analysis was performed only by PL and S (Table 4.3). Considering that the same chamber bottom was counted, the resulting CV is surprisingly high in many cases.

4.4.2 Mixed natural sample

During the workshop a species list, based on analyses of several net samples, was set up. Units to count and report, as well as magnification to be used for each of the species were decided upon (Table 4.4).

With Table 4.4 as a basis, each laboratory should count the 6-10 most abundant species. Results have been evaluated for species reported by 4 or more laboratories. For flagellates it was also done by pooling flagellates and other species that were likely to be included in the group of flagellates by some laboratories. Table 4.5 *gives* all species reported from the natural samples.

Counts of 5 samples

The results of the 11 species that were compared show great discrepancies (Table 4.6). No species had a grand CV of less than 50 % and for four of the eleven species the grand CV exceeded 100 %.

Individual CV were much better. Of the 50 calculated CV 27 were below 20 %.

Unlike last Biological Workshop in Stralsund 1979 the discrepancies between laboratories could not be attributed to magnification used but rather to the abundance got the highest CV (e.g Chaetoceros danicus, Chaetoceros eibenii, Nodularia spumigena). The laboratories based their results on varying numbers of cells/ units counted. Thus, e.g. FRG counted one unit of Chaetoceros eibenii giving a mean below unit/ml and an extremely high CV, while S counted 46-75 units giving a mean of 2.2 units/ml and a CV of 20 %.

Another reason for large differences and high CV is that certain species have a patchy distribution and/or may occur in large colonies or bundles. This is especially seen for Nodularia Spumigena which was reported quantitatively only by two laboratories, and for Aphanizomenon flos-aquae, present with 207-1608 um/ml (Tables 4.4 and 4.6).

Small species, especially flagellates, are difficult to determine. As the flagellates were poorly represented in the samples which were examined jointly during the Workshop their identification could not be agreed satisfactorily according to Table 4.1. In addition the varying methods of analysis used by laboratories result in large differences. This is seen in the high grand CV of flagellates < 3 um and > 7 um (> 110 %), while the individual CV in almost all cases were below 25 %. In an attempt to overcome this other flagellates of corresponding size were pooled together with the groups unidentified flagellates. In all cases CV was reduced but still remained on very high levels.

Parallel counts of the same chamber bottom

Parallel counts of the same chamber bottom showed good results (Table 4.7).

4.5 Conclusions

On the basis of the evaluation of the intercalibration results the following conclusions can be drawn:

- the good agreement of cellnumbers in the culture samples shows that the counting itself is acceptable
- the grand CV of all species in the natural sample shows that there are a number of problems to solve before results from different laboratories could be compared. The main peoblem seems to be the identification of the species, but discrepancies also emerge from low abundance and patchiness of large species. Performing a collective counting during the Workshop might have diminished many of the problems.

4.6 Comments from analysts

As the counting procedure to be used during the intercalibration somewhat differed from that given in the Guidelines for the Baltic Monitoring Programme for the First Stage all laboratories were requested to comment on it. Comments have been received from SF and FRG. SF commented that the counting of 6-10 species will probably give better results as you can concentrate on those species. There will probably not be no timesaving and it will be difficult to choose the dominant species, but SF is ready to use it.

FRG commented that it is a good idea to report numbers of the 6-10 dominant species, although it may be difficult to reach sufficient numbers. FRG also suggests the use of 16x objective instead of 10x.

At the 2nd Meeting of Experts on Monitoring, Vilnius, USSR, 8-11 June 1982, a new method for phytoplankton counting was proposed by SF and S (STC EM MON 2/3/14). The Working Group discussed the paper with great interest but did not reach a conclusion. This should be reached before the 2nd Stage of BMP.

4.7 Recommendations

The recommendations included in the report from the Stralsund intercalibration 1979 (Page 105, Report of the Biological Workshop, 26th August to 1st September, 1979, Stralsund, German Democratic Republic, Baltic Marine Environment Protection Commission, Helsinki Commission) are repeated and amended as follows:

1. To agree on the species identification, all persons working with phytoplankton counting on the BMP should together make a detailed list of species, with illustrations of peoblematic taxa, relevant to the BMP.

2. To adopt more strict rules for the BMP phytoplankton counting. The Guidelines for the Baltic Monitoring Programme (BMP) should be amended accordingly.

Table 4 .1

Species of the culture sample

Species

Dunaliella sp.

reported as: DK: Dunaliella sp.
SF IMR: Flagellata, figure
SF NBW: Flagellata, figure
GDR: Chlamydomonas sp.
FRG: Chroomonas ap.
PL: figure
S: Chlamydomonas sp.

Gyrodinium aureolum.

reported as: DK: Gyrodinium aureolum
SF IMR: Gymnodinium sp, figure
SF NBW: Gymnodinium sp, figure
GDR: Gymnodinium sp.
FRG: Gymnodinium simplex
PL: Gymnodinium aeruginosum
S: Gyrodinium aureolum

Heterocapsa triquetra.

reported as: DK: Heterocapsa triquetra
SF IMR Gymnodinium sp, figure
SF NBW: Gymnodinium sp, figure
GDR: Scrippsiella trochoidea
FRG: Heterocapsa triquetra
PL: figure
S: Heterocapsa triquetra

Isochrysis sp.

reported as: DK: Isochrysis sp.
SF IMR: Flagellata, figure
SF NBW: Flagellata, figure
GDR: Flagellates unidentified
FRG: Flagellates unidentified
PL: Chlorella sp.
S: Flagellate

Prorocentrum minimum.

reported as: DK: Prorocentrum minimum
SF IMR: Gymnodinium sp, figure
SF NBW: Gymnodinium sp, figure
GDR: Prorocentrum minimum
FRG: Prorocentrum balticum
PL: figure
S: Prorocentrum minimum

Table 4.2
Counting results of culture samples

Dunaliella sp.			Grand mean: 10466 cells/ml		
			Grand S: 1602 "		
			Grand CV: 15 %		
Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x32	10	12277	1937	16
SF IMR	-x40	10	8065	1853	23
SF NBW	800	10	11462	1091	10
GDR	-x10	10	11827	1838	16
FRG	-x40	10	9567	2173	23
PL	-x40	5	11113	1220	11
S	10x40	5	8955	1597	18

Gyrodinium aureolum.			Grand mean: 392 cells/ml		
			Grand S: 75 "		
			Grand CV: 19 %		
Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x32	10	426	69	16
SF IMR	-x40	10	352	121	34
SF NBW	800	10	400	60	15
GDR	-x10	10	284	42	15
FRG	-x25	10	467'	218	47
	-x40				
PL	-x40	5	327	207	63
S	10x40	5	490	132	27

Heterocapsa triquetra.			Grand mean: 3346 cells/ml		
			Grand S: 585 "		
			Grand CV: 17 %		
Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x32	10	3812	503	13
SF IMR	-x40	10	3311	440	13
SF NBW	800	10	3893	623	16
GDR	-x10	10	2620	237	9
FRG	-x25	10	3568	468	13
	-x40				
PL	-x40	5	2458	843	34
S	10x40	5	3763	362	10

Isochrysis sp.			Grand mean:	5837 cells/ml	
			Grand S:	2746 "	
			Grand CV:	47 %	
Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x32	10	6793	1239	18
SF IMR	-x40	10	5601	2578	46
SF NBW	800	10	10993	3025	28
GDR	-x40	10	3586	804	22
FRG	-x40	10	6345	2572	40
PL	-x40	5	2385	49	2
S	10x40	5	5157	794	15

Prorocentrum minimum.			Grand mean:	5681 cells/ml	
			Grand S:	905 "	
			Grand CV:	16 %	
Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x32	10	6668	686	I0
SF IMR	-x40	I0	5685	876	15
SF NBW	800	10	7090	746	11
GDR	-x10	10	5686	846	15
FRG	-x40	10	4894	771	16
PL	-x40	5	4967	613	12
S	10x40	5	4775	503	11

Table 4.3
Counting results of the same chamber bottom of the culture samples

Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
Dunaliella sp.					
S	10x40	5	5533	2846	51
P_1	-x40	5	14769	1189	8
P_2	-x40	5	10765	515	5
P_3	-x40	5	11939	1642	14
P_4	-x40	5	11437	748	6
P_5	-x40	5	9414	2370	25
Gyrodinium aureolum.					
S	10x40	5	407	53	13
P_1	-x40	5	465	175	38
P_2	-x40	5	245	74	30
P_3	-x40	5	325	209	64
P_4	-x40	5	325	71	22
P_5	-x40	5	290	69	24
Heterocapsa triquetra.					
S	10x40	5	3627	131	4
P_1	-x40	5	3254	1185	36
P_2	-x40	5	2364	217	9
P_3	-x40	5	2797	876	31
P_4	-x40	5	2745	505	18
P_5	-x40	5	2304	623	27
Isochrysis sp.					
S	10x40	5	4650	374	8
P_1	-x40	5	2562	78	3
P_2	-x40	5	2216	248	11
P_3	-x40	5	1955	184	9
P_4	-x40	5	2199	319	15
P_5	-x40	5	2538	107	4

Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
Prorocentrum minimum.					
S	10x40	5	5509	401	7
P_1	-x40	5	5403	1257	23
P_2	-x40	5	4407	283	6
P_3	-x40	5	4497	754	17
P_4	-x40	5	5401	949	18
P_5	-x40	5	3983	576	14

Table 4.4

Species list agreed upon during the Workshop

	Units to count to achieve statistically sufficient numbers	Unit to be reported/ml	Objective to-be used
NOSTOCOPHYCEAE			
Anabaena lemmermanni	chain	um	10x
A spiroides	colony	colony	10x
Aphanizomenon flos-aquae	chain	um	10x
Aphanothece sp.	colony	colony	10x
Gomphosphaeria pusilla	colony	colony	10x
Nodularia spumigena	chain	um	10x
DIATOMOPHYCEAE			
Actinocyclus octonarius	cell	cell	10x
Chaetoceros ceratosporum	cell	cell	40x
C. cf concavicomis	cell	cell	10x
C. danicus	cell	cell	10x
C. cf debilis	chain	cell	10x
C. eibenii	chain	cell	10x
Coscinodiscus granii	cell	cell	10x
Cf Detonula confervacea	chain	cell	10x
Nitzschia cf actinastroides	cell	cell	10x
N. closterium	cell	cell	10x
Rhirzosolenia fragilissima	cell	cell	10x
Thalassiosira sp.	cell	cell	10x
DINOPHYCEAE			
Ceratium furca	cell	cell	10x
C. tripos	cell	cell	10x
Dinophysis acuminata	cell	cell	10x
D. norvegica	cell	cell	10x
Diplopsalis sp.	cell	cell	10x
Ebria tripartita	cell	cell	10x
Gonyaulax grindleyii	cell	cell	10x
G. triacantha	cell	cell	10x
Gymnodinium simplex	cell	cell	40x
G. spp.	cell	cell	10 or 40x
Gyrodinium sp.	cell	cell	40x
Prorocentrum micans	cell	cell	10x
P. mirlimlml	cell	cell	40x
Protoperidinium breve	cell	cell	10x
Scrippsiella trochoidea	cell	cell	10x
Distephanus sp.	cell	cell	10x
Dictyocha sp.	cell	cell	10x
Oocystis borgeii	colony	colony	10x
Chlorella cf marina	colony	colony	10x
Botryococcus braunii	colony	colony	10x
Cryptophyceae sp.	cell	cell	40x
Pyramimonas sp.	cell	cell	40x
unidentified flagellates	< 3 um		40x
	3-7 um		40x
	> 7 um		40x

Table 4.5

Species reported in the final results

Species	Counted by	as present reported/by
Anabaena spiroides	FRG	S
Aphanizomenon flos-aquae	DK, SF-IMR, SF-NBW, GDR, PL, S	
Aphanothece sp.	DK, FRG	
Gomphosphaeria pusilla	FRG	DK, PL, S
Merismopedia punctata	FRG	
Nodularia spumigena	DK, FRG	S
Oscillatoria sp.	FRG	
Actinocyclus octonarius	SF-IMR, FRG	S
Biddulphia sp.		S
Chaetoceros ceratosporum		DK, PL
" concavicornis	FRG	
" danicus	DK, SF-IMR, SF-NBW, FRG	S
" debilis	DK, FRG	
" cf. densus		PL
" eibenii	DK, FRG, PL, S	
" septentrionale		S
" simplex-group		S
" sp.	FRG	DK
Coscinodiscus spp.	FRG	S
Melosira moniliformis	FRG	
Nitzschia cf. actinastroides	FRG	DK
" closterium	FRG	DK
" longissima		S
" sp.	FRG	
Rhizosolenia delicatula	FRG	
" fragilissima	FRG	DK, PL, S
Skeletonema costatum	FRG	DK, S
Synedra sp.		PL
Thalassiosira sp.		DK, PL, S
Ceratium tripos		S
Cladopyxis claytonii		DK

Species	counted by	as present reported/by
Dinophysis acuminata	FRG	DK, S
Diplopsalis sp.		DK
Ebria tripartita	FRG	DK, PL
Gonyaulax sp	FRG	PL
Gymnodinium simplex		PL
" sp.	DK, FRG	S
Katodinium rotundaturn		S
Prorocentrum minimum	DK, SF-IMR, SF-NBW, FRG, GDR, PL, S	
Dinoflagellates	DK, FRG	
Chrysochromulina sp.	SF-IMR, SF-NBW	
Cryptomonas marina	PL	
" sp.	SF-IMR, SF-NBW, S	
Cryptophyceae	DK, S	
Isochrysis sp.	FRG	
Pyramimonas sp.	SF-IMR, SF-NBW, S	
Rhodomonas minuta	S	
Dictyocha sp.		S
Oosystis borgeii	SF-IMR, FRG	S
" sp.	FRG	DK, PL
Flagellates < 3 um	DK, SF-NBW, FRG, GDR, PL, S	
" 3-7 um	DK, SF-IMR, SF-NBW, FRG, GDR, PL, S	
" > 7 um	DK, SF-IMR, FRG, GDR, PL, S	

Table 4.6

Counting results of the natural sample

Aphanizomenon flos-aquae.

Grand mean: 841 um/ml
Grand S: 601 "
Grand CV: 71 %

Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x10	5	1608	683	42
SF IMR	-x10	5	531	27	5
SF NBW	-x10	5	1280	192	15
GDR	-x10	5	1050	478	46
FRG					
PL	-x10	5	207	32	15
S	10x10	5	1209	222	18

Nodularia spumigena.

Grand mean: 10 cells/ml
Grand S: 18 "
Grand CV: 180 %

Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x10	5	44	58	131
SF IMR					
SF NBW					
GDR					
FRG	-x10	5	25	7	29
PL					
S					

Chaetoceros danicus.

