Appendix 1 – Chemistry: organic and trace metal data

The tables in this Appendix are the results of the chemical analyses of GEEP Workshop samples for the epibenthic sampling Sites 1 to 4 in Langesundfjord and the benthic community sampling Sites A to G in Frierfjord and Langesundfjord (Fig. 2 of Follum & Moe 1988). Also given are the results for the 4 Exposure conditions C, L, M and H in the mesocosm experiment at Solbergstrand (Bakke et al. 1988). The following analyses were performed.

Tables 1, 3 to 10. Selected aromatic hydrocarbons (AHs) analysed by GC/MS in water, sediments, mussels and crabs from the mesocosm experiment, and AHs and PCBs in mussels and crabs from Field sites 1 to 4, by Klungsøyr et al. (1988).

Table 2. Selected AHs analysed by GC/MS in sediments from Sites A to G, by staff of the Norwegian Institute for Water Research (NIVA).

Table 11. Selected chlorinated hydrocarbons analysed in flounder liver from Field sites 1, 3 and 4, by Addison & Edwards (1988).

Tables 12 to 18. Trace metal concentrations analysed in sediments, mussels, crabs and flounder from field sites and mesocosm basins, by Abdullah & Steffenak (1988).

The figures have been compiled (by K. R. Clarke, M. R. Carr and H. Archer) from the above tables and from additional chemical data in Livingstone (1988) and

Viarengo et al. (1988). Aromatic hydrocarbon data were totalled into 2- and 3-ring compounds (from naphthalene to C₃-dibenzothiophenes in Table 1, for example) and >3-ring compounds (from fluoranthene to perylene in Table 1).

As a result of variance-to-mean relationships in the original data, all values were log transformed before analysis. The pooled standard deviation from 1-way ANOVA was used to construct 95 % confidence intervals; these, and the means, are displayed on the following figures on transformed axes (logs to the base *e*). Symbols without error bars are for single replicates. Symbol conventions for mesocosm samples are: (○) 'initial', (Δ) 'mid-term' and (+) 'final' samples; dosing of the Cu/diesel oil mixture commenced on 25 April. All sampling dates given are for 1986; 'August sampling' refers to field collections on 12 to 15 Aug and mesocosm collections on 18 to 21 Aug (11 Aug for H basin mussels).

In order to facilitate comparison, the same axis scaling has been adopted for equivalent field and mesocosm samples, and these figures are juxtaposed and have corresponding designations (e.g. c for field, c' for mesocosm). Unless stated otherwise, mesocosm figures are from the same source as the corresponding field plots. The papers cited in this Appendix are all from this MEPS SPECIAL.

Table 1. Water concentrations (ng l⁻¹, detection limit 3 ng l⁻¹) of selected PAHs from the mesocosm basins

Basin: Sampling date (1986):	C 22 May	C 19 Jun	C 25 Jul	L 22 May	L 25 Jul	M 19 Jun	M 25 Jul	H 22 May	H 19 Jun	H 25 Jul
Naphthalene	4	4	9	7	9	13	7	48	100	6
C ₁ -Naphthalenes	7	9	26	40	34	120	25	270	690	75
C ₂ -Naphthalenes	8	16	13	45	33	160	38	210	720	150
C ₃ -Naphthalenes	6	19	12	27	19	100	29	76	380	140
Anthracene	—	—	—	—	—	—	—	—	—	—
Phenanthrene	8	5	—	3	—	15	3	11	45	8
C ₁ -Phenanthrenes	10	15	—	5	—	35	8	23	130	32
C ₂ -Phenanthrenes	18	20	—	8	—	43	11	33	160	43
Dibenzothiophene	—	—	—	—	—	6	—	—	21	6
C ₁ -Dibenzothiophenes	7	3	—	3	—	14	4	—	49	15
C ₂ -Dibenzothiophenes	21	6	—	6	—	31	4	39	110	29
C ₃ -Dibenzothiophenes	18	4	—	3	—	11	3	29	48	16
Fluoranthene	7	—	—	—	—	—	—	—	4	—
Pyrene	28	—	—	—	—	—	—	—	8	—
Benz(a)anthracene	—	—	—	—	—	—	—	—	—	—
Chrysene	—	—	—	—	—	—	—	—	—	—
Benz(b+k)fluoranthene	—	—	—	—	—	—	—	—	—	—
Benz(e)pyrene	—	—	—	—	—	—	—	—	—	—
Benz(a)pyrene	—	—	—	—	—	—	—	—	—	—
Perylene	—	—	—	—	—	—	—	—	—	—

Table 2. Sediment concentrations (ng g⁻¹ dry wt) of selected PAHs from the top 2 cm of Niemisto cores, taken at the macrofaunal sampling sites (A to E, G) on 22 Jan 1986 (2 replicate cores per site)

