

Supplementary Material

TABLE S1 The concentrations of heavy metals along the South Korean coast, Shenzhen Bay, Asan Bay, Dangdong Bay.

Heavy metals	South Korean Coast (2016-2017)	Shenzhen Bay (2018)	Asan Bay (2011)	Dangdong Bay (2016)
As, mg/kg	0.6-18 (7.8)	/	0.2-0.6 (0.37)	0.3-0.7 (0.48)
Cd, mg/kg	0.01-1.37 (0.14)	0.15-0.42 (0.27)	0.58-1 (0.71)	1.4-3.3 (2.56)
Cu, mg/kg	0.7-63.9 (14.9)	29.3-213 (90.9)	5-12.7 (9.1)	13.9-22.5 (17.17)
Pb, mg/kg	5.1-59.2 (25.7)	39-71.8 (58.94)	13.54-29 (22.4)	35.8-60 (50.06)
Zn, mg/kg	3.7-273.6 (73.8)	92-170.4 (153.26)	25.9-65.07 (44.4)	67.9-84.9 (76.1)

Note: /: Lack of data.

TABLE S2. The categorisation of macrobenthos into ecological groups and functional groups for the AMBI and the BPI.

Species	AMBI groups	BPI groups
<i>Acanthopleura japonica</i>	EGII	N1
<i>Alpheus digitalis</i>	EGII	N1
<i>Ammotrypane aulogaster</i>	EGIII	N3
<i>Ampelisca bocki</i>	EGI	N1
<i>Ampharete arctica</i>	EGI	N3
<i>Amphiodia craterodmeta</i>	EGI	N1
<i>Ancistrosyllis hanaokai</i>	EGII	N2
<i>Arca avellana</i>	EGI	N1
<i>Aricidea hartleyi</i>	EGI	N3
<i>Aricidea</i> sp.	EGI	N3
<i>Asabellides</i> sp.	EGI	N3
<i>Asterina pectinifera</i>	EGII	N1
<i>Barantolla</i> sp.	NA	N3
<i>Boccardia uncata</i>	EGIV	NA
<i>Caprella</i> sp.	EGII	N1
Caprellidae	EGII	N2
<i>Carcinoplax vestitus</i>	NA	N2
<i>Chaetozone setosa</i>	EGIV	N4
<i>Charybdis japonica</i>	EGII	N2
<i>Chone</i> sp.	EGII	N1
<i>Chone teres</i>	EGII	N1
<i>Cirratulus cirratus</i>	EGIV	N4
<i>Clymenella koreana</i>	EGI	N3
<i>Clymenura columbiana</i>	EGIII	N3
<i>Corophium</i> sp.	EGIII	N1
<i>Ctenotrypauchen microcephalus</i>	NA	NA

<i>Cumacea</i> unid.	EGI	N1
<i>Diopatra bilobata</i>	EGII	N1
<i>Dorvillea matsushimaensis</i>	EGV	N4
<i>Dorvillea</i> sp.	NA	N2
<i>Drilonereis</i> sp.	EGII	N1
<i>Echinoidea</i> unid.	EGI	N1
<i>Eocylichna braunsi</i>	EGII	N1
<i>Eteone longa</i>	EGIII	N2
<i>Euchone alicaudata</i>	EGII	N1
<i>Euchone</i> sp.	EGII	N1
<i>Eucrate crenata</i>	EGII	N2
<i>Eulimidae</i> indet.	EGI	N1
<i>Eumida sanguinea</i>	EGII	N2
<i>Eunice</i> sp.	EGII	N1
<i>Gastropoda</i> unid.	NA	NA
<i>Glossaulax didyma didyma</i>	EGI	N1
<i>Glycera chirori</i>	EGII	N1
<i>Glycera decipiens</i>	EGII	N1
<i>Glycera onomichiensis</i>	EGII	N1
<i>Glycinde</i> sp.	EGII	N2
<i>Goniada japonica</i>	EGII	N2
<i>Guernea</i> sp.	EGIII	N1
<i>Haminoeidae</i> indet.	EGII	N1
<i>Harmothoe imbricata</i>	EGII	N1
<i>Harmothoe praeclara</i>	EGII	N1
<i>Haustorioides koreanus</i>	EGI	N1
<i>Hawaiarca</i> sp.	EGI	N1
<i>Heteromastus filiformis</i>	EGIII	N3
<i>Heteromastus</i> sp.	EGIII	N3