Grand mean: 3.7 cells/ml
Grand S: 6.2 "
Grand CV: 168 %

DK	-x10	5	0.8	1.3	163
SF IMR	-x10	5	3.0	0.6	20
SF NBW	-x10	5	5.0	1.2	24
GDR					
FRG	-x10	5	17.2	6.0	34
PL					
S					

Chaetoceros eibenii.			Grand mean:	1.7 cells/ml	
			Grand S:	2.4 "	
			Grand CV:	140 %	
Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x10	5	6	1.4	24
SF IMR					
SF NBW					
GDR					
FRG	-x10	5	0	0.1	224
PL	-x10	5	3.9	1.9	49
S	10x10	5	2.2	0.4	20

Prorocentrum minimum.			Grand mean:	30 cells/ml	
			Grand S:	17 "	
			Grand CV:	55 %	
Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x10	5	42	18	42
SF IMR	-x10	5	22	3	14
SF NBW	-x10	5	20	2	13
GDR	-x10	5	21	5	26
FRG	-x40	5	64	51	80
PL	-x10	5	22	1	6
S	10x40	5	22	7	32

Flagellates < 3 urn.			Grand mean:	2187 cells/ml	
			Grand S:	2246 "	
			Grand CV:	103 %	
Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x32	5	4573	1830	40
SF IMR	-x40	5	845	147	7
SF NBW	-x40	5	1535	368	24
GDR	-x40	5	1625	195	12
FRG	-x40	5	6074	1149	19
PL	-x40	5	190	20	10
S	10x40	5	467	218	47

Flagellates + Cryptophyceae < 3 um

Grand mean: 2364 cells/ml
Grand S: 2182 "
Grand CV: 92 %

Lab	Counting magnification	n	x cells/ml	S cells/ml	CV%
DK	-x32	5	4573	1830	40
SF IMR	-x40	5	1348	135	10
SF NBW	-x40	5	2270	371	16
GDR	-x40	5	1625	195	12
FRG	-x40	5	6074	1149	19
PL	-x40	5	190	20	10
S	10x40	5	467	218	47

Flagellates 3-7 um

Grand mean: 1386 cells/ml
Grand S: 711 "
Grand CV: 51 %

Lab	Counting magnification	n	x cells/ml	S cells/ml	CV%
DK	-x32	5	2233	744	33
SF IMR	-x40	5	1601	181	11
SF NBW	-x40	5	1395	309	22
GDR	-x40	5	1801	418	23
FRG	-x40	5	1807	395	22
PL	-x40	5	200	76	38
S	10x40	5	665	270	41

Flagellates + Cryptophyceae + Pyramimonas + Rhodomonas 3-7 um

Grand mean: 1748 cells/ml
Grand S: 882 "
Grand CV: 50 %

Lab	Counting magnification	n	x cells/ml	S cells/ml	CV%
DK	-x32	5	2233	744	33
SF IMR	-x40	5	2785	197	4
SF NBW	-x40	5	2397	319	13
GDR	-x40	5	1801	418	23
FRG	-x40	5	1807	395	22
PL	-x40	5	200	76	38
S	10x40	5	1017	293	29

<u>Flagellates > 7 um</u>

Grand mean: 124 cells/ml
Grand S: 101 "
Grand CV: 81 %

Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x32	5	164	61	37
SF IMR					
SF NBW					
GDR	-x10	5	244	43	18
FRG	-x40	5	216	34	16
PL	-x40	5	179	36	20
S	10x40	5	67	25	37

<u>Flagellates + Cryptophyceae + Chrysochromulina + Isochrysis > 7 um</u>

Grand mean: 348 cells/ml
Grand S: 229 "
Grand CV: 66 %

Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
DK	-x32	5	777	186	24
SF IMR	-x40	5	333	76	11
SF NBW	-x40	5	540	135	25
GDR	-x10	5	224	43	18
FRG	-x40	5	224	39	17
PL	-x40	5	179	36	20
S	10x40	5	160	38	24

Table 4.7

Counting results of the same chamber bottom of the natural sample

Lab	Counting magnification	n	$\bar{x}$ cells/ml	S cells/ml	CV%
Chaetoceros danicus.					
DK	-x10	5	1.0	0	0
SF IMR	-x10	5	2.6	0.2	9
SF NBW	-x10	5	5.6	0.6	10
FRG	-x10	5	11.6	0.9	7
Chaetoceros eibenii.					
DK	-x10	5	4.6	0.5	12
PL	-x10	5	3.3	0.2	6
S	10x10	5	1.4	0.5	39
Prorocentrum minimum.					
DK	-x10	5	46	5	10
SF IMR	-x10	5	22	2	8
SF NBW	-x10	5	17	2	10
GDR	-x10	5	24	1	5
FRG	-x40	5	29	7	24
PL	-x10	5	23	2	7
S	10x10	5	25	4	15
Aphanizomenon flos-aquae.					
DK	-x10	5	2115	261	12
SF IMR	-x10	5	530	12	2
SF NBW	-x10	5	1560	167	11
GDR	-x10	5	1102	176	16
PL	-x10	5	215	10	5
S	10x10	5	811	87	11
Flagellates < 3 urn.					
DK	-x32	5	4359	162	4
SF IMR	-x40	5	1658	162	10
SF NBW	-x40	5	2144	510	24
GDR	-x40	5	1652	146	9
FRG	-x40	5	6113	686	11
PL	-x40	5	207	8	4
S	10x40	5	175	108	62

Lab	Counting magnification	n	x cells/ml	S cells/ml	CV%
Flagellates 3-7 urn.					
DK	-x32	5	2529	170	7
SF IMR	-x40	5	2246	182	8
SF NBW	-x40	5	1717	279	16
GDR	-x40	5	1807	136	8
FRG	-x40	5	1426	109	8
PL	-x40	5	184	60	33
S	10x40	5	572	186	32
Flagellates > 7 urn.					
DK	-x32	5	332	0	0
SF IMR	-x40	5	257	30	12
GDR	-x40	5	224	29	13
FRG	-x40	5	222	52	23
PL	-x40	5	194	13	7
S	10x40	5	56	15	28

5. REPORT OF THE WORKING GROUP ON MESOZOOPLANKTON

5.1 Participating laboratories

DK Marine Pollution Laboratory, Charlottenlund (G. Rasmussen)

SF Institute of Marine Research, Helsinki (A. Sundberg)

GDR Wilhelm-Pieck-Universitgts, Rostock (G. Nicolaus)

FRG Institut für Meereskunde, Kiel (G. Schneider)

PL Institute for Environmental Development, Branch of Gdansk (P. Ciszewski (convener))

S National Swedish Environment Protection Board, Uppsala (C. Sellei)

USSR Academy of Sciences of the Latvian SSR, Riga (A. Andrushaitis)

5.2 Introduction

The aim of the intercalibration exercise was:

- to compare the influence of sampling equipment, especially breakers on WP-2 plankton net, on the results obtained in the Baltic Monitoring Programme (experiment A),
- to compare the methods used in the determination of mesozooplankton species and numbers of individuals used in the Baltic Monitoring Programme (experiment B).

5.3 Sampling

All samples were collected on board the participating research vessels at the station Bornholm N ($55^{o}16'5$ N - $15^{o}00'0$ E) on August 19, 1982.

Simultaneously all the participants collected 10 samples with a 100 urn WP-2 net from 25 m to the surface.
The samples were preserved following the normal procedure

and delivered to the Danish laboratory for determination of the displacement volume (experiment A).

At the same time 10 samples were collected on each vessel with the same equipment, preserved and brought to the laboratories where they were treated following the procedure normally used in the Baltic Monitoring Programme (experiment B).

5.4 Results and discussion

5.4.1 Experiment A

The results of the displacement volume determinations are given in Table 5.1. The results vary markedly, the highest being three times greater than the lowest. Some possible explanations can be given to this deviation as follows:

- the actually whinch-speeds used during the sampling procedure may have differed from one vessel to another,
- the beakers differ substantially in construction (it was agreed that the participants should forward accurate descriptions of their beakers to the Convener. However, the Steering Group has received no information on this matter),
- the results are most probably affected by a patchiness in the distribution of the mesozooplankton.

It was not possible to decide which explanation is correct. Further discussion is related to experiment B.

5.4.2 Experiment B

Subsampling

The participants used various methods for subsampling the mesozooplankton samples (Table 5.2). Determination of specimens was made on the basis of two subsamples as the mean of the two.

Determination and counting

The results of the experiment are compiled in Table 5.3. The mean number of Copepod nauplii, Copepods without nauplii, Cladocerans, and total number of individuals are shown in Figure 5.1. Great deviations occur between the results obtained by the individual laboratories. It can not be concluded if this occur due to a patchiness or methodological variation. However, if one compares the results of Experiment A with Experiment B (Figure 5.2) a high correlation is obtained despite the time gap between the sampling events. This could be explained by patchiness only if no advection took place during the sampling. This could not be excluded but other elements might contribute. An argument for the "patchiness" explanation could be the isolated large abundance of Acartia discaudata in the DK samples and also the uneven distribution of phyllopods and nauplii. Some discrepancies within the genera Acartia and Podon seem to indicate taxonomic problems.

The total mean, standard deviation, and coefficient of variation found by the laboratories are shown in Figure 5.3.

Figure 5.4 shows the correlation between the number of specimens in a taxonomic group and the coefficient of variation. The basic dependance between the number of specimens and CV was confirmed.

5.5 Conclusions

1. The results of the intercalibration exercise indicate that major differences in the sampling technique and/or the equipment, i.e. beaker construction, exist between the participating

laboratories, despite the possible effect of patchiness on the intercalibration results.

2. The Guidelines for the Baltic Monitoring Programme should include precise descriptions of sampling equipment, in particular the beaker construction.

3. There is a need for future exercises aiming at harmonizing the determination of certain taxonomic groups (e.g. Acartia and Podon).

5.6 Recommendations

Due to high coefficient of variation of the less abundant taxa groups (< 15 ind./m^3 or 100 ind./sample) the evaluation of the monitoring results should be based upon quantitative abundant taxa (> 400 ind./m^3 or 2.500 ind./sample). All data should, however, be reported in order to use them as indicator species.

Table 5.1

Results of the biomass determination in 10 samples obtained by using the displacement volume method

	1	2	3	4	5	6	7	8	9	10	$\bar{x}$	S.D.	CV%
DK		14.33	16.30	13.59	13.87	14.02	15.11	15.01	13.76	15.74	14.64	0.95	6.4
SF	4.46	4.11	5.13	5.49	5.24	5.64	5.45	6.96	4.85	6.76	5.41	0.90	16.6
GDR	11.27	11.65	11.74	13.50	14.40	13.14	16.05	13.50	9.42	13.22	12.79	1.84	14.3
FRG	5.34	10.37	10.37	9.26	9.93	9.51	9.63	8.71	10.48	10.51	9.31	1.57	16.8
PL	7.97	5.57	7.25	6.13	5.21	6.70	8.73	9.72	5.92	8.36	7.36	1.40	19.0
S	12.02	11.01	9.58	13.96	15.99	7.94	10.35	10.26	10.60	9.37	11.11	2.35	21.1
USSR	6.32	7.74	7.72	6.05	4.32	5.45	7.31	6.38	6.69	7.24	6.52	1.07	16.4

Table 5.2

Methods of subsampling, counter part, and number of specimens counted in the subsamples

	DK	SF	GDR	FRG	PL	S	USSR
Method of splitting	1/1,000 pa* of the original concentration	Folsom sample splitter	Stempel pipette	Kott's splitter	Folsom sample splitter	Random sampling method	Stempel pipette
Counted part of the sample	2/1000	1/256	1/300	from 1/100 to 1/500	1/512	1/300-1/400	1/150
Number of specimens counted in each subsample	> 500	619-1 125	1 228-1 856	597-1 002	579 - 1 074	1 068-1 820	

TABLE 5.3 Mean number of individuals ($\bar{x}$) and standard deviation (SD) for 10 samples of zooplankton

No	List of taxa noted in the samples		DK $\bar{x}$	DK SD	SF $\bar{x}$	SF SD	GDR $\bar{x}$	GDR SD	FRG $\bar{x}$	FRG SD	PL $\bar{x}$	PL SD	S $\bar{x}$	S SD	USSR $\bar{x}$	USSR SD
1	Acartia bifilosa	fem.	300	258	4710**	1317	6126	1573	3650	810	6348	1658	4115	1859	2336	802
2		mal.	650	474	3916	1555	7581	1628	3850	1094	3968	1220	6135	2030		
3		cop. Iv-v	4200	2175	5683	1515	5922	979	4000	1364	5376	1587			1108	663
4	Acartia longiremis	fem.	1100	1308	870	605	1000	488	850	1075	947	498	1615	681	1221	616
5		mal.	600	994	307	479	370	277	400	485	768	800	820	486		
6		cop. Iv-v	350	337	384	324	561	369	375	503	1049	425			1050	669
7	Acartia tonsa	fem. (mal.)					54(15)	96(45)			102	178	150	230		
8	Acartia diskalldata	fem.	600	774												
9		mal.	2800	1418												
10		cop. Iv-v	500	408												
11	Acartia spp.	cop. I-III	16800	5105	7219	1907	6510	773	7841	2180	12160	3415	13550*	2933*	1615	520
12	Eurytemora spp.	fem.	650	474	1049	767	1570	465	650	358	840	401	1560	541	1379	485
13		mal.	1050	864	998	474	2746	419	750	527	1305	608	1870	531		
14		cop. Iv-v	1550	1802	2816	1873	4377	1081	1375	1062	2534	786			1044	372
15		cop. I-III	1300	1183	2560	1343	927	153	1450	949	2739	734	4990	1502	450	225
16	Centropages hamatus	fem.	50	158	102	132	48	62	175	237	51	161	70	91	40	54
17		mal.	50	158	25	80	60	78	225	321	128	217	135	156		
18		cop. Iv-v			51	107	142	117	200	329	230	224	610	235		
19		cop. I-III	150	337	409	470			125	132	716	396			6	18
20	Pseudocalanus	fem.													40	61
21	elongatus	mal.														
22		cop. Iv-v	50	158	51	107	24	53					140	157	29	56
23		cop. I-III			204	494									86	136
24	Temora longicornis	fem.	650	529	640	811	488	282	600	980	870	726	1640	747	969	604
25		mal.	1750	1918	435	615	340	354	275	299	640	471	1075	413		
26		cop. Iv-v	2250	3039	1126	1113	969	822	3100	2396	1868	1242	14050	7778	865	643
27		cop. I-III	14900	13933	6860	2516	564	295	1000	2472	8243	3009			721	667
28	Copepoda nauplii		23400	9996	26470	6095	234	194	19250	3596	36531	7053	19390	4940	6923	2281
29	Copepoda ad+ cop.		49600	23335	42834	11684	40395	5701	30891	9267	50820	7552	51695	11162	13954	3722
30	Evadne nordmanni		400	516	921	605	783	165	400	242	332	296	350	239	294	179
31	Bosmina coregoni maritima		511550	78192	147814	32180	429549	71892	315675	61613	388569	82123	434405	113243	54208	9582
32	Pcdon leuckarti								250	236	128	324			75	94
33	Podon poliphemoides				128	181	1899	638	475	448	230	474	100	113	63	99
34	Podon intermedius		650	625	1024	757			125	117	665	366	1045	474	583	189
35	Cladccera		512400	78767	259014	33088	432231	71885	316925	61982	340325	a2253	435900	118565	55222	9792
36	Synchaeta spp.				230	306	54	101	-		460	314	260	154	259	263
37	Keratella cuadrata														6	la
38	Collotheca pelagica				665	485	-	-	-							
39	Lamellibranhiata larvae		250	500	1177	542	636	238	300	230	537	489	655	370	6	18
40	Gastropoda larvae		150	370	179	172	a4	125	225	299	51	161	315	225	358	173
41	Polichaeta						54	101	-						6	18
42	Oicopleura odioica														69	93
43	Total Zooplankton		602650	80288	220395	39761	473640	69903	367591	66166	428727	91016	509230	131448	76798	13939

* cop. I-V

** Includes all Acartia spp. except A. longiremis

Table 5.4 Extreme values and total values of mean number of individuals ($\bar{x}$), standard deviation (SD) and coefficient of variation (CV %) for 10 zooplankton samples of all laboratories