Site:	A	A	B	B	C	C	D	D	E	E	F	F	G	G
Phenanthrene	282	607	499	504	367	480	1322	577	312	260	2000	538	1333	418
Anthracene	49	0	46	52	39	0	0	0	26	58	102	132	40	116
2-Methylanthracene	0	0	0	0	0	0	0	0	0	88	0	0	0	56
1-Methylphenanthrene	0	0	0	0	0	63	0	0	0	31	88	0	0	59
Fluoranthene	1829	891	319	815	227	599	1268	651	276	390	2406	1188	825	1113
Pyrene	1536	702	280	807	192	367	1739	536	282	379	992	1138	539	1493
Benzo(a)fluorene	0	0	0	122	0	0	0	0	52	173	228	274	0	9
Benzo(b)fluorene	0	0	63	171	0	55	0	0	42	183	229	270	0	0
1-Methylpyrene	0	0	0	0	0	66	0	0	47	0	177	73	0	0
Benzo(a)anthracene	775	761	382	338	125	383	881	189	387	420	977	1538	612	1365
Triphenylene/Chrysene	957	871	658	529	209	746	1823	396	666	726	2596	3392	938	2911
Benzo(b + j, k) fluoranthene	323	1539	1948	1172	528	1107	2536	1082	1913	3161	4900	4494	1968	4929
Benzo(e)pyrene	152	350	945	490	0	485	0	404	915	1096	0	1890	942	2115
Benzo(a)pyrene	150	300	1150	500	152	0	997	0	950	1009	1834	2456	2411	2300
Perylene	0	0	0	0	0	0	0	0	0	242	0	0	0	515
O-Phenylenepylene	155	349	588	354	388	506	0	341	756	745	1351	1395	768	845
Dibenz(a, h)anthracene	0	136	192	62	128	0	0	146	227	248	0	328	106	389
Benzo(ghi)perylene	498	619	655	372	723	938	0	1027	718	725	1450	1144	427	1938

Table 3. Sediment concentrations (ng g⁻¹ dry wt) of selected PAHs from the top 3 cm of box cores placed in the mesocosm basins on 17 Apr 1986 (5 boxes to each basin)

Basin	C	C	C	C	C	C	C	C	C	C	C	
Box number:	1	1	2	2	3	3	4	4	1	2	3	4
Sampling date (1986):	16 May	16 May	16 May	16 May	16 May	16 May	16 May	16 May	13 Jun	13 Jun	7 Jul	7 Jul
Naphthalene	9	10	13	9	7	5	12	15	11	8	6	11
C ₁ -Naphthalenes	12	11	15	12	9	6	12	16	12	9	7	13
C ₂ -Naphthalenes	22	25	42	30	16	11	22	28	29	16	13	20
C ₃ -Naphthalenes	18	17	18	22	12	10	17	23	17	13	11	19
Anthracene	18	16	12	25	12	8	14	23	14	12	7	15
Phenanthrene	63	51	38	76	46	30	47	72	49	39	30	50
C ₁ -Phenanthrenes	51	43	51	78	37	28	42	66	45	35	29	45
C ₂ -Phenanthrenes	45	44	25	35	33	28	48	60	44	38	30	51
Dibenzothiophene	8	6	4	9	7	4	6	10	6	5	4	7
C ₁ -Dibenzothiophenes	6	6	3	7	5	4	6	10	7	5	4	6
C ₂ -Dibenzothiophenes	17	18	15	15	13	11	20	25	20	15	13	20
C ₃ -Dibenzothiophenes	17	17	17	20	13	10	18	23	17	13	11	20
Fluoranthene	120	110	90	150	89	71	110	150	129	97	73	110
Pyrene	120	120	100	160	98	73	120	160	120	110	74	140
Benz(a)anthracene	66	68	140	140	39	36	73	92	69	63	26	59
Chrysene	63	51	120	120	36	33	54	60	53	48	28	47
Benz(b + k)fluoranthene	180	150	460	440	88	89	170	190	160	160	44	99
Benz(e)pyrene	120	64	230	300	57	50	88	120	84	90	45	77
Benz(a)pyrene	64	38	180	170	26	25	50	63	44	45	21	48
Perylene	41	23	96	92	19	16	28	39	30	28	14	25

Table 3. (continued)