<i>Heterospio</i> sp.	EGII	N3
<i>Holothuroidea</i> unid.	EGI	NA
<i>Iphimedia mala</i>	EGI	N1
Isopoda unid.	NA	NA
<i>Lagis bocki</i>	EGI	N3
<i>Langerhansia japonica</i>	EGII	NA
<i>Laonice cirrata</i>	EGII	N2
<i>Laternula (Laternula) anatina</i>	EGI	N1
<i>Latreutes planirostris</i>	EGI	N1
<i>Leptochela gracilis</i>	EGIII	N1
<i>Limaria (Limaria) orientalis</i>	EGI	N1
<i>Lumbrineris heteropoda</i>	EGII	N3
<i>Lumbrineris japonica</i>	EGII	N3
<i>Lumbrineris longifolia</i>	EGII	N4
<i>Lygdamis giardi</i>	EGI	N1
<i>Mactrotoma depressa</i>	EGII	N1
<i>Magelona japonica</i>	EGI	N2
<i>Mediomastus californiensis</i>	EGIII	N3
<i>Megangulus venulosus</i>	EGI	N1
<i>Melinna cristata</i>	EGII	N2
<i>Melinna</i> sp.	EGIII	N2
<i>Melita</i> sp.	EGI	N1
<i>Micropodarke dubia</i>	EGIV	N4
<i>Mitrella bicincta</i>	EGI	N1
<i>Moerella jodoensis</i>	EGI	N2
<i>Moerella rutila</i>	EGI	N2
<i>Musculista senhousia</i>	EGIII	N1
<i>Myriochele</i> sp.	EGIII	NA

<i>Mytilidae</i> indet.	EGI	N1
<i>Mytilus galloprovincialis</i>	EGIII	N1
Nemertea	EGIII	N2
<i>Nephtys polybranchia</i>	EGII	N1
<i>Nereis longior</i>	EGIII	N1
<i>Nicomache minor</i>	EGII	NA
<i>Nipponarca bistrigata</i>	EGII	N1
<i>Notomastus latericeus</i>	EGIII	N3
<i>Notomastus</i> sp.	NA	N3
Nudibranchia	NA	NA
<i>Oncoscolex</i> sp.	EGIII	N3
<i>Ophiodromus pugettensis</i>	EGIII	N2
<i>Ophiodromus</i> sp.	EGII	N2
<i>Owenia fusiforme</i>	EGII	N2
<i>Paralacydonia paradoxa</i>	EGII	N3
<i>Paraprionospio</i> sp.	EGIV	N4
<i>Parthenope valida</i>	NA	N2
<i>Phacosoma abyssicolum</i>	EGI	N1
<i>Pherusa parmata</i>	EGI	N2
<i>Pherusa plumosa</i>	EGIII	N2
<i>Philyra kanekoi</i>	EGII	N2
<i>Phyllodoce</i> sp.	EGII	N1
<i>Phyllophorus ordinatus</i>	NA	N2
<i>Phylo felix asiaticus</i>	EGI	N3
<i>Pista</i> sp.	NA	N2
<i>Platyhelminthes</i> unid.	EGII	NA
<i>Poecilochaetus johnsoni</i>	EGII	N2
<i>Polydora</i> sp.	EGIV	N4
<i>Polynoidae</i> indet.	NA	N1