			$\bar{x}$ from	$\bar{x}$ to	SD from	SD to	CV % from	CV % to	$\bar{x}$ Total	SD Total	CV % Total
1	Acartia bifilosa	fem.	300	6348	258	1658	22	86	3752	2495	66,4
2		mal.	650	3968	474	1555	28	72	3096	1810	58,4
3		cop. IV-v	4108	5922	663	1587	16	60	4381	2158	49,2
4	Acartia longiremis	fem.	a50	1100	498	1308	52	126	941	901	95,7
5		mal.	307	768	479	994	64	165	518	719	138,8
6		cop. IV-V	350	1050	324	669	401	134	633	532	84,0
11	Acartia spp.	cop. I-III	1615	16800	520	5105	12	32	a704	5491	63,0
12	Eurytemora spp.	fem.	650	1049	401	767	47	73	728	531	66,0
13		mal.	750	1305	474	864	46	a2	1026	643	62,7
14		cop. IV-v	1044	4377	372	la73	24	77	2295	1653	72,0
15		cop. I-III	450	2739	153	1343	16	91	1557	1205	77,0
16	Centropaqes hamatus	fem.	50	175	132	237	129	316	94	177	188,7
17		mal.	25	225	80	321	142	320	107	219	205,3
18		cop. IV-v	51	230	107	224	a3	210	88	143	163,5
19		cop. I-III	6	716	18	470	55	224	247	394	159,7
22	Pseudocal. elong.	cop. IV-v	24	51	13	158	193	316	38	a3	218,4
24	Temora longimmis	fem.	600	978	529	980	81	163	662	735	111,o
25		mal.	275	1750	471	1918	73	141	775	1162	149,9
26		cop. IV-v	a50	3100	643	2396	66	743	1346	1791	133,0
27		cop. I-III	564	14900	295	13933	36	247	5731	7642	133,5
28	Nauplii copepoda		232	36531	194	9996	18	a3	17982	13359	74,2
29	Copepoda		13954	50820	3722	23335	26	147			
30	Evadne nordm.		294	921	179	605	21	129	526	430	81,7
31	Bosmina cor. mar.		54208	511550	9582	82123	17	22	2977	167088	56,1
32	Podon leuckarti		75	128	94	324	94	253	95	200	211,2
33	Podon poliphemoides		63	475	99	638	94	206	179	338	188,8
34	Podon intermedius		125	1024	la9	757	32	96	614	550	89,6
35	Cladocera		55222	512400	9792	a2253	13	24			
36	Synchaeta spp.		54	466	101	314	68	187	171	256	149,7
39	Lamellibranchiata larvae		6	1177	18	542	37	300	293	348	118,9
40	Gastropoda larvae		51	358	125	370	48	240	174	219	126,0
43	Total Zooplankton		76798	602650	13939	91016	13	21	360149	183968	51,0

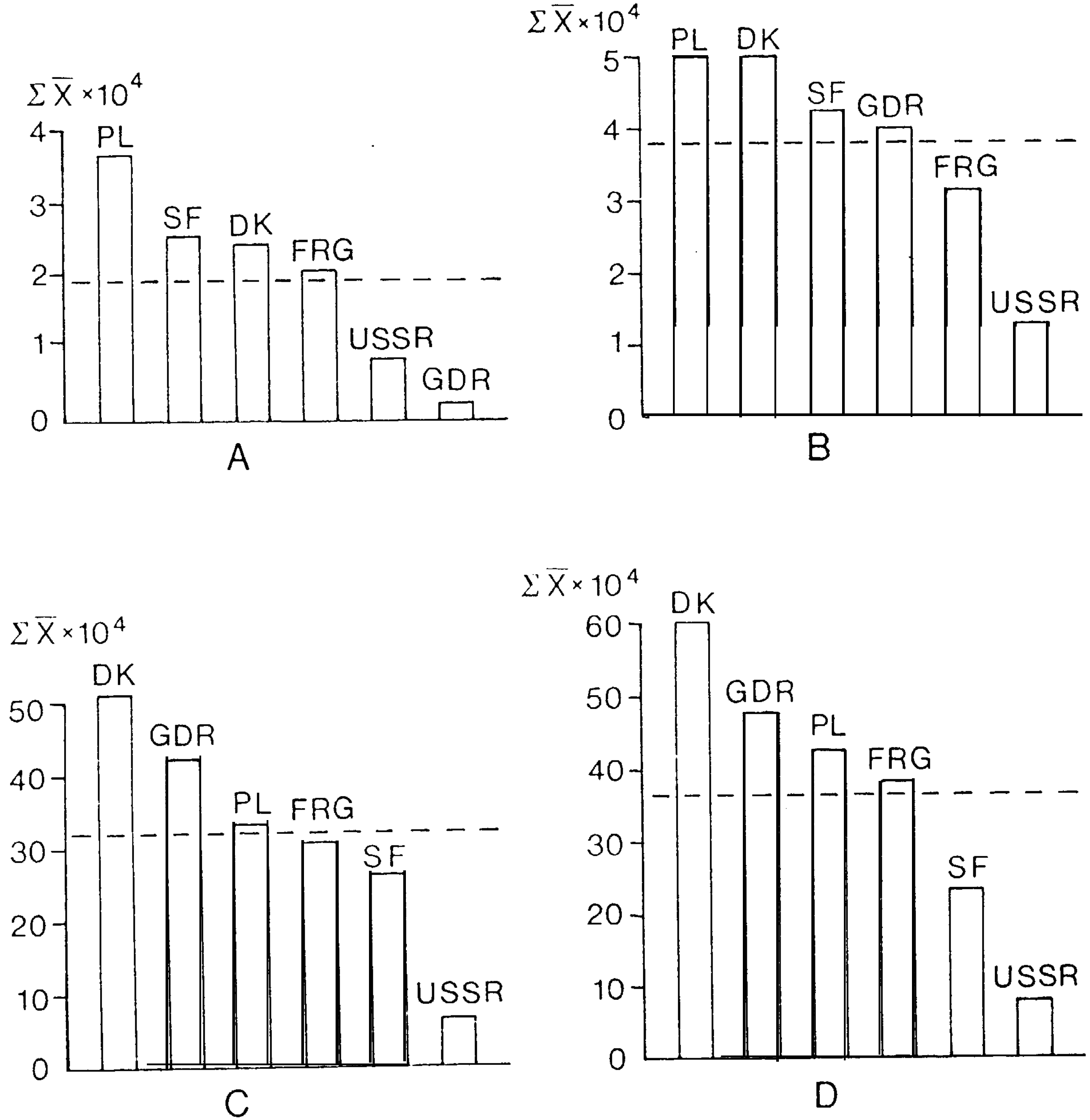

Fig. 5.1. The number (mean for 10 samples) of: A - Copepod nauplii; B - copepods without nauplii; C - cladocerans; D - total mean values of individuals

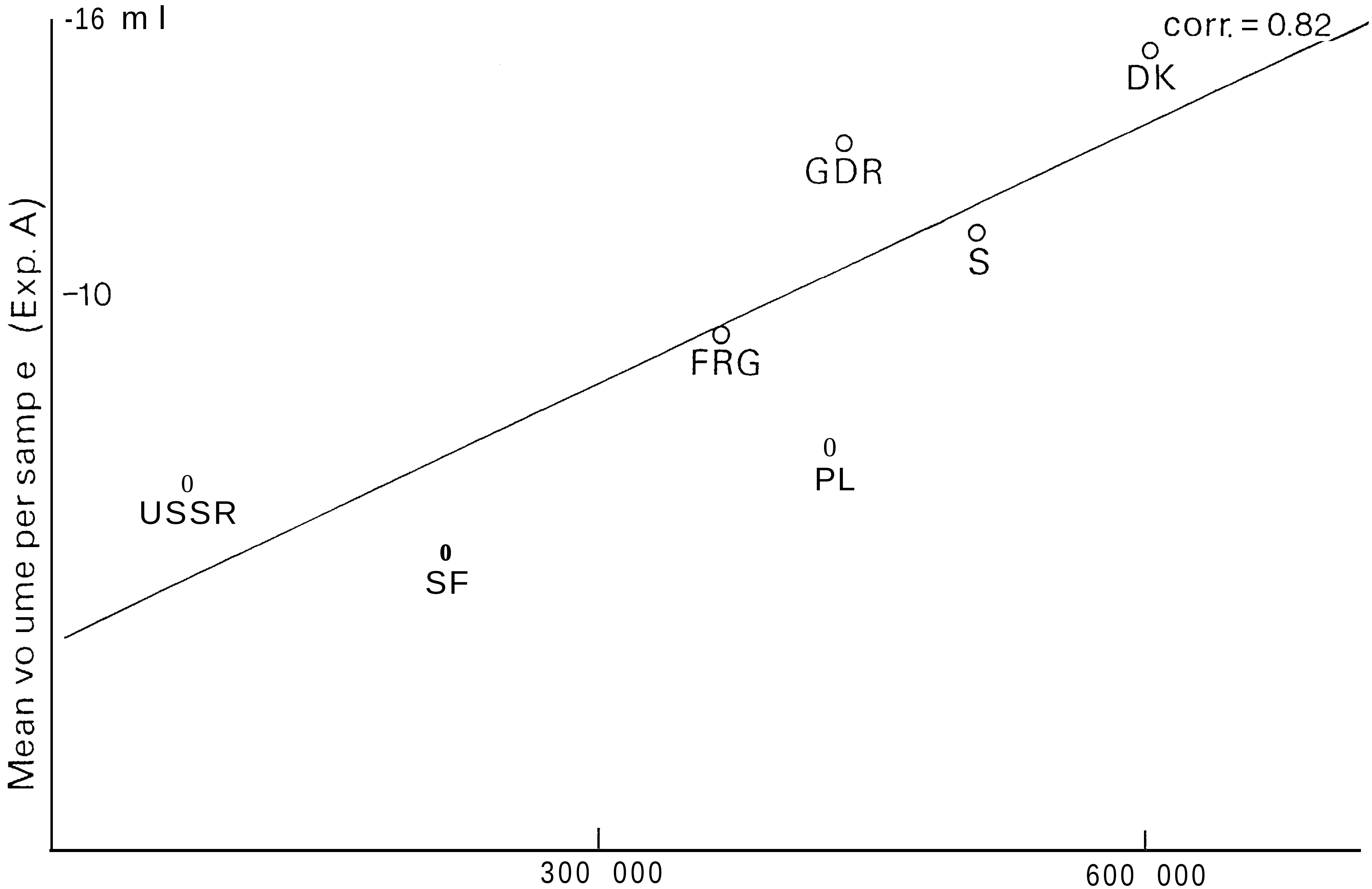

Fig. 5.2. Correlation between results of experiments A and B

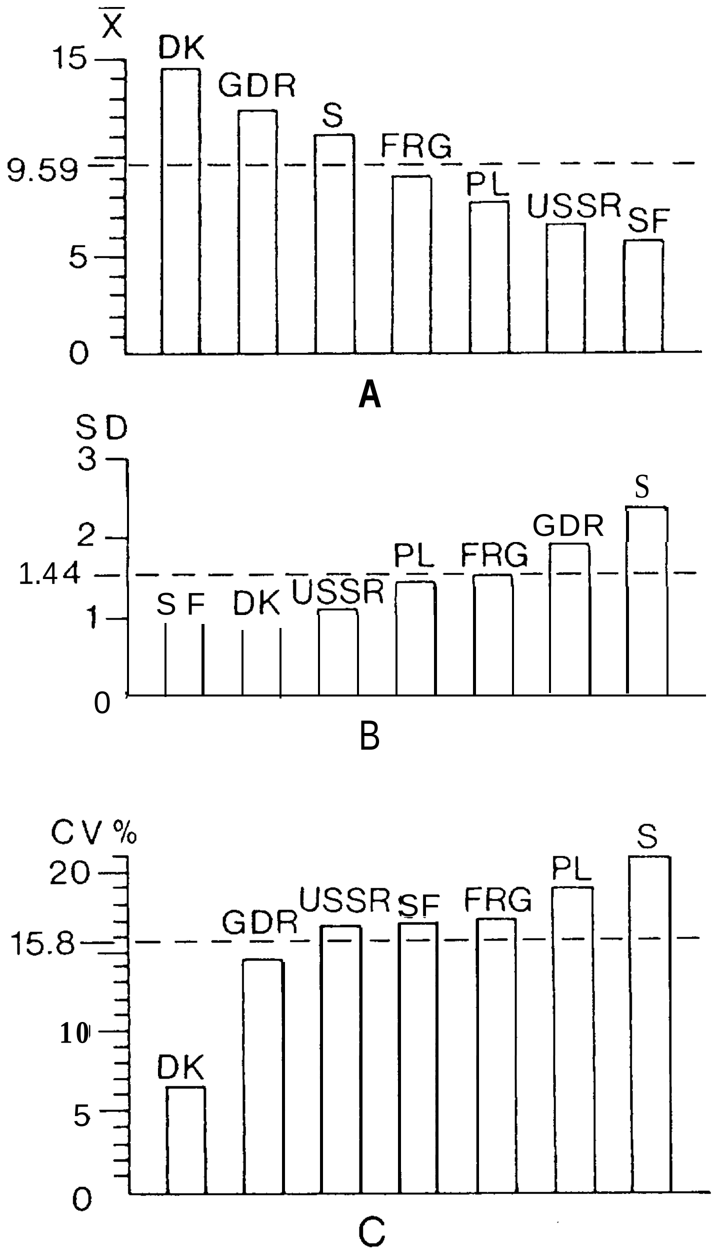

Fig. 5.3
Mean values of biomass (A), standard deviation (B) and coefficients of variation (C) for samples taken by participating laboratories.
Dashed lines indicate total mean values.