Basin:	L	L	L	L	M	M	M	M	H	H	H	H
Box number:	1	2	3	4	1	2	3	4	1	2	3	4
Sampling date (1986):	13 Jun	13 Jun	7 Jul	7 Jul	13 Jun	13 Jun	7 Jul	7 Jul	13 Jun	13 Jun	7 Jul	7 Jul
Naphthalene	12	15	8	12	13	7	16	14	11	10	14	10
C ₁ -Naphthalenes	12	15	8	14	13	9	16	16	18	12	14	11
C ₂ -Naphthalenes	18	27	13	22	23	16	27	26	26	21	24	17
C ₃ -Naphthalenes	17	22	13	18	21	12	21	20	22	15	19	16
Anthracene	16	21	8	16	17	9	16	18	15	10	19	13
Phenanthrene	52	60	35	56	58	31	59	56	47	37	59	45
C ₁ -Phenanthrenes	42	55	34	48	54	30	50	54	44	34	48	39
C ₂ -Phenanthrenes	46	56	33	48	57	30	51	55	48	35	49	41
Dibenzothiophene	7	8	4	8	7	4	7	8	7	5	7	6
C ₁ -Dibenzothiophenes	6	8	4	8	7	4	8	9	7	6	7	6
C ₂ -Dibenzothiophenes	17	25	13	22	21	13	21	23	18	16	18	17
C ₃ -Dibenzothiophenes	14	23	11	20	19	12	20	22	16	17	17	15
Fluoranthene	120	150	88	120	150	72	130	130	110	81	130	110
Pyrene	140	150	81	130	160	80	140	150	150	90	150	120
Benzo(a)anthracene	76	96	26	79	72	38	73	71	74	43	71	54
Chrysene	53	67	24	68	57	34	63	63	54	40	61	43
Benzo(b + k)fluoranthene	190	220	32	230	130	98	190	140	190	120	160	88
Benzo(e)pyrene	120	130	21	130	73	63	120	95	110	84	120	65
Benzo(a)pyrene	57	64	11	75	42	27	68	55	53	41	74	40
Perylene	29	40	7	53	23	31	41	31	28	26	32	19

Site: Sampling date (1986):	1 11 Aug	1 11 Aug	2 13 Aug	2 13 Aug	3 12 Aug	3 12 Aug	4 14 Aug	4 14 Aug
Naphthalene	85	51	15	17	22	22	17	24
C ₁ -Naphthalenes	41	36	26	31	39	39	31	39
C ₂ -Naphthalenes	64	62	57	63	79	65	70	86
C ₃ -Naphthalenes	78	87	110	100	130	110	150	200
Anthracene	17	15	26	22	71	49	62	57
Phenanthrene	170	160	310	320	660	600	490	620
C ₁ -Phenanthrenes	150	130	300	300	460	420	460	610
C ₂ -Phenanthrenes	160	170	410	420	610	550	820	1100
Dibenzothiophene	18	17	33	36	62	59	50	64
C ₁ -Dibenzothiophenes	28	24	48	47	72	70	76	100
C ₂ -Dibenzothiophenes	93	81	200	190	300	290	410	640
C ₃ -Dibenzothiophenes	64	60	150	140	240	230	420	650
Fluoranthene	680	630	2200	2200	3900	3500	3300	4300
Pyrene	140	140	390	320	1200	910	1100	1300
Benz(a)anthracene	110	98	320	230	670	560	1500	1200
Chrysene	250	210	880	860	1500	1600	2600	2700
Benz(b + k)fluoranthene	110	120	330	300	1100	960	1600	1900
Benz(e)pyrene	46	44	160	110	750	660	590	1000
Benz(a)pyrene	14	16	29	32	150	130	230	240
Perylene	4	4	8	7	45	40	60	68

Site: Sampling date (1986):	1 11 Aug	1 11 Aug	2 13 Aug	2 13 Aug	3 12 Aug	3 12 Aug	4 14 Aug	4 14 Aug
Naphthalene	12	10	10	14	29	24	10	23
C ₁ -Naphthalenes	18	17	14	18	32	22	14	27
C ₂ -Naphthalenes	8	14	12	13	32	23	11	22
C ₃ -Naphthalenes	-	-	7	7	10	12	7	12
Anthracene	-	-	-	-	-	-	-	-
Phenanthrene	12	11	15	11	38	20	29	32
C ₁ -Phenanthrenes	6	5	6	7	12	10	10	13
C ₂ -Phenanthrenes	-	-	6	-	-	-	11	18
Dibenzothiophene	-	-	3	2	7	-	-	4
C ₁ -Dibenzothiophenes	-	-	-	-	-	-	-	-
C ₂ -Dibenzothiophenes	-	-	-	-	-	-	-	-
C ₃ -Dibenzothiophenes	-	-	-	-	-	-	-	-
Fluoranthene	14	11	18	14	26	15	46	55
Pyrene	5	5	7	4	10	6	15	21
Benz(a)anthracene	-	-	6	7	-	9	13	11
Chrysene	5	-	9	8	8	8	25	30
Benz(b + k)fluoranthene	-	-	6	-	-	-	12	17
Benz(e)pyrene	-	-	3	-	-	-	-	-
Benz(a)pyrene	-	-	-	-	-	-	-	-
Perylene	-	-	-	-	-	-	-	-

[illegible]

Table 7. *Mytilus edulis*. Whole tissue concentrations (ng g⁻¹ dry wt, detection limit 1 ng g⁻¹) of selected PAHs in mussels from the later restocking of mesocosm basins (18 Jul 1986, a further 2 cages basin⁻¹, pool of 10 ind. sample⁻¹). T₀ readings are from this population, prior to stocking in the basins