<i>Praxillella affinis</i>	EGIII	N3
<i>Prionospio krusadensis</i>	EGIV	N4
<i>Prionospio pinnata</i>	EGIV	N4
<i>Prionospio</i> sp.	EGIV	N4
<i>Pugettia quadridens</i>	EGI	N1
Pyuridae	NA	N1
<i>Raetella pulchella</i>	EGIV	N4
<i>Ruditapes philippinarum</i>	EGIII	N1
Sepiolidae	NA	NA
Sigalionidae indet.	NA	NA
<i>Sigambra tentaculata</i>	EGIV	N4
<i>Sternaspis scutata</i>	EGIII	N3
<i>Streblosoma</i> sp.	EGI	N2
<i>Syllis</i> sp.	EGII	NA
<i>Synchelidium miraculum</i>	EGI	N1
Tanaidacea unid.	EGII	NA
Tellinidae	EGI	N2
<i>Temnopleurus toreumaticus</i>	EGI	N2
<i>Terebella ehrenbergi</i>	EGI	N2
<i>Terebella punctata</i>	EGII	N2
<i>Terebellides</i> sp.	EGI	N2
<i>Tharyx</i> sp.	EGIII	N2
<i>Thelepus</i> sp.	EGII	N2
<i>Theora fragilis</i>	EGIV	N4
<i>Tritodynamia rathbuni</i>	EGII	N2
Unglulinidae indet.	NA	N1
<i>Volachlamys hirasei</i>	EGI	N1
<i>Xenophthalmus pinnotheroides</i>	EGI	N1

Zoanthidea indet.	EGI	N1
-------------------	-----	----

Note: EGI: disturbance-sensitive species; EGII: disturbance-indifferent species; EGIII: disturbance-tolerant species; EGIV: second-order opportunistic species; EGV: first-order opportunistic species; N1: filter feeders or large carnivores; N2: surface deposit feeders or small carnivores; N3: subterranean deposit feeders; N4: opportunistic species; NA: not assigned.

TABLE S3 The values of environmental factors at each station

Sampling stations	COD, mg/g	IL, %	As, mg/kg	Cd, mg/kg	Cu, mg/kg	Pb, mg/kg	Zn, mg/kg
A1spr	4.64	2.85	0.52	0.77	9.74	21.98	50.91
A2spr	5.58	1.69	0.60	0.68	12.00	13.54	47.71
A3spr	9.77	4.84	0.51	0.58	9.38	27.41	50.10
A4spr	2.58	4.17	0.42	0.83	6.49	25.10	38.47
A5spr	4.75	4.52	0.22	0.72	7.44	19.44	29.65
A6spr	8.45	4.36	0.30	0.79	11.25	25.24	25.90
A7spr	5.62	4.85	0.35	0.98	12.63	29.04	50.59
A8spr	5.39	1.85	0.20	0.68	11.58	15.15	54.32
A9spr	7.08	7.63	0.28	0.63	11.47	24.50	65.07
A10spr	9.02	1.85	0.22	0.62	9.80	17.45	50.60
A1sum	3.88	3.84	0.40	0.73	8.87	22.74	45.54
A2sum	3.47	1.88	0.37	0.70	6.08	20.27	41.71
A3sum	3.26	3.82	0.34	0.68	6.94	22.46	37.72
A4sum	3.40	3.14	0.42	0.65	5.88	23.29	39.50
A5sum	3.83	3.5	0.36	0.75	5.01	20.62	39.22
A6sum	4.04	4.57	0.36	0.71	9.06	24.81	46.15
A7sum	4.62	3.84	0.46	0.76	11.51	24.03	43.55
A8sum	5.53	2.81	0.38	0.73	12.70	28.17	53.86
A9sum	3.92	3.58	0.36	0.64	6.65	23.35	38.67
A10sum	3.26	2.89	0.37	0.68	7.37	19.51	38.80
D1spr	31.65	38	0.50	3.30	22.40	53.90	84.90
D2spr	29.06	37.5	0.40	3.00	20.60	53.90	67.90
D3spr	36.46	32.7	0.40	2.90	20.70	56.30	74.00
D4spr	40.41	34.5	0.40	3.10	16.20	50.70	74.30
D5spr	56.45	21.7	0.50	3.10	15.20	52.20	79.50
D6spr	40.39	27.5	0.50	2.90	15.70	54.00	78.40
D1sum	30.08	31.6	0.60	1.40	22.50	41.80	78.80
D2sum	28.36	37.6	0.50	2.20	14.70	60.00	78.80
D3sum	38.50	34	0.70	2.20	15.50	35.80	77.00
D4sum	43.22	31.6	0.50	2.20	14.50	55.20	74.20
D5sum	58.47	25.5	0.30	2.20	14.10	44.10	73.00
D6sum	39.74	26.2	0.40	2.20	13.90	42.80	72.40