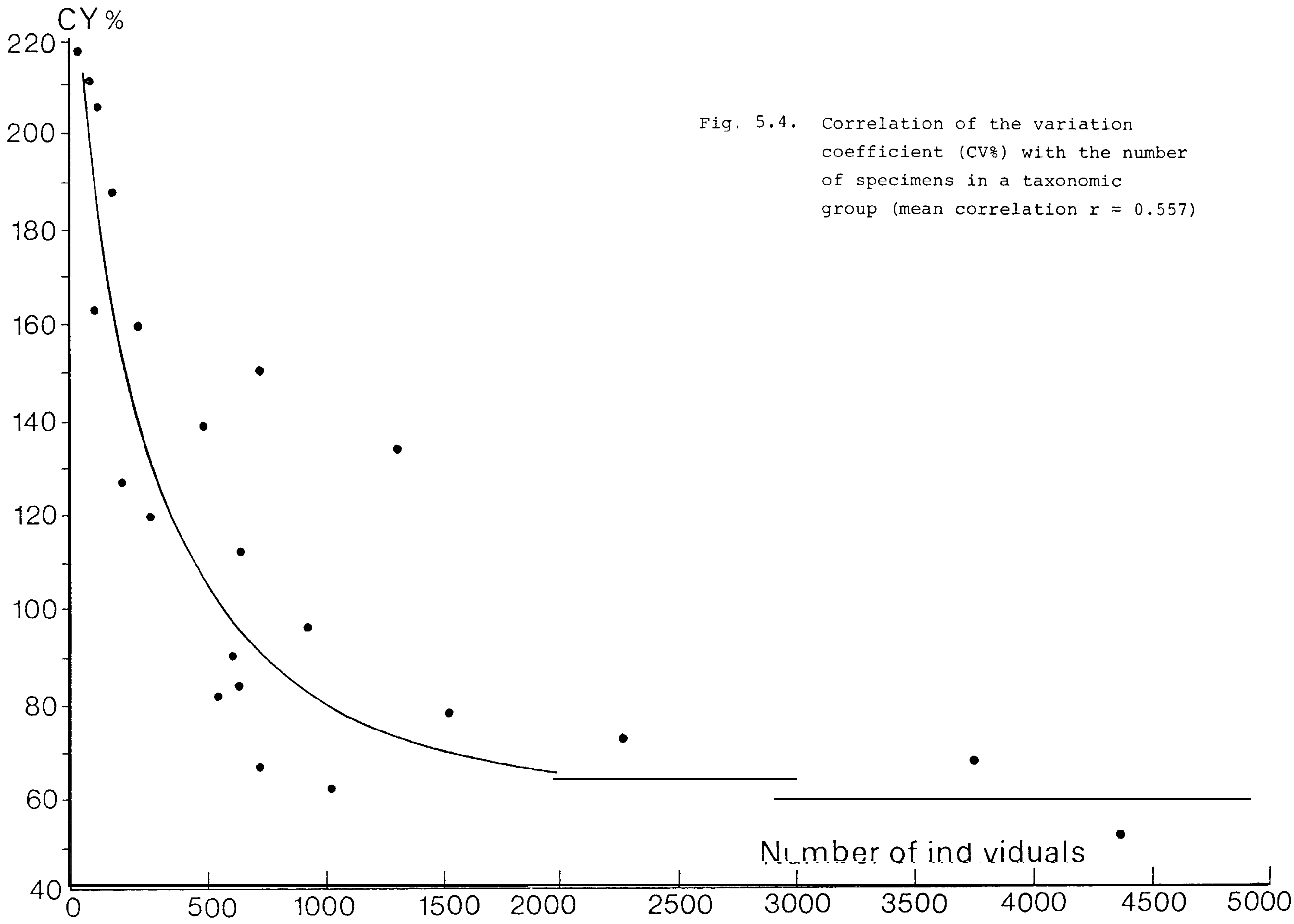

Fig. 5.4. Correlation of the variation coefficient (CV%) with the number of specimens in a taxonomic group (mean correlation r = 0.557)

6. REPORT OF THE WORKING GROUF ON SOFT BOTTON MACROZOOBENTHOS

6.1 Participating

DK Marine Pollution Laboratory, Charlottenlund (K. Jensen)

SF Institute of Marine Research, Helsinki (A-B. Andersin)

GDR Wilhelm-Pieck-Universitat, Rostock (F. Gosselck (convener))

FRG Institut für Meereskunde, Kiel (T. Brey)

PL Institute for Environmental Development, Branch of Gdansk (A. Osowiecki)

S Institute of Hydrographic Research, Göteborg (B. Yhlen)

USSR State Committee for Hydrometeorology and Control of the Natural Environment, Moscow (G. Lagzdinsh)

6.2 Introduction

Three experiments were performed to compare the methods used for investigating the macrozoobenthos:

Experiment A: Comparison of sieving techniques. The Working Group received 10 non-fixed core samples which the laboratories then sieved and processed with their own equipment (1 mm and 0.5 mm sieve)

Experiment B: Comparison of all steps involved in processing macrozoobenthos samples. Each laboratory took 10 samples with its own equipment at a buoy station.

Experiment C: Comparison of new techniques. This experiment was voluntary.

The samples for experiment A were obtained by DK at station BY 1 on 16 August 1982 using a HAPS core

($0.014\ m^2$). Experiments B and C were performed at a buoy station ($55^{o}16'25$ N - $14^{o}59'3$ E) at a depth of 65 m on 19 August 1982. The sediment was a soft mud with a yellowbrown layer at the surface.

6.3 Determination

Various literature was used to identify the species. This report uses an uniform terminology in which the following names are considered to be synonymous:

Pseudopolydora	=	Polydora quadrilobata
Ampharete baltica	=	Ampharete finmarchica
Aricidea suecica	=	Arecidea jeffreysi
Saduria entomon	=	Mesidothea entomon

The three Astarte species and the two Macoma species were not identified by all laboratories. Since at least the Astarte species are dominant, differences must be expected in the calculation of the diversity index.

6.4 Results

6.4.1 Experiment A

Table 6.2 shows the mean number of individuals from the 10 samples in the 1 mm and 0.5 mm sieve fractions.

% is the loss of individuals of the different species, i.e. the animals which passed through the 1 mm sieve expressed as a percentage of the animals which remained in the 1 mm sieve fraction.

The numbers of animals in the core samples were regrettably so small that the interpretation of the values would lead to false conclusions. Losses of up to 100 %in some species were often caused by the fact that only one single specimen was found in the 0.5 mm fraction and that none was found in the 1 mm fraction. Conversley, the frequent appearance of losses of 0 8 is just as misleading.

Since particularly the sieving technique is of outstanding importance we consider it essential that this experiment should be repeated.

6.4.2 Experiment B

The mean number of individuals in the 10 samples are compared in Table 6.3 and the mean wet and dry weights of the different species in Table 6.4 (cf. Fig. 6.1). The values forwarded by the USSR are based on 9 samples since haul No.8 was unsuccessful.

All working groups except DK found abundances that were in good agreement. The differences in values, including that of the value submitted by DK, were probably due to differences in the quantitative composition of the bottom fauna near the buoy station. The higher values found by the USSR and PL are caused mainly by the Astarte species (Fig. 6.2, Table 6.3 values in brackets) and Terebellides. Both of these taxa show a strong tendency to patchiness.

The ratio percentage was calculated between dry weight (DW) and wet weight (WW) for the whole sample and separately for the bivalves. These values show a good agreement between the groups except the bivalve value reported by the GDR (Fig. 6.3).

All groups reported similar values for the DW and WW of 100 individuals, but the values reported by SF suffest that this group had predominantly smaller individuals in their samples (Table 6.5).

The percentage ratio DW to WW was calculated for most of the species collected (Table 6.6). This shows good agreement between the laboratories for most taxa except the bivalves, although PL's and SF's values are generally lower and values reported by GDR are higher (except for the bivalves). The Astarte DW to WW ratio shows good agreement between FRG, S, and USSR (about 70 %) and between DK, SF, GDR, and PL (about 80 %). Values of the ratio for Macoma agree between DK, SF, GDR, and S and equal to about 50 %. The bivalve weight percentages are contradictory: the GDR, for example, has an extremely high value for Astarte, but the lowest for Macoma.

The differences in the ratio between DW and WW are caused by the natural drying of species before the determination of the wet weight. This drying peocess depends on the room temperature, the quality of the filter paper and the residence time of the animals on the filter paper. In case of the bivalves it is necessary to remove water from the mantle cavity (cf. Guidelines for the Baltic Monitoring Programme for the First Stage).

Despite the generally good agreement between the weight determinations an experiment should be devoted especially to the measurement of wet and dry weights at the next intercalibration workshop. This would involve the distribution of prepared samples of various taxa (polychaetes, crustaceans and bivalves).

It seems probable that even better agreement between the weight determinations can be achieved.

The dominant species are Astarte borealis and Astarte elliptica. These are followed by various polychaetes of which Terebellides stromei is the most common, with Aricidea jeffreysi, Harmothoe sarsi and Scoloplos armiger occupying ranks 3 to 6 (Table 6.7). Halicryptus spinulosus and Diastylis rathkei follow the polychaetes. USSR reports give a slightly different order: Macoma calcarea and Pygospio elegans belong to the six most common species.

If the different compositions of the Astarte species are disregarded, all reports give quite a uniform picture of the macrozoobenthos community: the two dominant taxa are followed by a number of species that are regularly found but only account for a small fraction of the total number of individuals.

The Shannon-Wiener index ($H = \sum_{1}^{s} n_i/N \log 2\, n_i/N$) was used to calculate the diversity. The means of the 10 (USSR 9) samples are shown in Table 6.2. The low value reported by PL results from the large number of Astarte individuals and the small number of species.

USSR also passed the samples for experiment B through a 0.5 mm sieve. The results are briefly reported in Table 6.8. The mean loss of the most common species was 12 %. Very few bivalves and crustaceans passed through the 1 mm sieve, but losses of polychaetes were grester. Compared to the results obtained by SF and FRG at the first Biological Workshop in Stralsund, GDR, these losses are small. The fraction of small individuals passing through 1 mm sieve depends on the relative number of juveniles and the taxa composing the community. The effects on ecological parameters can be great although the biomass values are scarcely affected.

Due to the longer time needed for the procedure the constant use of a 0.5 mm sieve remains unjustified, but the proposal made at Stralsund (1979) to use the 0.5 mm sieve for one of every three hauls deserves serious consideration.

6.4.3 Experiment C

DK demonstrated a HAPS core samples and took samples for a comparison to the van Veen grab. The mean number of individuals and the wet weight referred to 1 m^2 is higher than that obtained with the van Veen grab at the same station (Fig. 6.4).

The number of species per sample taken with the HAPS sampler and corresponding mean values are higher than those for the samples yielded by the van Veen grab. But the overall number of species from the HAPS core samples is 16 and from the van Veen grab it is 19 (Fig. 6.5). Three rare species (Pholoë minuta, Heteromastus filiformis and Priapulus caudatus) were not caught by the HAPS core sampler. This tendency to miss rare species should be checked in further comparisons in different areas, e.g. in areas with both high and with low diversity.

The HAPS core sampler gave good or better results than the van Veen grab at the same station thogh it can not be compared with the results of sampling by HAPS by the other laboratories. Its most important advantage is that it saves time at sea and in the laboratory (see Jensen, K., 1981, Environmental Technology Letters, Vol. 2, pp. 81-84).

6.5 Conclusions

1. The buoy station near Bornholm can be considered a suitable intercalibration station. The qualitative and quantitative compositions of the macrozoobenthos samples were similar so that comparison of the methods could be expected to yield meaningful results.

2. The results show that the methods are comparable. Nevertheless it seems necessary to repeat experiment A (comparison of sieving techniques). The methods used to determine the wet and dry weights should still be checked and compared in the future.

3. Experiment C (comparisons of new techniques) should be reconsidered by all participants. The current trend is towards grabs with a smaller biting area. Sieves with nylon gauze (USSR) should also be tested parallel to conventional sieves.

6.6 Recommendations

1. The Workshop proposed that the Guidelines for the Baltic Monitoring Programme should be completed with a sentence which includes a recommendation that at least one sample is sieved through both 1 mm and 0.5 mm sieves in order to make it possible to obtain a general picture of the community structure with regard to small species.

2. When a research vessel arrives at a station in the Baltic Sea, the samples for chemical analysis should be taken first. If H_2S is found in the bottom waters, only one macrozoobenthos sample should be taken for the further analysis.

3. Directing a jet of water into the gauze from directly above during the sieving procedure should be avoided as far as possible.

4. It is recommended that a sieving arrangement should be constructed for the further use by all the participating laboratories.

5. It is recommended that the station grid should be made denser in the deeper part of the Baltic Sea by adding at least two stations. It is also recommended that macrozoobenthos samples should be taken in the central and southern Baltic areas during the winter. All samples should be taken during the daytime.

6. The group recommends that the levels of species determination should be decided upon before the next intercalibration workshop.

Table 6.1

The characteristics of the used grabs are compiled in Table 6.1.
The used van Veen grabs.

Country	Biting area m^2	Weight kg	Net covered area of upper surface (%)
DK	0.1005	39	48
SF	0.112	25	48
GDR	0.112	25	48
FRG	0.0992	40	3
PL			
S	0.1005	39	48
USSR	0.1056	43	40

The values given for experiment B have been recalculated to correspond to a biting area of 0.1 m^2.

Table 6.2 Experiment A: Loss of macrofauna due to the sieving procedure (%)

Species	DK	SF			GDR			FRG			PL	S			USSR		
	(1.0 + 0.5)	1.0	(1.0+0.5)	Δ%	1.0	(1.0+0.5)	Δ%	1.0	(1.0+0.5)	Δ%	1.0	1.0	(1.0+0.5)	Δ%	1.0	(1.0+0.5)	Δ%
Halacampa duodecimcirrata	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Macoma spec.	0.6	1.9	2.2	13.6	3.1	3.1	0	1.9	2.3	18.4	1.3	1.3	1.3	0	1.6	1.6	0
Arctica islandica	-	-	-	-	0.1	0.1	0	0.1	0.1	0	-	0.1	0.1	0	-	-	-
Astarte spec.	8.2	0.2	0.2	0	0.2	0.7	71.4	0.2	0.2	0	0.3	0.3	0.3	0	-	-	-
Nemertini	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Halicryptus spinulosus	1.8	0	0.1	100	0.1	0.2	50	0.1	0.2	50	-	-	-	-	-	-	-
Priapulus caudatus	-	0	0.1	100	0.1	0.1	0	-	-	-	-	-	-	-	-	-	-
Harmothoe sarsi	1.9	-	-	-	0.5	0.5	0	1.2	1.2	0	-	0	0.1	100	0.2	0.2	0
Aricidea jeffreysi	2.8	0.3	0.9	76.7	0.1	0.2	50.0	0	0.5	100	0.7	0.2	1.2	83.3	-	-	-
Pygospio elegans	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	1.3	76.9
Paraonis gracilis	-	-	-	-	-	-	-	-	-	-	-	0	0.1	100	-	-	-
Ampharete baltica	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polydora quadrilobata	-	0.2	0.5	60.0	0.1	0.2	50.0	0.3	0.7	57.2	-	0.2	0.6	76.7	-	-	-
Scoloplos armiger	4.1	-	-	-	0.3	2.3	87.0	0.2	2.3	91.3	-	0	0.7	100	0	0.1	100
Capitella capitata	-	0.1	0.5	93.3	0.2	1.6	87.5	0.1	1.5	93.3	-	0.2	1.0	80.0	-	-	-
Terebellides stroemi	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.2	50.0
Oligochaeta	-	0	0.2	100	0	0.2	100	-	-	-	-	0	0.3	100	-	-	-
Gammarus ozeanicus	-	-	-	-	0.1	0.1	0	-	-	-	-	-	-	-	-	-	-
Pontoporeia femorate	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diastylis rathkei	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pontoporeia affinis	-	0	0.4	100	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 6.3 Experiment B: Mean number of individuals