Basin: Cage number: Sampling date (1986):	T ₀ — 7 Jul	T ₀ — 7 Jul	C 3 4 Aug	C 4 4 Aug	L 3 4 Aug	L 4 4 Aug	M 3 4 Aug	M 4 4 Aug	H 3 4 Aug	H 4 4 Aug
Naphthalene	5	2	12	9	16	21	13	13	32	22
C ₁ -Naphthalenes	25	8	75	61	130	180	200	200	480	680
C ₂ -Naphthalenes	47	35	140	120	410	290	1000	1200	2400	2600
C ₃ -Naphthalenes	40	37	130	120	670	730	2500	2700	2500	2700
Anthracene	—	1	—	—	2	2	9	8	8	10
Phenanthrene	17	18	9	9	32	36	110	110	120	180
C ₁ -Phenanthrenes	23	22	42	41	290	290	1200	1200	520	820
C ₂ -Phenanthrenes	35	31	79	74	690	580	3100	2700	500	800
Dibenzothiophene	2	2	1	1	10	14	40	42	51	87
C ₁ -Dibenzothiophenes	7	8	15	11	120	120	420	540	230	340
C ₂ -Dibenzothiophenes	25	19	62	59	560	470	2300	2100	320	570
C ₃ -Dibenzothiophenes	22	17	38	40	340	270	1300	1200	110	170
Fluoranthene	8	8	17	14	19	24	34	28	17	28
Pyrene	7	7	14	13	20	23	51	45	16	26
Benz(a)anthracene	—	2	1	2	2	1	4	4	1	1
Chrysene	5	4	8	8	11	9	17	17	4	5
Benz(b + k)fluoranthene	2	3	2	1	2	2	2	—	1	—
Benz(e)pyrene	3	4	4	2	6	5	3	—	3	—
Benz(a)pyrene	—	—	—	—	—	—	—	—	—	—
Perylene	—	—	—	—	—	—	—	—	—	—

Table 8. *Carcinus maenas*. Whole tissue concentrations (ng g⁻¹ dry wt, detection limit 1 ng g⁻¹) of selected PAHs in crabs from mesocosm basins (placed in basins on 12 May 1986; pool of 4 ind. sample⁻¹)

Basin: Sampling date (1986):	C 4 Aug	C 4 Aug	L 4 Aug	L 4 Aug	M 4 Aug	M 4 Aug	H 4 Aug	H 4 Aug
Naphthalene	10	11	26	12	70	36	37	37
C ₁ -Naphthalenes	64	35	130	91	240	280	770	910
C ₂ -Naphthalenes	34	18	89	71	83	190	1300	1300
C ₃ -Naphthalenes	6	9	30	17	34	44	510	340
Anthracene	—	—	—	—	—	—	1	2
Phenanthrene	2	3	8	2	9	3	34	29
C ₁ -Phenanthrenes	2	3	8	5	12	12	65	45
C ₂ -Phenanthrenes	—	—	9	10	11	24	58	44
Dibenzothiophene	—	—	1	1	2	3	34	28
C ₁ -Dibenzothiophenes	—	—	4	2	5	7	40	28
C ₂ -Dibenzothiophenes	—	—	9	6	9	17	42	36
C ₃ -Dibenzothiophenes	—	—	6	4	7	15	17	19
Fluoranthene	—	—	1	—	1	—	1	1
Pyrene	—	—	—	—	1	—	2	1
Benz(a)anthracene	—	—	—	—	—	—	—	—
Chrysene	—	—	—	—	—	—	—	—
Benz(b + k)fluoranthene	—	—	—	—	—	—	—	—
Benz(e)pyrene	—	—	—	—	—	—	—	—
Benz(a)pyrene	—	—	—	—	—	—	—	—
Perylene	—	—	—	—	—	—	—	—

Table 9. *Mytilus edulis*. Whole tissue concentrations (ng g⁻¹ dry wt, detection limit 0.1 ng g⁻¹) of selected PCB congeners, and total PCBs, in mussels from Field sites 1 to 4 (pool of 10 ind. sample⁻¹). IUPAC 53 used as internal standard

Site:	1	1	2	2	3	3	4	4
Date:	11 Aug	11 Aug	13 Aug	13 Aug	12 Aug	12 Aug	14 Aug	14 Aug
(1986):								
IUPAC								
52	9.3	9.0	46.0	42.0	57.0	69.0	63.0	69.0
44	2.8	2.6	3.2	3.5	3.0	3.0	4.3	5.8
95	4.3	3.4	5.3	6.3	6.6	6.9	9.2	12.0
101	5.1	4.6	8.1	8.7	10.0	11.0	13.0	16.0
110	4.1	3.2	6.1	4.5	8.1	8.9	11.0	15.0
118	4.8	3.8	7.7	9.5	9.2	11.0	14.0	18.0
153	7.8	7.0	13.0	15.0	15.0	18.0	17.0	19.0
138	6.9	5.9	11.8	13.0	13.0	15.0	16.0	19.0
128	1.1	1.1	1.7	2.6	2.8	3.0	4.2	3.7
180	1.2	0.8	2.3	4.1	4.3	5.1	4.9	5.8
170	0.4	—	1.3	2.0	2.3	1.6	2.1	2.1
194	—	—	0.9	1.4	0.8	1.0	1.2	1.6
Total PCBs	83	70	170	190	210	240	250	300

Table 10. *Carcinus maenas*. Whole tissue concentrations (ng g⁻¹ dry wt) of selected PCB congeners, and total PCBs, in crabs from Field sites 1 to 4 (pool of 4 ind. sample⁻¹)

Site:	1	1	2	2	3	3	4	4
Date:	11 Aug	11 Aug	13 Aug	13 Aug	12 Aug	12 Aug	14 Aug	14 Aug
(1986):								
IUPAC								
52	7.7	6.0	11.0	12.0	11.0	11.0	18.0	24.0
44	1.6	1.0	1.1	2.5	2.4	2.0	2.3	4.3
95	5.8	4.7	10.0	13.0	11.0	10.0	17.0	35.0
101	11.0	10.0	22.0	19.0	16.0	17.0	22.0	26.0
110	2.8	3.3	7.0	9.7	7.3	7.7	12.0	18.0
118	11.0	11.0	28.0	21.0	21.0	26.0	34.0	51.0
153	20.0	21.6	37.0	31.0	33.0	39.0	40.0	43.0
138	11.0	17.0	32.0	28.0	27.0	31.0	36.0	43.0
128	2.5	2.2	4.4	3.9	3.2	3.5	5.6	6.6
180	4.2	4.4	10.0	8.6	6.0	16.0	16.0	21.0
170	1.7	1.6	3.9	4.3	9.2	9.3	7.4	11.0
194	1.2	1.2	2.3	2.5	5.2	4.8	3.4	5.6
Total PCBs	160	160	340	300	330	350	410	550

Table 11. *Platichthys flesus*. Liver concentrations ($\mu\text{g g}^{-1}$ wet wt) of selected PCB congeners (and the total of these congeners), hexachlorobenzene and octachlorostyrene in fish from 3 field sites (mean $\pm$ SD, from $n = 5, 10, 11$ fish from Sites, 1, 3, 4 respectively)

Site: Sampling date (1986):	1 11–12 Aug	3 12–13 Aug	4 14–15 Aug
IUPAC number			
31	0.000 ± 0.000	1.535 ± 0.794	1.851 ± 1.974
87	0.025 ± 0.050	0.000 ± 0.000	0.000 ± 0.000
60	0.000 ± 0.000	0.055 ± 0.094	0.002 ± 0.008
101	0.128 ± 0.046	0.060 ± 0.063	0.029 ± 0.020
154	0.000 ± 0.000	0.000 ± 0.000	0.003 ± 0.008
151	0.010 ± 0.020	0.023 ± 0.029	0.005 ± 0.009
118	0.000 ± 0.000	0.040 ± 0.063	0.029 ± 0.026
153	0.000 ± 0.022	0.077 ± 0.040	0.084 ± 0.081
141	0.011 ± 0.014	0.024 ± 0.028	0.005 ± 0.009
137	0.000 ± 0.000	0.016 ± 0.033	0.008 ± 0.024
138	0.032 ± 0.020	0.053 ± 0.057	0.081 ± 0.053
187	0.000 ± 0.000	0.034 ± 0.014	0.022 ± 0.018
159	0.007 ± 0.009	0.043 ± 0.018	0.046 ± 0.046
182	0.000 ± 0.000	0.035 ± 0.015	0.036 ± 0.039
183	0.000 ± 0.000	0.017 ± 0.021	0.029 ± 0.041
156	0.000 ± 0.000	0.021 ± 0.022	0.018 ± 0.029
202	0.000 ± 0.000	0.015 ± 0.015	0.013 ± 0.022
200	0.000 ± 0.000	0.052 ± 0.028	0.050 ± 0.041
180	0.008 ± 0.011	0.006 ± 0.013	0.016 ± 0.016
191	0.000 ± 0.000	0.007 ± 0.014	0.001 ± 0.003
170	0.033 ± 0.041	0.024 ± 0.036	0.007 ± 0.016
201	0.005 ± 0.010	0.014 ± 0.020	0.022 ± 0.033
203	0.005 ± 0.006	0.039 ± 0.025	0.078 ± 0.073
196	0.004 ± 0.007	0.051 ± 0.032	0.047 ± 0.037
208	0.003 ± 0.006	0.054 ± 0.020	0.047 ± 0.038
207	0.030 ± 0.016	0.038 ± 0.066	0.124 ± 0.111
206	0.011 ± 0.009	0.060 ± 0.063	0.072 ± 0.076
209	0.133 ± 0.011	0.536 ± 0.271	0.827 ± 1.417
Total	0.501 ± 0.132	3.049 ± 1.502	3.551 ± 3.060
Hexachlorobenzene	0.296 ± 0.143	1.800 ± 0.859	1.372 ± 0.844
Octachlorostyrene	0.063 ± 0.018	0.944 ± 1.231	0.710 ± 1.023