Species		DK			SF			GDR			FRG			a			S			USSR		
		$\bar{x}$	%	rank	$\bar{x}$	%	rank	$\bar{x}$	%	rank	$\bar{x}$	%	rank	$\bar{x}$	%	rank	x	%	rank	$\bar{x}$	%	rank
Tunicata					0.2																	
Perigonimus spec.	.	–			+			•														
Halcampa duodecimcirrata		3.2			5.0			1.0			2.1			2.4			2.9			4.1		
Halicryptus spinulosus		5.3			19.8			14.2			19.0	7.0	3.	20.9	5.2	4.	15.2			13.1		
Priapulus caudatus		0.4			4.0			3.3			2.3			1.4			1.2			3.4		
Hydrobia spec.								0.1												–		
Retusa truncatula					0.5												0.2			–		
Macoma baltica	x	3.2			4.0			2.5			3.4			3.6			3.3			5.1		
Macoma calcarea	x	–						1.1									0.5			27.0	7.1	3.
Astarte borealis	x	23.1	21.0	1.	30.4	9.3	4.	43.2	17.9	2.							44.3	15.5	2.			
Astarte elliptica	x	5.7			53.1	16.3	2.	31.1	12.9	3.	87.4	32.1	2.	220.8	54.9	2.	54.2	19.0	1.	145.8	38.3	3.
Astarte montagui	x	0.1			9.2																	
Mytilus edulis					0.4						0.1			0.1			0.8			0.1		
Nemertini		1.7			1.6			1.3			3.2			2.3			2.1			2.4		
Harmothoe sarsi		9.4	8.5	5.	22.5	6.9	4.	20.9	8.7	4.	12.4	4.6		26.0	6.5	3.	31.5	11.0	4.	22.7	6.0	5.
Pholoe minuta		0.2			1.2			1.1			0.8						1.2			1.1		
Pygospio elegans		3.1			6.9			6.8			2.3						7.5			25.4	6.7	4.
Scoloplos armiger		17.9	16.3	2.	28.2	8.6	5.	16.6	6.9	6.	17.2	6.3	5.	15.8	3.9	6.	24.7	8.6	6.	14.1		
Ampharete baltica		1.7			1.3			1.2			1.0						4.1					
Aricidea jeffreysi		15.0	13.6	3.	37.2	11.4	3.	17.6	7.3	5.	17.8	6.5	4.	19.7	4.9	5.	36.0	12.6	3.			
Terebellides stroemi		10.9	9.9	4.	53.4	16.4	1.	52.1	21.6	1.	74.8	27.5	1.	62.1	15.4	1.	30.9	10.8	5.	78.9	20.7	1.
Fabricia sabella																				0.7		
Heteromastus filiformis		0.7																				
Nereis diversicolor																				0.2		
Pontoporeia femorata		2.2			26.3	8.1	6.	10.5			16.5			13.0			6.7			15.7		
Cammarus salinus																	0.3					
Mesidothea entomon					0.1			0.1			0.2			0.4			0.2			0.2		
Idotea baltica								0.1														
Mysis mixta								0.2												0.1		
Diastylis rathkei		7.0	6.4	6.	20.1			16.4			12.2	4.5	6.	14.9			18.9			19.1	5.0	6.
No. of species $\bar{x}$		13.8	75.7%		15.8	70.1%		16.2	82.1%		14.0	83.9%		12.0	90.8%		15.9	77.5%		14.0	83.8%	
Ni . No of individuals		110.6			326.3			241.4			272.3			402.4			286.5			380.7		
Ni without Macomat Astarte		78.5			233.6			163.5			181.9			179.0			184.4			202.0		
Diversity H		3.028			2.243			3.147			2.778			2.382			3.224			2.77		

Table 6.4 Experiment B: Wet weight/dry weight (mg) (means of the samples)

Species	DK		SF		GDR		FRG		PL		S		USSR	
	ww	dw	ww	dw	ww	dw	ww	dw	ww	dw	ww	dw	ww	dw
Tunicata			12.0											
Perigonimus spec.			+		+									
Halcampa duodecimcirrata	82.4	1.6	19.0	2.0	3.9	0.8	8.1	<1.0	7.6	0.7	10.8	1.4	15.4	2.9
Halicryptus spinulosus	164.6	1a.0	371.0	26.0	267.9	27.4	318.0	35.0	567.2	37.0	417.0	38.0	266.3	24.6
Priapulus caudatus	49.1	4.6	104.0	7.0	184.2	17.4	154.0	17.0	239.7	17.2	45.3	3.6	136.1	13.7
Hydrobia spec.					0.3	0.2							0.3	0.2
Retusa truncatula			1.0	1.0	-						1.5	0.6	-	-
Macoma baltica	947.7	496.1	1104.0	554.0	1078.5	461.7	1168.0	552.0	1052.2	648.2	1169.0	574.1	1367.9	577.3
Macoma calcarea					263.2	122.6					148.2	68.4	14456.7	10128.7
Astarte borealis	5104.0	4089.0	6428.0	5015.0	8460.8	7533.3	17680.0	12230.0			10460.0	7558.0	5131.3	3614.2
Astarte elliptica	379.0	302.2	1651.0	1322.0	1084.3	765.4	-		19364.5	15091.3	2387.0	1536.0	-	
Astarte montagui	1.3	1.2	109.0	86.0	-									
Mytilus edulis			67.0	21.0	-		16.0	6.0	1.4	0.6	136.4	48.2	0.2	0.2
Nemertini	70.6	8.8	127.0	12.0	38.8	6.3	143.0	20.0	138.9	11.5	73.1	a.8	93.1	12.2
Harmothoe sarsi	113.3	10.1	178.0	14.0	239.0	29.2	107.0	10.0	168.6	12.9	281.1	29.0	138.8	17.8
Pholoe minuta	0.3	0	2.0	0.2	5.3	0.7	1.4	< 1.0	-		2.8	0.3	1.9	0.9
Pygospio elegans	1.9	0.1	2.0	0.3	5.4	1.0	1.3	< 1.0	-		3.3	0.5	24.5	3.2
Scoloplos armiger	221.0	28.8	252.0	26.0	184.8	30.9	155.0	20.0	65.6	5.9	263.1	31.8	89.9	11.4
Ampharete baltica	3.7	0.1	1.0	0.1	4.1	0.6	< 0.1	< 0.1	-		5.5	0.6	-	
Aricidea jeffreysi	38.2	5.1	121.0	15.0	60.0	10.0	49.0	7.0	22.2	2.7	403.7	13.9	-	
Terebellides stroemi	227.7	32.0	1278.0	143.0	1282.3	230.7	1702.0	255.0	1422.1	173.9	754.3	106.8	1051.4	125.3
Fabricia sabella													0.1	< 0.1
Heteromastus filiformis	3.6	0.6	-											
Nereis diversicolor													0.3	0.2
Pontoporeia femorata	9.5	1.7	129.0	21.0	62.3	11.7	80.0	15.0	56.9	0.9	38.8	6.8	46.8	a.7
Gammarus salinus											1.3	0.2	-	
Mesidothea entomon			0.2	< 0.1	61.5	10.4	1.0	< 0.2	1.4	< 0.1	0.8	0.1	125.6	18.1
Idotea baltica					0.3	< 0.7	-							
Mysis mixta					1.0	0.1	-						1.3	0.2
Diastylis rathkei	24.1	4.6	70.0	11.0	65.3	10.1	53.0	11.0	63.5	11.3	90.9	15.3	61.1	8.6
Total $\bar{x}$	7447.0/5005.0		12033/7276.6		13353.8/9270.4		21639.0/13179.0		23156.4/16000.0		1639.0/10040.0		22825.7/14641.0	

Table 6.5

Experiment B: Wet weight/dry weight relationship of bivalve

	DK	SF	GDR	FRG	PL	S	USSR	
Percentage of dry weight to wet weight	≤7.°	≤°.5	≤9.4	≤°.9	69.1	61.3	≤4.1	%
Percentage of d.w. to w.w. from Astarte and Macoma	7≤ °	75.1	81.≤	67.8	77.1	≤8.7	≤9.8	%
W.w. from 100 individuals	≤.73	3.69	≤.24	7.95	5.75	5.72	≤.°°	%
D.w. from 100 individuals	4.53	2.23	3.87	4.84	3.98	3.5°	3.4≤	%

Table 6.6

Experiment B: Percentage dry weight to wet weight

Species	DK	SF	GDR	FRG	PL	S	USSR
Halcampa duodecimcirrata	1.9	10.5	20.5		9.2	13.0	18.8
Nemertini	12.5	9.4	16.2	14.0	8.3	12.0	13.1
Halicryptus spinulosus	10.9	7.0	10.2	11.o	7.3	9.1	9.2
Priapulus caudatus	9.4	6.7	9.4	11.o	7.2	7.9	10.1
Harmothoe sarsi	8.9	7.8	12.2	9.3	7.7	10.3	12.5
Pholoe minuta	-		13.2			10.7	47.4
Scolopos armiger	13.0	10.3	16.7	12.9	9.0	12.1	12.7
Pygospio elegans	5.3	15.0	18.5			15.2	13.1
Aricidea jeffreysi	13.4	12.4	16.7	14.3	12.2	13.4	
Ampharete baltica	2.7		14.6			10.9	-
Terebellides stroemi	14.1	11.2	18.0	15.0	12.2	14.2	11.9
Diastylis rathkei	19.4	15.7	15.5	20.8	17.8	16.8	14.1
Mesidothea entomon	-		16.9			12.5	14.4
Gammarus salinus						15.4	-
Pontoporeia femorata	17.9	16.3	18.8	18.8	17.4	17.9	18.6
Mytilus edulis		31.3		37.5	42.9	35.3	-
Astarte borealis) Astarte elliptica)	80.0	78.4	86.9	69.2	77.6	70.8	70.4
Macoma baltica) Macoma calcarea)	52.3	53.3	43.5	47.3	61.6	48.8	67.7

Table 6.7

Mean ind. dominance (%) at a rank of the predominant species

		DK	SF	GDR	FRG	PL	S	USSR
Astarte borealis	X	21	9.3	17.9	32.1	54.9	15.5	38.3
	rank	1	4	2	1	1	2	1
Astarte elliptica	X		16.3	12.9			19.°	
	rank		2	3			1	
Terebellides stroemi	X	9.9	16.4	21.6	27.5	15.4	10.8	20.7
	rank	4	1	1	2	2	5	2
Aricidea jeffreysi	X	13.6	11.4	7.3	6.5	4.9	12.≤	
	rank	3	3	5	4	5	3	
Harmothoe sarsi	X	8.5	6.9	8.7	4.6	6.5	11.°	6.°
	rank	5		4	6	3	4	5
Scoloplos armiger	X	16.3	8.6	6.9	6.3	3.9	8.≤	3.7
	rank	2	5	6	5	6	6	
Diastylis rathkei	X	6.4		6.8	4.5	3.7	6.≤	5.0
	rank	6			6			6
Halicyptus spinulosus	X	4.8		5.8	7.0	5.2	5.3	3.4
	rank				3	4		
Macoma calcarea	X	Pontopo	8.1					7.1
	rank	femorat	6					3
Pygospio elegans	X							6.7
	rank							4
$\bar{z}$ of 6 predominant species		75.7	70.1	82.1	83.9	9°.8	77.5	83.8

Table 6.8

Experiment B (USSR): Loss of macrofauna due to the sieving procedure (%)

Species \ Samples	I 1.0	I (1.0+0.5)	I Δ %	II 1.0	II (1.0+0.5)	II Δ %	III 1.0	III (1.0+0.5)	III Δ %	IV 1.0	IV (1.0+0.5)	IV Δ %	V 1.0	V (1.0+0.5)	V Δ %
Halicryptus spinulosus	15	15	0	13	15	13.3	4	5	20.0	17	17	0	9	9	0
Macoma calcarea	14	14	0	30	30	0	18	18	0	68	68	0	7	7	0
Astarte borealis	135	136	0.7	115	115	0	118	118	0	493	493	0	66	67	1.5
Harmothoe sarsi	26	29	10.4	18	19	5.3	18	19	5.3	26	28	7.2	22	22	0
Pygospio elegans	0	41	100	16	36	65.6	23	65	64.7	1	1	0	39	66	40.9
Scoloplos armiger	16	19	15.8	19	31	38.7	20	23	13.0	12	24	50.0	14	15	6.7
Terebellides stroemi	55	62	11.3	68	87	21.9	17	31	45.2	81	86	5.8	53	63	15.9
Pontoporeia femorata	30	31	3.3	15	15	0	7	7	0	11	11	0	10	10	0
Diastylis rathkei	6	6	0	9	9	0	8	8	0	37	37	0	12	12	0
Total	297	353	15.9	303	357	15.2	233	294	20.7	748	765	2.2	232	271	14.4

Species \ Samples	VI 1.0	VI (1.0+0.5)	VI Δ %	VII 1.0	VII (1.0+0.5)	VII Δ %	IX 1.0	IX (1.0+0.5)	IX Δ %	X 1.0	X (1.0+0.5)	X Δ %
Halicryptus spinulosus	9	9	0	19	19	0	17	17	0	15	15	0
Macoma calcarea	50	50	0	16	16	0	16	18	11.1	24	24	0
Astarte borealis	66	66	0	93	93	0	63	63	0	160	160	0
Harmothoe sarsi	24	24	4.0	23	24	4.2	11	12	6.4	36	37	2.7
Pygospio elegans	64	92	30.4	36	52	30.8	21	50	58.0	29	53	45.3
Scoloplos armiger	10	10	0	17	19	10.5	10	15	33.3	9	11	18.2
Terebellides stroemi	120	124	3.3	89	98	9.2	139	148	6.1	88	94	6.4
Pontoporeia femorata	15	15	0	13	13	0	17	17	0	23	23	0
Diastylis rathkei	47	47	0	19	19	0	17	17	0	17	17	0
Total	405	438	7.5	325	353	7.9	311	374	16.8	401	435	7.8

; Δ % = 12.0

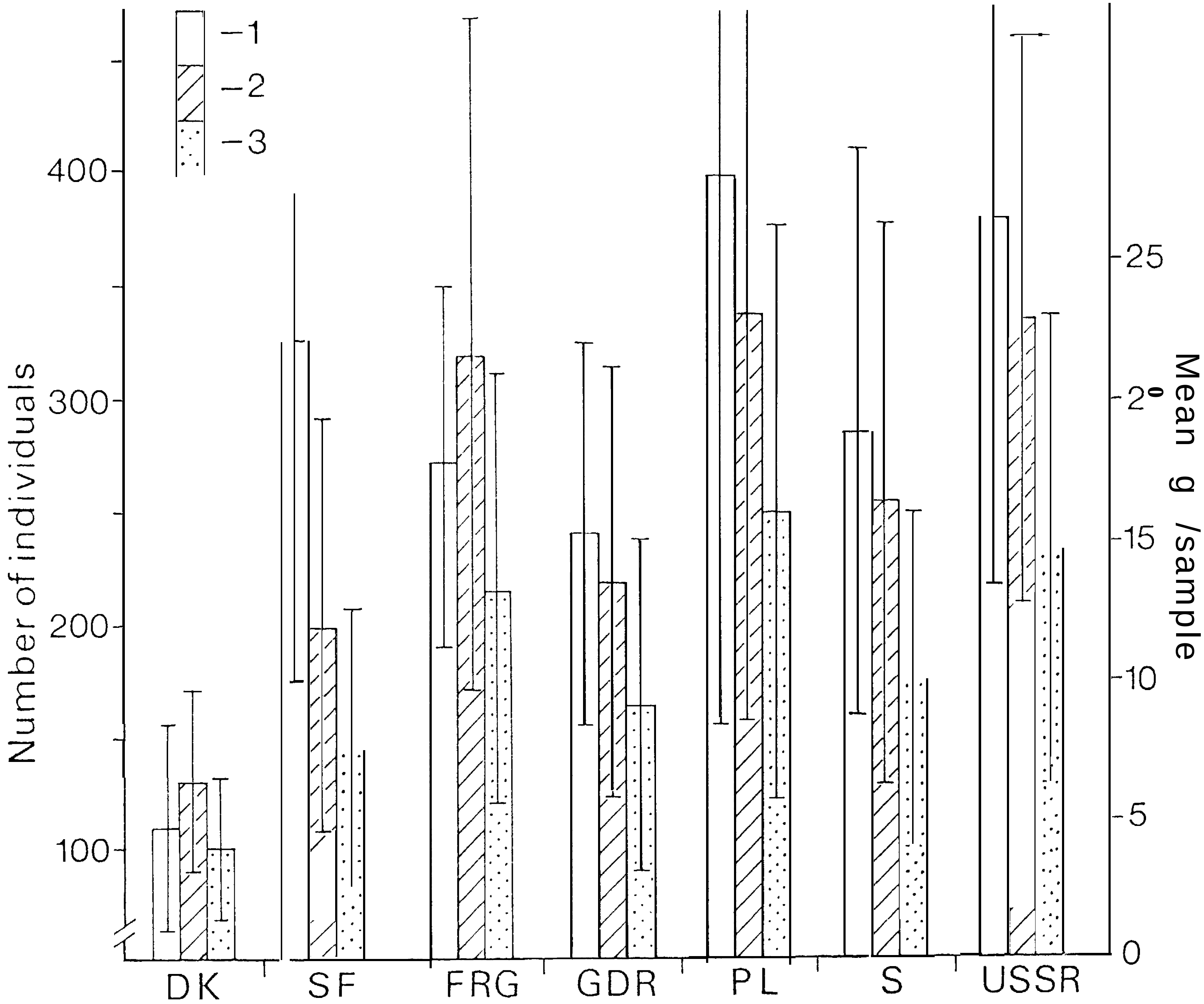

Fig. 6.1. Mean number of individuals in samples taken by each laboratory (1), and corresponding wet (2 and dry (3) weight values