Table 12. Trace metal concentrations ($\mu\text{g g}^{-1}$ dry wt, Fe as % dry wt) in the top 2 cm of sediments (size fraction $< 63 \mu\text{m}$) from 3 replicate cores at the benthic macrofaunal sampling sites (A to G) in Frierfjord/Langesundfjord

Site	Cu	Zn	Pb	Ni	Cr	Cd	Mn	Fe
A	28	141	73	33	40	0.8	454	3.5
	26	139	71	30	40	(0.6)	653	3.3
	27	147	67	29	35	(0.6)	503	3.1
B	48	238	134	33	50	(0.6)	1 050	3.5
	47	228	130	32	50	1.1	2 880	3.5
	64	297	167	32	40	1.1	664	3.1
C	44	228	135	35	51	0.8	1 500	4.1
	42	216	126	35	60	0.8	5 570	4.2
	42	208	117	33	45	1.1	5 880	4.0
D	48	241	142	37	56	0.9	1 720	4.3
	39	205	114	33	50	0.8	8 480	4.4
	44	238	141	35	54	1.1	5 440	4.1
E	38	199	160	22	40	0.8	484	2.2
	40	241	156	25	46	1.1	925	2.1
	107	275	184	28	45	1.1	1 400	2.5
F	48	328	118	32	56	3.6	10 380	3.1
	44	296	110	30	35	3.1	5 880	3.0
	47	320	118	32	35	3.4	7 430	3.0
G	67	349	212	35	61	2.2	1 060	2.8
	70	357	229	35	66	2.5	638	2.7
	77	417	267	38	70	4.5	619	2.6

Table 13. Trace metal concentrations ($\mu\text{g g}^{-1}$ dry wt, Fe as % dry wt) in the top 1 cm of sediments, from 4 boxes in each of the 4 mesocosm basins. Samples taken after 3 mo of control, low, medium and high levels of water dosing of a copper-containing contaminant

Basin	Cu	Zn	Fe	Mn	Cd	Pb
C	32.6	142	1.38	370	1.4	64
	29.2	131	1.38	363	1.4	56
	22.5	113	1.39	453	1.0	42
	45.4	142	1.23	530	1.2	71
L	36.7	163	1.52	326	1.5	70
	38.6	148	1.31	407	1.6	77
	25.4	123	1.36	440	1.0	48
	48.0	164	1.44	431	1.4	82
M	36.9	141	1.39	538	1.3	64
	27.8	121	1.47	380	1.4	51
	42.2	146	1.36	366	0.7	73
	45.8	146	1.41	436	1.4	72
H	43.3	135	1.53	490	1.2	64
	27.0	96	1.32	447	1.6	42
	45.5	145	1.36	327	1.3	72
	41.8	129	1.26	517	1.2	64

Table 14. *Platichthys flesus*. Metal content ($\mu\text{g g}^{-1}$ dry wt) of liver and kidney samples from individual flounder, collected at Sites 1 to 4 on 11 to 14 Aug (liver samples only, for Site 4). Numbers in parentheses: detection limits

Site		Cu	Zn	Fe	Mn	Cd	Pb
1	Liver	36.6	99	208	1.51	0.28	(0.4)
		13.3	87	152	1.69	0.55	0.8
		30.5	86	178	2.12	0.35	1.2
		42.3	110	370	2.84	0.42	0.6
		29.0	191	356	3.69	0.85	1.1
		39.2	124	219	2.32	0.51	(0.3)
	Kidney	9.0	272	706	4.02	0.66	2.2
		8.8	394	600	3.56	0.65	2.2
		6.8	217	536	2.02	0.55	2.8
		7.3	222	905	2.25	0.41	2.1
		8.1	189	751	3.33	0.46	2.3
		8.6	145	654	2.30	0.63	(1.1)
	Liver	45.3	112	340	2.22	0.38	1.8
		61.9	160	310	2.41	0.33	1.1
		29.3	124	316	1.73	0.32	1.1
		40.7	113	297	1.98	0.31	1.6
		69.5	159	417	5.68	2.36	7.8
		56.8	180	722	6.97	1.45	4.8
		46.1	153	472	4.25	2.35	11.7
		11.7	200	396	4.21	0.87	2.9
		10.0	201	914	3.22	0.49	2.0
		8.1	254	577	3.37	0.70	2.3
		9.1	199	1009	3.83	0.49	4.0
		7.0	196	767	3.87	0.61	3.0
2	Liver	5.8	199	405	5.84	1.44	(3.6)
		9.5	236	395	4.85	1.01	7.5
		7.3	490	576	4.92	1.36	10.1
	Kidney	31.6	61	70	1.82	(0.12)	1.4
		49.1	76	151	2.08	0.21	1.2
		16.7	58	279	2.14	0.39	1.5
		28.1	68	170	2.40	0.34	0.8
		56.8	90	198	1.96	0.35	1.4
		28.1	84	182	1.39	0.25	1.4
		36.6	104	97	2.84	0.43	1.4
		27.2	78	83	1.83	0.22	1.1
		5.4	160	434	4.25	0.98	3.7
		9.5	384	495	7.16	0.77	6.5
		8.0	165	558	3.63	0.65	3.6
		6.3	264	700	4.23	0.65	7.3
3	Liver	7.9	345	450	3.77	0.61	4.7
		7.3	75	373	5.18	0.50	3.8
		6.0	184	492	4.43	0.65	6.2
		9.8	237	343	5.24	0.53	8.1
	Kidney	24.2	192	207	2.08	0.67	4.7
		42.3	241	98	1.92	0.69	5.4
		48.8	261	275	2.68	0.26	5.5
		33.2	249	311	2.77	1.03	4.4
	Liver	24.2	192	207	2.08	0.67	4.7
		42.3	241	98	1.92	0.69	5.4
		48.8	261	275	2.68	0.26	5.5
		33.2	249	311	2.77	1.03	4.4
		24.2	192	207	2.08	0.67	4.7
		42.3	241	98	1.92	0.69	5.4
		48.8	261	275	2.68	0.26	5.5
		33.2	249	311	2.77	1.03	4.4
		24.2	192	207	2.08	0.67	4.7
		42.3	241	98	1.92	0.69	5.4
		48.8	261	275	2.68	0.26	5.5
		33.2	249	311	2.77	1.03	4.4

Table 15. *Platichthys flesus*. Metal content ($\mu\text{g g}^{-1}$ dry wt) of liver samples from individual flounder in mesocosm basins; fish were sampled on 18 to 21 Aug 1986 after an exposure period of about 16 wk. Hyphen: missing data

Basin	Cu	Zn	Fe	Mn	Cd	Pb
C	20.1	87	698	2.72	0.92	5.4
	18.7	68	402	2.31	0.82	5.1
	23.0	317	481	3.03	0.83	6.6
	41.3	139	-	7.62	1.79	14.1
L	23.4	59	363	2.95	0.54	5.7
	19.4	73	299	1.98	0.78	4.9
	36.0	92	300	2.56	0.80	6.3
	31.9	-	278	4.05	0.89	16.3
M	29.9	339	1790	2.68	2.89	7.6
	25.2	158	147	2.75	0.62	4.6
	102.4	487	1163	22.83	2.74	14.5
	15.4	85	205	2.21	0.66	6.3
H	29.2	103	625	4.81	1.20	8.8
	27.6	293	309	1.94	0.80	4.9
	20.3	80	195	2.88	0.63	5.8
	16.2	63	184	2.60	0.71	5.3

Table 16. *Mytilus edulis*. Mussel whole tissue metal concentrations ($\mu\text{g g}^{-1}$ dry wt) from Field sites 1 to 4, collected 11 to 14 Aug 1986 (2 replicate pools of 10 ind. each)

Site	Cu	Zn	Fe	Mn	Cd	Pb
1	13.9	176	258	25.1	1.70	2.8
	14.6	210	256	25.9	1.39	4.1
2	15.3	144	293	61.1	2.32	6.3
	17.9	154	324	59.1	2.61	6.9
3	15.9	127	580	42.7	2.94	6.6
	17.0	170	583	33.3	2.49	6.4
4	16.4	127	417	70.0	2.51	7.1
	17.6	173	379	73.9	2.70	8.7

Table 17. *Mytilus edulis*. Metal concentrations ($\mu\text{g g}^{-1}$ dry wt) of mussel whole tissues and digestive glands from the mesocosm experiment. Also given are dates on which mussel stocks were placed in the contaminant-dosed basins, and on which sampling took place. Values are of single replicates, each a pool of 10 individuals (except for digestive gland samples from C, L and M, for which pool size was 30)