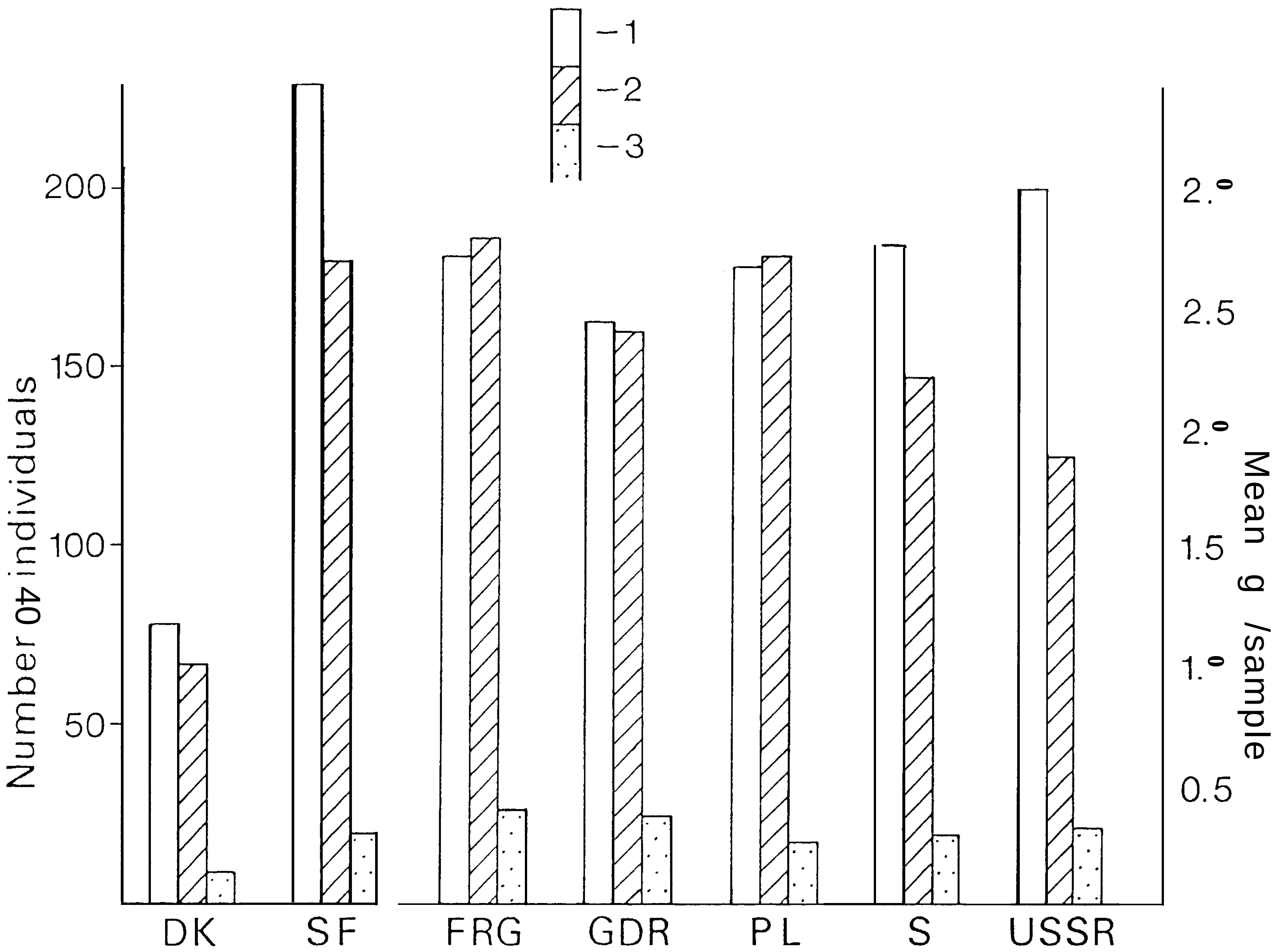

Fig. 6.2. Mean number of individuals in samples taken by each laboratory (1) and corresponding wet (2) and dry (3) weight values. Astarte and Macoma species excluded.

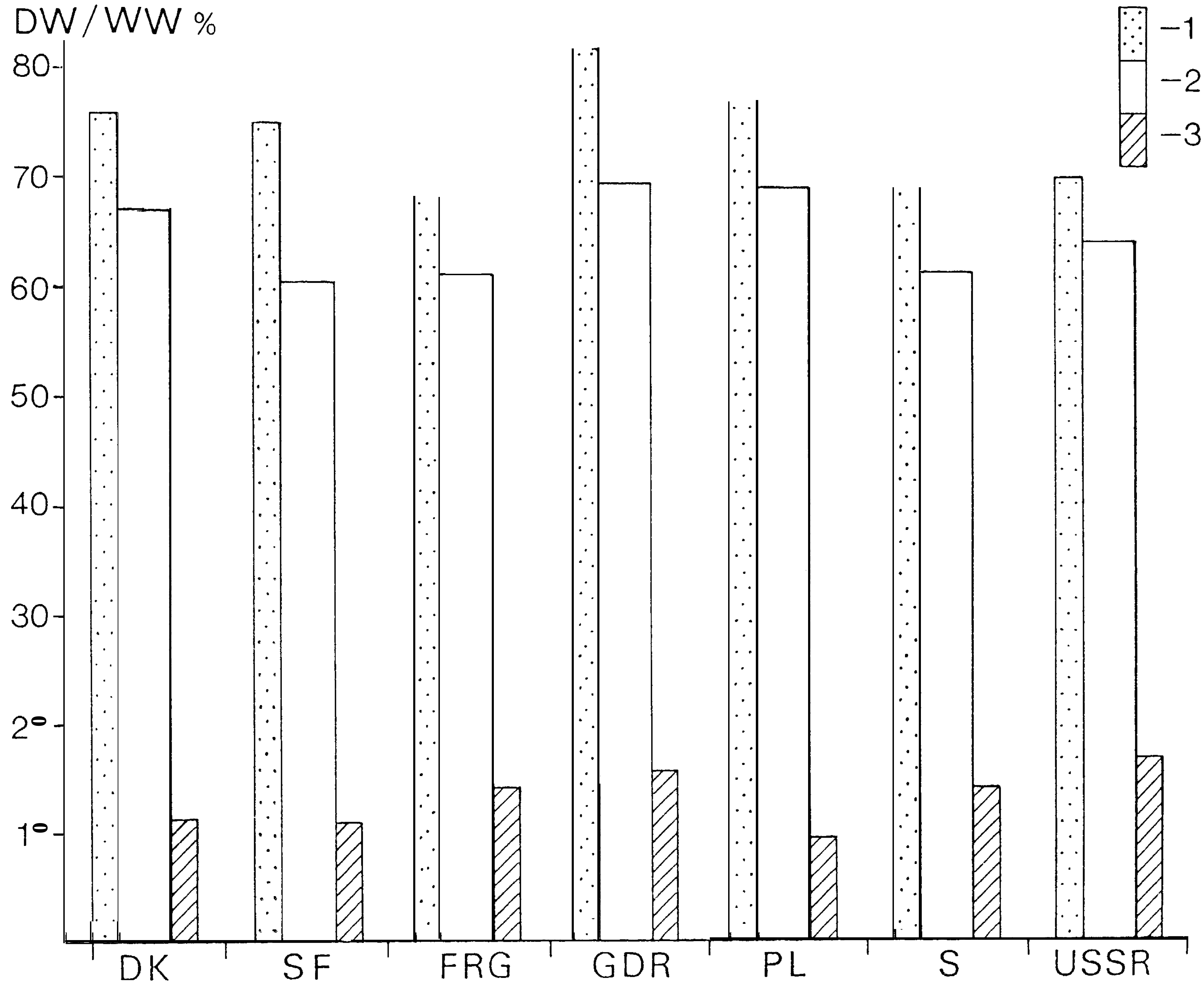

Fig. 6.3 Percentage of dry weight (DW) to wet weight (WW) for Astarte and Macoma species (1), for samples without Astarte and Macoma (3) and original samples (2).

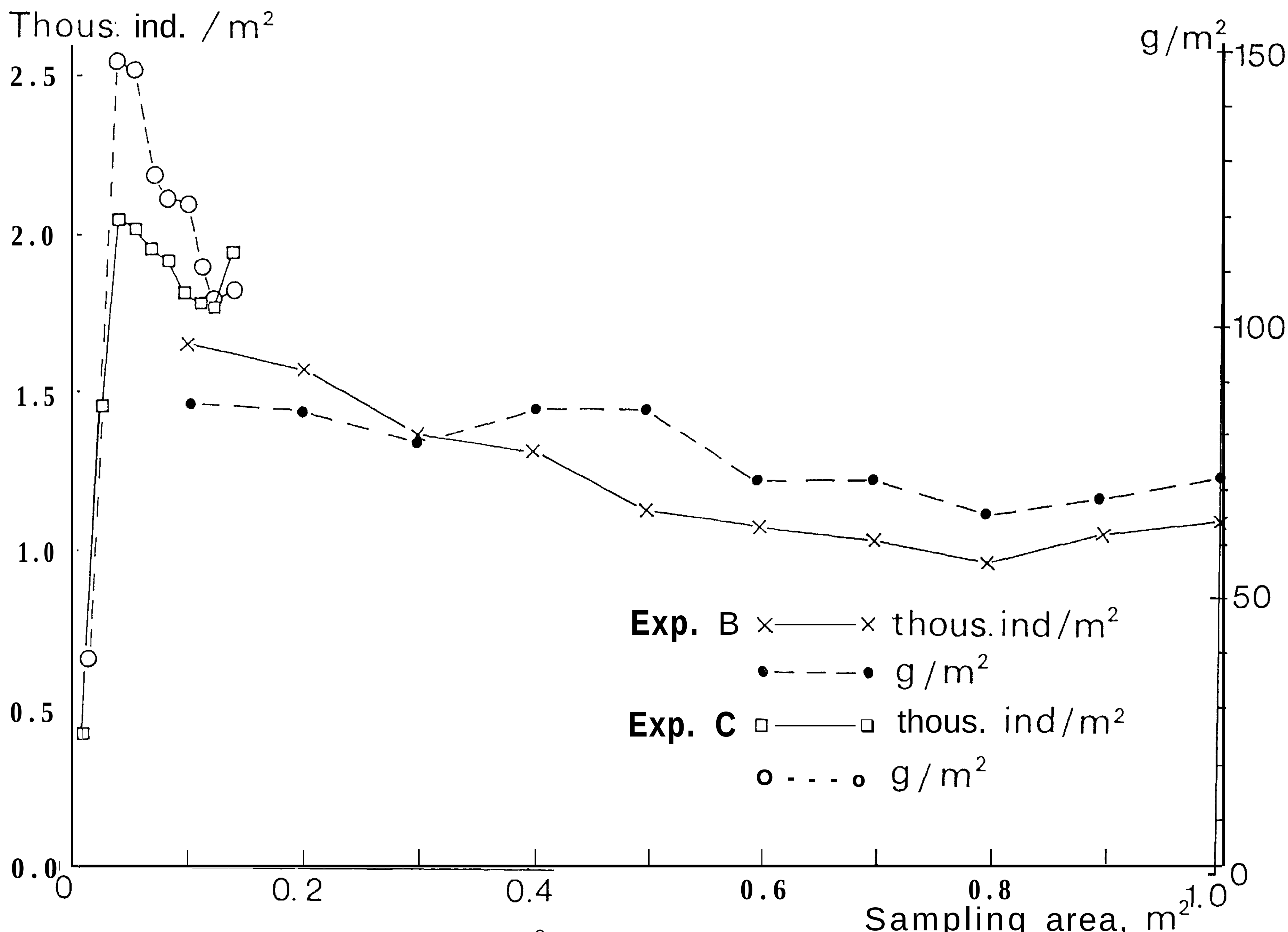

Fig. 6.4. Number of individuals per 1 m^2 in samples and sample weights for experiments B and C in relation to the sampling area.

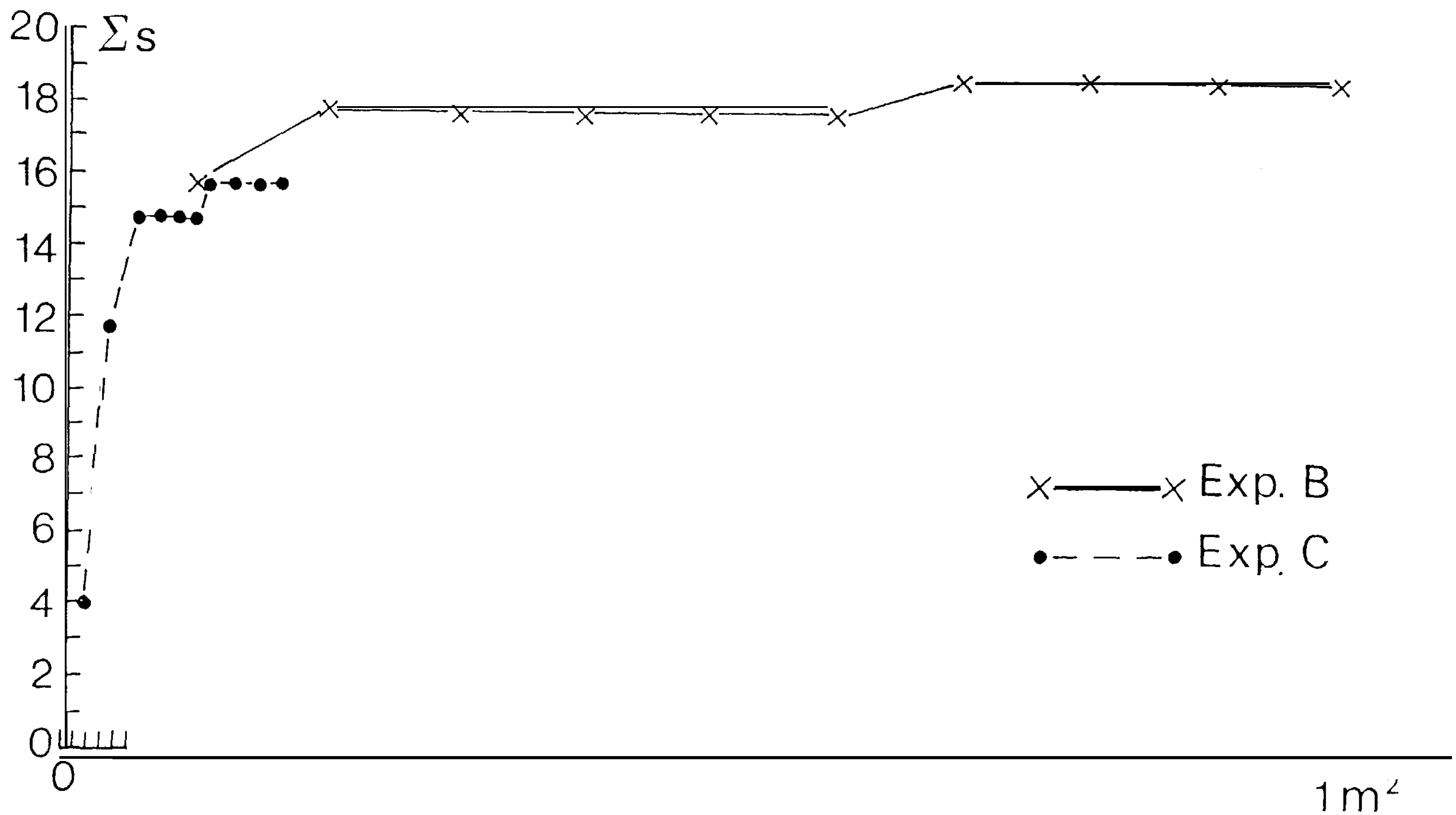

Fig. 6.5. Overall number of individuals (Σs) in relation to the sampling area for experiments B and C.