Basin	Stock date (1986)	Sample date (1986)	Cu	Zn	Fe	Mn	Cd	Pb
Whole								
C	25 Apr	13 Jun	7.8	114	190	13.7	1.1	2.7
L	25 Apr	13 Jun	10.3	147	148	10.7	0.8	2.8
M	25 Apr	13 Jun	17.8	156	121	10.6	1.1	2.9
H	25 Apr	13 Jun	52.1	86	67	5.6	0.9	2.2
H	25 Apr	13 Jun	47.0	78	83	7.4	0.8	2.5
C	25 Apr	4 Aug	7.3	158	217	9.8	1.2	4.9
L	25 Apr	4 Aug	16.3	159	389	17.4	1.3	4.0
M	25 Apr	4 Aug	26.8	155	194	9.6	1.2	3.9
C	18 Jul	4 Aug	6.6	58	173	7.2	1.1	3.8
L	18 Jul	4 Aug	9.9	102	243	9.3	1.1	3.3
M	18 Jul	4 Aug	14.1	88	218	7.8	1.1	4.0
H	18 Jul	4 Aug	59.0	91	155	4.7	1.2	3.1
D Gland								
C	25 Apr	19 Aug	14.8	175	458	23.8	1.3	5.0
L	25 Apr	20 Aug	27.3	196	667	21.3	1.8	3.3
M	25 Apr	18 Aug	35.9	171	365	25.3	1.3	3.1
H	18 Jul	11 Aug	79.5	100	128	4.3	1.5	3.4

Table 18. *Carcinus maenas*. Whole tissue metal concentrations ($\mu\text{g g}^{-1}$ dry wt) from mesocosm basins. Crabs dosed from 12 May 1986 and samples taken on 4 Aug 1986 (2 replicate pools of 4 ind. each)

Basin	Cu	Zn	Fe	Mn	Cd	Pb
C	96	173	1773	20.36	1.49	6.8
	97	165	416	14.61	1.56	8.8
L	70	174	422	14.81	1.23	7.0
	88	189	335	9.76	1.04	6.7
M	131	131	569	14.70	1.46	9.0
	144	176	556	8.30	1.17	7.4
H	127	179	280	7.42	1.49	7.8
	113	171	307	9.20	1.04	6.1

CHEMISTRY: AROMATIC HYDROCARBONS

FIELD

MESOCOSM

Fig. 1. Aromatic hydrocarbons. (a'), (b') Basin water, sampled at 22 May (○), 19 Jun (Δ), 12 Jul (+); (c), (d) sediment, for mesocosm, sampled at 16 May (○), 13 Jun (Δ), 7 Jul (+); (e), (f) *Mytilus edulis*, for mesocosm, individuals stocked in basins on 25 Apr and sampled at 16 May (○), 13 Jun (Δ), 4 Aug (+); (g'), (h') mussels stocked 18 Jul and sampled from stock field population at 7 Jul (○) and basins at 4 Aug (+). Units: (a), (b) ng l⁻¹; (c), (d) ng g⁻¹ dry wt; (e) to (h) μg g⁻¹ dry wt. Source: (a) to (h) Klungsøyr et al. (1988) except (c'), (d') NIVA

CHEMISTRY: AROMATIC HYDROCARBONS

FIELD

MESOCOSM

Fig. 1 (continued). Aromatic hydrocarbons. (i), (j) *Carcinus maenas*, sampled August; (k) *Littorina littorea*, sampled August ('total' 2- & 3-ring AH measurements not comparable with GC/MS analysis of other material). Units: (i), (j) $\mu\text{g g}^{-1}$ dry wt; (k) $\mu\text{g g}^{-1}$ wet wt. Source: (i), (j) Klungsoyr et al. (1988); (k) Livingstone (1988)

CHEMISTRY: CHLORINATED HYDROCARBONS

Fig. 2. Chlorinated hydrocarbons. (a), (b) PCBs for *Mytilus edulis* and *Carcinus maenas* (estimated total of all congeners); (c) PCBs for *Platichthys flesus* (totals of a subset of 28 congeners); (e), (f) hexachlorobenzene and octachlorostyrene for *P. flesus*. Units: (a), (b) ng g^{-1} dry wt; (c) to (e) $\mu\text{g g}^{-1}$ wet wt. Source: (a), (b) Klungsoyr et al. (1988); (c) to (e) Addison & Edwards (1988)

CHEMISTRY: METALS

FIELD

MESOCOSM

Fig. 3. Trace metals. (a) to (f) Sediments, field samples at 22 Jan, mesocosm at 10 Jul; (g) to (l) *Platyichthys flesus* liver (▽) and kidney (*), sampled August. Units: (a) to (l) $\mu\text{g g}^{-1}$ dry wt. Source: Abdullah & Steffenak (1988)

Fig. 3 (continued). Trace metals. (m) to (r) *Mytilus edulis* (whole tissues), sampled August; (m') mussels stocked in basin on 25 Apr, sampled at 13 Jun (Δ) and 4 Aug (+), except for H basin sampled at 4 Aug ($\times$) which were mussels restocked at 18 Jul; (s) to (u) mussels (digestive gland), sampled Aug; (v) *Carcinus maenas*, sampled Aug. Units: (m) to (r), (v) $\mu\text{g g}^{-1}$ dry wt; (s) to (u) $\mu\text{g g}^{-1}$ wet wt. Source: (m) to (r), (v) Abdullah & Steffenak (1988); (s) to (u) Viarengo et al. (1988)