7. REPORT OF THE WORKING GROUP ON NUTRIENTS

7.1 Participating laboratories

DK Marine Pollution Laboratory, Charlottenlund
(K. Sauerberq)

SF Institute of Marine Research, Helsinki
(F. Koroleff (convener), T. Juntunen)

GDR Institut für Meereskunde, Warnemünde (G. Nehring, A. Irmisch)

FRG Institut für Meereskunde, Kiel (H. Johannsen)

PL Institute for Meteorology and Water Management, Gdynia (E. Milewska, M. Szymański)

S National Board of Fisheries, Göteborg
(J. Valderrama, B. Thorstensson).

7.2 Samples and sampling

In the afternoon on Tuesday, 17. August, DK delivered to each laboratory three mixed sample portions, one for analysis of phosphate and total phosphorus, nitrate and nitrite, one for ammonia analysis and one for silicate analysis. The salinity of the sample was 8.046 o/oo. The samples were kept cool in the dark until the following morning when the determinations started. For each determinand ten subsamples were analyzed and each laboratory used its normal routine procedures.

At Thursday, 19. August, all ships met at the station (55°16ä5 N 15°00'0 E); R/v Gunnar Thorson anchored on the position and the other ships within 0,7 nautic miles from the center. Alkor and Hydromet were closest to the shore. At 10.00 the water sampling started at the following depths: 0, 5, 10, 15, 20, 40, 60 m and max, i.e. 1 m above the bottom. The analyses started immediately afterwards.

7.3 Laboratory Procedures

The laboratories from PL, S and GDR used manual procedures: in general those described in "Methods of Seawater analysis" by Klaus Grasshoff, Verlag Chemie, Weinheim, 1976. The laboratories from S and SF used for the determination of total phosphorus and nitrogen a simultaneous alkaline oxidation with persulphate as developed by Koroleff (cf. "Report of the Baltic Intercalibration Workshop, Kiel 7-19 March, 1977". In this report slightly different procedures used by GDR are also described.

Laboratories from DK, SF, and FRG used automated procedures with different analyzers. The DK instrument hax mixing coils with an ID of 2.4 mm. whereas the FRG analyzer has 0.5 mm tubes combined with glass coils of 2.0 mm ID. Consequently the volume of the sample and the reagents is larger in the DK system. SF used a commercial "AKEA" system with PE. The mixing coils having an ID of 1.8 mm. The volumes are about the same as in the FRG system.

The automated methods are based on the manual procedures: small modifications are found in the various systems but they are of minor importance.

7.4 Data

All results and calculations are presented in Tables:

Table 7.2 gives the replicate analysis results of the mixed sample. The arithemic means for each laboratory, the standard deviation and the relative standard deviation equal to the coefficient of variation are included.

Table 7.3 presents individual means, the overall mean, SD, CV% and t values for the various determinands in the mixed sample.

Table 7.4 gives the data from the field station. For each laboratory the mean values of the various determinands are given. The averages, the standard deviations and CV% for various depths have been calculated.

Table 7.5 gives triplicate data from the various depths as analysed by SF, FRG and GRD laboratories. Data from DK, PL and S are missing.

7.5 Discussion and conclusions

The nutrient content of the mixed sample was close to the detection limit for the various procedures, and consequently the relative standard deviations were rather high. It is of interest to compare the results for the mixed sample with two samples analysed by 9 to 14 participants at the Kiel Workshop in 1977 (Table 7.1) (Report of the Baltic Intercalibration Workshop, Kiel 7-19 March 1977). The first sample was a filtered North Sea sample diluted with distilled water to a salinity of 5 o/oo, thereby obtaining an extremely low concentration of nutrients. The second sample was a surface field sample from the Kiel Bight.

As can be seen from Table 7.1 the coefficients of variation are in most of the cases smaller for the mixed sample than for the "Kiel 5 o/oo sample". At higher concentrations the CV decreases to less than 10 % for the "Kiel field sample", which was not the case for the field samples at 40 and 60 m in the present intercalibration (Table 7.4). This difference may be explained by the natural variability in the water mass at the field station Bornholm N. If all laboratories had analyzed the same 40 or 60 m sample the coefficients of variation had most probably been of the same order of magnitude as the "Kiel field sample".

The standard deviations are referred in Table 7.2. The results of triplicate analyses in three laboratories given in Table 7.5 indicate corresponding precision of the analysis. The precision is in general satisfactory, but FRG probably has had some troubles with the autoanalyzer.

The determination of total nitrogen was performed by three laboratories only, all using an alkaline oxidation with persulphate. In spite of the variability in sea water the coefficients of variation were around 10 % (Table 7.4) indicating that the procedure is improved since the Kiel Workshop and is now rather satisfactory.

The determination of total phosphorus is clearly influenced by the analytical oxidation phase, and the determination of ammonia is sensitive to the temperature in the automated procedures of outer contaminations. On the other hand the ammonia exercise went far better than at the Kiel Workshop.

As the actual values of the mixed and the field samples are unknown, accuracy can not be calculated. For the extremely low concentrations of phosphate, nitrate and nitrite results between the laboratories scatter up to about 30 %. This has been noted in most previous intercalibration exercises. The obtaining of correct blank values is of great importance as also the applying turbidity corrections. These factors may have influenced the silicate values of the field samples given by PL.

Finally, it may be concluded that precision still is somewhat better for a manual procedure than for an automated one.

7.6 Recommendations

1. At its first meeting the Working Group (WG) generally discussed the obligatory chemical determinands as given in the Report of the Second Meeting of Experts on Monitoring of the Baltic Sea Area, Vilnius, USSR, 8-11 June 1982. For none of them methodological changes were suggested.

2. The WG also discussed the determination of pH and alkalinity and came to the conclusion that procedures in use shall still be valid. The WG was of the opinion that no new nutrient determinands should be added to the monitoring programme.

3. At the second meeting the WG came to the conclusion that the results for the mixed sample were surprisingly good taking into consideration the extremely low concentrations of nutrients in the sample.

4. The statistical evaluation has confirmed the statement of the WG concerning the mixed sample.

5. The outcome of the field samples exercise seemed strongly influenced by a patchiness. Therefore, in forthcoming intercalibrations one and the same sample should always be analyzed.

6. Before automated procedures are taken into use they must be checked against the basic manual procedure.

Table 7.1

Results from the Baltic Intercalibration Workshop in Kiel, 1977

	PO_4		P_T		NO_3		NO_2		NH_3		SiO_4	
	mean	cv%	mean	cv%	mean	cv%	mean	cv%	mean	cv%	mean	cv%
Mixed Sample	0.14	32	0.51	15	0.17	39	0.02	50	0.61	20	7.8	9
Kiel, 5 o/oo	0.06	46	0.15	26	0.19	58	0.04	45	0.38	68	6.9	3
Kiel, surface	0.46	9	0.93	23	6.39	4	0.70	5	1.05	34	9.2	7
Detection limit 5 cm **A =** 0.005	0.04		0.04		0.03		0.02		0.05		0.05	

Table 7.2

Intercalibration of Mixed Sample.
Replicate analyses, with results in $\mu mol \cdot L^{-1}$
Letter after Lab. code indicates procedure: A automated, M Manual
Underlined values not considered in the statistical evaluation

		1	2	3	4	5	6	7	8	9	10	Mean	S	CV%
PO_4-P	DK-A	0.10	Run directly from sample bottle. Recorder stable								0.10	0.10	0	0
	SF-A	0.13	0.13	0.12	0.12	0.12	0.12	0.14	0.12	0.12	0.13	0.13	0.006	5
	GDR-M	0.13	0.11	0.11	0.11	0.11	0.11	0.12	0.11	0.11	0.11	0.11	0.006	5
	FRG-A	0.28	0.24	0.23	0.21	0.22	0.21	0.21	0.20	0.22	0.22	0.22	0.020	9
	PL-M	0.22	Only one value reported									0.22		
	S-M	0.13	0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.13	0.14	0.14	0.007	5
Tot.-P	DK-A	0.54	0.51	0.50	0.61	0.54	0.55	0.98	0.57	0.52	0.52	0.59	0.023	4
	SF-A	0.44	0.51	0.48	0.48	0.54	0.60	0.50	0.50	0.51	0.53	0.51	0.038	7
	GDR-M	0.53	0.49	0.51	0.45	0.47	0.45	0.51	0.51	-	-	0.50	0.015	3
	FRG-A	0.43	0.43	0.47	0.45	0.50	0.47	0.45	0.47	0.47	0.45	0.46	0.019	4
	PL-M	Not determined												
	S-M	0.52	0.52	0.53	0.53	0.53	0.52	0.52	0.52	0.53	0.52	0.52	0.004	1
NO_3-N	DK-A	0.07	Pun directly from sample bottle. Recorder stable								0.07	0.07	0	0
	SF-A	0.16	0.17	0.16	0.16	0.16	0.16	0.17	0.16	0.16	0.16	0.16	0.004	3
	GDR-M	0.22	0.22	0.20	0.20	0.19	0.20	0.21	0.15	0.19	0.18	0.20	0.007	4
	FRG-A	0.25	0.27	0.18	0.18	0.12	0.11	0.12	0.11	0.12	0.12	0.16	0.056	35
	PL-M	0.12	Only one value reported.									0.12		
	S-M	0.26	0.26	0.26	0.26	0.25	0.26	0.26	0.24	0.28	0.26	0.26	0.009	3
NO_2-N	DK-A	0.01	Run directly fran sample bottle. Recorder stable.								0.01	0.01	0	0
	SF-M	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.03	0.004	13
	SF-A	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.000	0
	GDR-M	0.06	0.06	0.05	0.06	0.06	0.05	0.06	0.05	0.05	0.05	0.05	0.005	10
	*FRG-A	0.05	0.03	0.02	0.02	0.05	0.05	0.05	0.04	0.05	0.05	0.04	0.012	30
	PL-M	0.04	Only one value reported									0.04		
	S-M	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.000	0

* not corrected for turbidity

		1	2	3	4	5	6	7	8	9	10	Mean	S	CV%
NH_3-N	DK-M	0.56	0.90	0.54	0.66	0.66	0.59	0.58	0.57	0.84	0.56	0.59	0.028	5
	SF-A	0.53	0.50	0.47	0.54	0.47	0.45	0.43	0.53	0.49	0.50	0.49	0.034	7
	GDR-M	0.48	0.51	0.46	0.46	0.47	0.50	0.46	0.48	0.45	0.50	0.48	0.019	4
	FRG-A	0.71	0.73	0.73	0.71	0.76	0.76	0.80	0.79	0.76	0.76	0.75	0.029	4
	PL-M	0.88	Only one value reported									0.88		
	S-M	0.65	0.62	0.61	0.61	0.64	0.66	0.65	0.66	0.65	0.65	0.64	0.018	3
Tot-N	SF-MA	20.3	20.3	21.5	21.3	22.5	21.5	21.1	21.0	20.8	22.4	21.3	0.71	3
	GDR-M	24.3	Only one value reported									24.3		
SiO_4-Si	DK-A	6.57	Run directly from sample bottle. Recorder stable.								6.57	6.6	0	0
	SF-A	6.7	7.0	6.7	6.8	6.8	7.0	7.0	7.0	6.5	6.5	6.8	0.189	3
	GDR	Not determined												
	FRG-A	7.5	7.5	8.2	8.4	8.4	7.7	7.8	7.8	7.8	7.9	7.9	0.313	4
	PL-M	6.0	Only one value reported									6.0		
	S-M	7.8	7.8	7.8	7.8	7.0	7.7	7.7	7.7	7.8	7.8	7.8	0.015	0.2

Table 7.3.

Intercalibration of Mixed Sample. Mean values and statistics

Individual means							Overall			
	DK	SF	GDR	FRG	PL	S	mean	S	CV%	n
PO_4-P	0.10	0.13	0.11	0.22	0.22	0.14	0.141	0.046	32	51
Tot-P	0.59	0.51	0.50	0.46	-	0.52	0.516	0.077	15	48
NO_3-N	0.07	0.16	0.20	0.16	0.12	0.26	0.168	0.066	39	59
NO_2-N	0.01	0.02	0.05	0.04	0.04	0.02	0.030	0.015	50	61
NH_3-N	0.59	0.49	0.48	0.75	0.88	0.64	0.606	0.123	20	51
SiO_4-Si	6.6	6.8	-	7.9	6.0	7.8	7.22	0.627	9	41

t-value for the various Labs

Parameter	DK	SF	GDR	FRG	PL	S	t(0.01)	t(0.05)
PO_4-P	-2.77	0.74	-2.09	5.24	1.68	-0.067	2.66	1.67
Tot-P	2.02	-0.236	-0.643	-2.25	-	0.161	2.68	1.68
NO_3-N	-4.62	-0.377	1.46	-0.353	-0.713	4.33	2.66	1.67
NO_2-N	-4.16	0	1.98	-2.08	0.656	-2.08	2.65	1.67
NH_3-N	-0.372	-2.91	-3.18	3.62	2.18	0.858	2.66	1.67
SiO_4-Si	-3.07	-2.05	-	3.26	-1.90	2.87	2.68	1.68

if /t/ < (0.05); no significant differences in the S-values

if /t/ > (0.01); difference in S-values significant

Table 7.4

Intercalibration of field station samples, mean values.
Nutrient results in $\mu mol \cdot L^{-1}$

	Lab.	t	S	O_2	PO_4	P_T	NO_3	NO_2	NH_3	N_T	Si
0 m	DK				0.01	0.50	0	0.02	0.16		4.1
	SF	18.12	7.63	6.12	0.08	0.39	0.10	0.03	0.15	21.1	5.8
0.5 m *	GDR		7.72		0.03	0.37	0.22	0.02	0.25	26.0	
	FRG		7.57		0.14	0.29	0.07	0.04	0.16		6.0
	PL	18.40	7.67		0.09		0.03	0.05			6.8
	S	18.24	7.73	6.14	0.03	0.47	0.15	0.02	0.43	20.0	5.4
average		18.25	7.664	6.13	0.063	0.403	0.095	0.030	0.26	22.70	5.620
S		0.11	0.059		0.044	0.074	0.073	0.011	0.106	2.33	0.886
CV%		0.6	0.8		70	18	77	36	41	10	16
5 m	DK				0.01	0.54	0	0.01	0.14		4.1
	SF	18.19	7.62	6.19	0.11	0.47	0.06	0.02	0.09	22.5	5.7
	GDR		7.72		0.04	0.35	0.21	0.02	0.40	24.2	
	FRG		7.57		0.13	0.27	0.06	0.05*	0.18		5.9
	PL	18.42	7.66		0.12	-	0.04	0.08			(10.5)
	S	18.24	7.73	6.15	0.02	0.48	0.16	<0.02	0.39	20.1	5.4
average		18.28	7.660	6.17	0.071	0.422	0.088	0.033	0.240	22.27	5.275
S		0.10	0.060		0.049	0.097	0.072	0.024	0.129	1.68	0.701
CV%		0.5	C.8		69	23	82	73	54	7.5	13
10 m	DK				0.01	0.48	0	0.01	0.27		4.1
	SF	18.14	7.62	6.06	0.12	0.41	0.05	0.02	0.15	20.6	5.8
	GDR		7.70		0.05	0.34	0.20	0.04	0.38	24.9	
	FRG		7.57		0.16	0.33	0.05	0.05	0.50		6.0
	PL	18.08	7.67		0.11	-	0.02	0			(10.0)
	S	18.27	7.72	6.19	0.04	0.49	0.33	<0.02	0.33	18.3	5.6
average		18.01	7.655	6.13	0.081	0.410	0.108	0.023	0.326	21.50	5.375
S		0.19	0.054		0.052	0.067	0.118	0.016	0.116	2.45	0.749
cv%		1.0	0.7		64	16	109	69	35	11	14
15 m	DK				0.02	0.46	0	0.01	0.38		4.4
	SF	17.61	7.63	5.92	0.13	0.38	0.06	0.02	0.25	19.2	6.2
	GDR		7.71		0.06	0.29	0.38	0.02	0.39	27.6	
	FRG		7.62		0.14	0.27	0.07	0.03*	0.75		6.5
	PL	17.15	7.66		0.15	-	0.35	0.05			(10.1)
	S	18.15	7.73	6.17	0.03	0.49	0.24	20.02	0.35	20.4	5.5
average		17.84	7.674	6.05	0.088	0.378	0.183	0.025	0.423	22.40	5.650
S		0.23	0.043		0.053	0.087	0.147	0.012	0.170	3.71	0.807
		1.3	0.6		60	23	80	18	40	16	14
20 m	DK				0.02	0.41	0	0.01	0.29		4.7
	SF	14.19	7.62	5.81	0.15	0.40	0.05	0.02	0.11	19.2	6.7
	GDR		7.77		0.10	0.23	0.10	0.02	0.23	18.6	
	FRG		7.66		0.39	(1.98?)	0.29	0.03	0.61		7.8
	PL	15.61	7.70		0.25	-	0.12	0.01			(11.0)
	S	13.67	7.73	6.06	0.03	0.49	0.59	to.02	1.10	20.2	5.6
average		14.49	7.696	5.94	0.156	0.382	0.191	0.018	0.468	19.33	6.200
S		0.82	0.052		0.129	0.094	0.199	0.006	0.356	0.66	1.164
cv%		5.6	0.7		82	25	100	33	76	3.4	19
40 m	DK				0.67	1.13	0.93	0.30	1.07		17.2
	SF	4.96	8.35	5.88	0.63	0.85	0.87	0.23	0.78	18.7	18.1
	GDR		8.34		0.55	0.50	0.60	0.19	0.52	21.1	
	FRG		8.62		0.97	1.07	1.23	0.40*	1.55		19.7
	PL	4.31	8.71		0.24	-	1.42	0.31			(28.2)
	S	6.76	8.21	5.85	0.49	0.84	0.48	0.13	0.58	16.8	15.4
average		5.343	8.446		0.591	0.878	0.921	0.260	0.899	19.07	17.60
S		1.036	0.187		0.218	0.221	0.327	0.087	0.377	2.02	1.55
cV%		19	2.2		36	25	35	33	42	11	9
60 m	DK				1.50	1.98	5.54	0.04	0.21		35.2
	SF	7.85	12.98	5.12	0.48	0.76	1.27	0.04	0.11	21.4	(15.7)
	GDR		13.15		1.15	1.20	6.06	0.05	0.09	23.1	
	FRG		12.93		1.48	2.49	5.63	0.10*	0.34		33.8
	PL	1.22	13.05		0.91	-	6.73	0.05			(48.0)
	S	8.28	11.70	3.12	0.89	1.24	4.59	0.02	0.30	20.0	35.5
average		7.783	12.762		1.068	1.534	4.970	0.050	0.210	21.50	
S		0.435	0.536		0.357	0.618	1.773	0.024	0.099	1.27	
cV%		5.6	4.2		33	40	35	48	47	6	
69 m	DK				1.54	-	6.47	0.43	0.54		38.8
66 m	SF	7.25	13.37	1.09	2.83	3.23	5.99	0.14	0.63	25.7	(59.1)
70 m	GDR		13.48		1.05	1.07	7.07	0.12	0.13	19.9	
62.5 m	FRG		13.04		1.84	2.54	6.05	0.19*	0.48		36.3
66 m	PL	7.95	13.40		2.41	-	6.82	0.11			(42.2)
66 m	S	8.20	12.78	2.69	0.94	1.33	3.74	to.02	0.23	19.8	32.1

* not corrected for turbidity

Table 7.5

Field sample in triplicate by 3 laboratories.

Depth	Laboratory	Phosphate			Total P			Silicate			Nitrate			Nitrite			Ammonia		
0 m	SF-A	0.08	0.08	0.08	0.37	0.39	0.40	5.8	5.8	5.8	0.10	0.10	0.10	0.03	0.03	0.03	0.16	0.13	
(0.5m)	GDR-M	0.02	0.03	0.03	0.35	0.37	0.37				0.22	0.22	0.21	0.02	0.02	0.02	0.24	0.25	0.26
	FRG-A	0.13	0.15	0.14	MO.28	0.32	0.28	5.9	6.0	6.2	0.10	0.07	0.04	0.04	0.04	0.04	0.15	0.18	0.15
5 m	SF-A	0.11	0.10	0.11	0.44	0.44	0.54	5.7	5.7	5.7	0.06	0.06	0.06	0.02	0.02	0.02	0.08	0.08	0.11
	GDR-M	0.04	0.04	0.03	0.36	0.34	0.34				0.21	0.21	0.20	0.02	0.02	0.02	0.45	0.40	0.35
	FRG-A	0.12	0.13	0.12	MO.27	0.27	0.27	5.8	5.8	6.0	0.07	0.06	0.04	0.05	0.05	0.05	0.18	0.19	0.18
10 m	SF-A	0.12	0.12	0.12	0.39	0.42	0.42	5.8	5.8	5.8	0.06	0.05	0.05	0.02	0.02	0.02	0.15	0.16	0.15
	GDR-M	0.05	0.06	0.04	0.32	0.34	0.36				0.20	0.20	0.20	0.05	0.04	0.03	0.37	0.38	0.38
	FRG-A	0.14	0.21	0.13	M0.29	0.32	0.37	6.0	6.0	5.9	0.06	0.06	0.04	0.05	0.05	0.05	0.51	0.48	0.51
15 m	SF-A	0.13	0.13	0.13	0.36	0.42	0.37	6.2	6.3	6.2	0.05	0.06	0.06	0.02	0.02	0.02	0.22	0.26	0.26
	GDR-M	0.06	0.05	0.06	0.29	0.28	0.31				0.38	0.36	0.38	0.03	0.02	0.02	0.37	0.39	0.42
	FRG-A	0.14	0.12	0.14	M -	0.25	0.29	6.5	6.5	6.5	0.07	0.08	0.05	0.04	0.03	0.03	0.77	0.74	0.74
20 m	SF-A	0.16	0.15	0.15	0.41	0.38	0.41	6.7	6.7	6.7	0.05	0.05	0.05	0.02	0.02	0.02	0.06	0.13	0.13
	GDR-M	0.08	0.10	0.11	0.23	0.22	0.25				0.11	0.10	0.10	0.01	0.02	0.02	0.22	0.25	0.21
	FRG-A	0.38	0.55	0.25	M1.98	2.01	1.96	7.9	7.9	7.7	0.37	0.25	0.25	0.03	0.03	0.03	0.64	0.64	0.56
40 m	SF-A	0.62	0.64	0.64	0.84	0.85	0.87	18.1	18.1	18.0	0.86	0.87	0.87	0.23	0.23	0.23	0.79	0.78	0.77
	GDR-M	0.55	0.55	0.55	0.51	0.49	0.51				0.59	0.61	0.60	0.19	0.19	0.19	0.51	0.57	0.48
	FRG-A	1.06	0.91	0.94	M1.25	1.06	0.92	19.4	19.9	19.8	0.40	0.40	0.40	0.40	0.40	0.40	1.40	1.48	1.76
60 m	SF-A	0.48	0.48	0.47	0.76	0.80	0.74	15.7	15.7	15.7	1.26	1.28	1.28	0.04	0.04	0.04	0.11	0.11	0.10
	GDR-M	1.16	1.14	1.14	1.18	1.21	1.20				6.14	6.06	5.98	0.05	0.05	0.05	0.08	0.11	0.09
	FRG-A	1.61	1.42	1.43	M2.46	2.47	2.55	33.8	33.8	33.6	5.58	5.67	5.64	0.08	0.12	0.10	0.36	0.33	0.33
66 m	SF-A	2.8	2.84	2.84	3.26	3.20	3.24	59.4	59.0	58.8	5.86	5.96	5.99	0.14	0.14	0.14	0.61	0.63	0.65
70 m	GDR-M	1.05	1.04	1.05	1.05	1.08	1.06				7.11	7.05	7.05	0.12	0.12	0.12	0.13	0.13	0.13
62,5 m	FRG-A	1.70	1.88	1.95	M2.49	2.57	2.57	36.3	36.6	36.0	5.91	6.13	6.11	0.20	0.18	0.20	0148	0.46	0.51

8. OVERALL CONCLUSIONS

The Biological Intercalibration Workshop held in Rønne, August 1982, was very successful. From the data in the Working Group's reports it can generally be concluded that a better agreement between the various laboratories was reached compared to the 1st Workshop (Stralsund, 1979).

The Intercalibration of maximum potential primary production measured in incubators showed a good agreement between the results obtained by different laboratories. The measurements and estimations of daily production, which will be included in the Guidelines for the BMP for the 2nd Stage, were not intercalibrated at the present Workshop.

The Intercalibration of measurements of chlorophyll-a showed a good agreement between different laboratories. The spectrophotometric measurements of phaeopigment concentrations gave uncomparable results and should be discontinued.

The intercalibration of phytoplankton counting showed that the counting procedure itself is acceptable. However, there is still a number of problems to solve before results from the different laboratories can be compared. The main problem is the identification of the species, and there is an urgent need for further standardization; but discrepancies also emerge from low abundance of large species and uneven distribution in the sea of some taxa forming large colonies of aggregates (bundles).

The intercalibration of mesozooplankton indicated that differences in sampling technique and the equipment may influence the results of different laboratories. There is an urgent need for the further standardization of the sampling method.

The intercalibration of the soft bottom macrozoobenthos showed that methods used are comparable. Nevertheless, it is necessary to repeat the experiment aimed at comparing the sieving techniques, and to standardizing the determination of wet weight.

The intercalibration of nutrients in mixed samples gave very good results taking into consideration the extremely low concentrations of nutrients in the sample. On the other hand the outcome of the field sample exercise seemed strongly influenced by patchiness.

After examining the results from the working groups for phytoplankton, zooplankton and macrozoobenthos it may be concluded that the taxonomic levels to which organisms are determined vary from one laboratory to another.

Further on it can be concluded from the results for all the natural samples that the variations between individual laboratories are partly due to a patchy distribution of measured determinands. Consequently mixed samples should be preferred for intercalibration purposes. The water should be sampled by one ship and the mixed samples should be distributed and used for the intercalibration of phytoplankton, chlorophyll-a, primary production, and nutrients. Zooplankton samples should be sampled by all the participating laboratories from one ship. Macrozoobenthos should be sampled by each ship as close as possible to an anchored bouy.

Although, it can be concluded that many good results were obtained at the Biological Workshops held to, many problems still remain unsolved. It is important that intercalibrations are arranged with regular intervals.

9. RECOMMENDATIONS

At the Meeting of the Steering Committee and Working Group Conveners 26-28 April, Copenhagen, Denmark the following recommendations were made:

1. The working groups on phytoplankton, zooplankton, and macrozoobenthos of the 2nd Biological Workshop continue their work as independent ad hoc groups with the task to:

   Consider matters related to species determination, and to make appropriate proposals for amendments to the Guidelines for the BMP in order to achieve a unified reporting of biological monitoring data.

2. Improvement of the mesozooplankton sampling technique should be considered in the near future.

3. Spectrophotometric measurements of phaeopigments should be discontinued within the BMP.

4. All background material from the different Working Groups of the Ist, 2nd and future Biological Workshops should be kept in the files of the Secretariate of the Helsinki Commission.

5. The Baltic Sea States are invited to investigate the possibility for arranging a 3rd Biological Intercalibration Workshop within 2-3 years, e.g. in spring 1985.

BALTIC SEA ENVIRONMENT PROCEEDINGS

No. 1 JOINT ACTIVITIES OF THE BALTIC SEA STATES WITHIN THE FRAMEWORK OF THE CONVENTION ON THE PROTECTION OF THE MARINE ENVIRONMENT OF THE BALTIC SEA AREA 1974-1978
(1979)*

No. 2 REPORT OF THE INTERIM COMMISSION (IC) TO THE BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION
(1981)

No. 3 ACTIVITIES OF THE COMMISSION 1980
- Report on the activities of the Baltic Marine Environment Protection Commission during 1980
- HELCOM Recommendations passed during 1980
(1981)

No. 4 BALTIC MARINE ENVIRONMENT BIBLIOGRAPHY 1970-1979
(1981)

No. 5A ASSESSMENT OF THE EFFECTS OF POLLUTION ON THE NATURAL RESOURCES OF THE BALTIC SEA, 1980
PART A-l: OVERALL CONCLUSIONS
(1981)

No. 5B ASSESSMENT OF THE EFFECTS OF POLLUTION ON THE NATURAL RESOURCES OF THE BALTIC SEA, 1980
PART A-l: OVERALL CONCLUSIONS
PART A-2: SUMMARY OF RESULTS
PART B: SCIENTIFIC MATERIAL
(1981)

No. 6 WORKSHOP ON THE ANALYSIS OF HYDROCARBONS IN SEAWATER
Institut für Meereskunde an der Universität Kiel, Department of Marine Chemistry, March 23 - April 3, 1981
(1982)

No. 7 ACTIVITIES OF THE COMMISSION 1981
- Report of the activities of the Baltic Marine Environment Protection Commission during 1981 including the Third Meeting of the Commission held in Helsinki 16-19 February 1982
- HELCOM Recommendations passed during 1981 and 1982
(1982)

No. 8 ACTIVITIES OF THE COMMISSION 1982
- Report of the activities of the Baltic Marine Environment Protection Commission during 1982 including the Fourth Meeting of the Commission held in Helsinki l-3 February 1983
- HELCOM Recommendations passed during 1982 and 1983
(1983)

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* out of print