Note: COD, chemical oxygen demand; IL, ignition loss.

TABLE S4 The eigenvectors of environmental factors with PC1 and PC2.

Variable	PC1	PC2
COD	0.409	-0.144
IL	0.412	-0.086
As	0.218	0.966
Cd	0.406	-0.141
Cu	0.375	-0.067
Pb	0.400	-0.113
Zn	0.387	0.029

Note: COD, chemical oxygen demand; IL, ignition loss.

TABLE S5 The values of number of species, abundance of species, and species indices at each station

Sampling stations	Number of species	Abundance of species	Species richness index	Pielou's evenness index	Shannon-wiener index
A1spr	39	3925	4.59	0.43	2.29
A2spr	27	2290	3.36	0.48	2.26
A3spr	33	42185	3.83	0.48	2.42
A4spr	18	805	2.54	0.70	2.94
A5spr	11	2055	1.31	0.23	0.80
A6spr	8	2470	0.90	0.16	0.47
A7spr	23	1185	3.11	0.67	3.04
A8spr	10	350	1.54	0.59	1.97
A9spr	29	905	4.11	0.86	4.16
A10spr	15	470	2.28	0.83	3.23
A1sum	23	3950	2.66	0.56	2.52
A2sum	30	3175	3.60	0.76	3.74
A3sum	23	1180	3.11	0.86	3.91
A4sum	24	4835	2.71	0.52	2.38
A5sum	14	785	1.95	0.79	3.01
A6sum	31	5160	3.51	0.50	2.50
A7sum	23	3735	2.68	0.63	2.86
A8sum	18	1420	2.34	0.78	3.27
A9sum	18	480	2.75	0.94	3.91
A10sum	12	1055	1.58	0.77	2.75
D1spr	19	530	2.87	0.61	2.59
D2spr	36	1065	5.02	0.67	3.47
D3spr	9	175	1.55	0.70	2.21
D4spr	6	30	1.47	1.00	2.59
D5spr	13	300	2.10	0.82	3.05
D6spr	3	35	0.56	0.72	1.15
D1sum	3	20	0.67	0.95	1.50
D2sum	4	45	0.79	0.83	1.66
D3sum	4	25	0.93	0.96	1.92
D4sum	4	95	0.66	0.89	1.79
D5sum	9	465	1.30	0.60	1.92
D6sum	5	60	0.98	0.68	1.59

TABLE S6 The values of heavy metal indices and level of ecological risk at each station

Sampling stations	Pollution load index	Level of ecological risk	Nemerow pollution index	Level of ecological risk
A1spr	0.70	Unpolluted	7.50	Heavy pollution
A2spr	0.65	Unpolluted	5.73	Heavy pollution
A3spr	0.68	Unpolluted	4.32	Heavy pollution
A4spr	0.61	Unpolluted	8.49	Heavy pollution
A5spr	0.48	Unpolluted	6.51	Heavy pollution
A6spr	0.58	Unpolluted	7.79	Heavy pollution
A7spr	0.75	Unpolluted	12.01	Heavy pollution
A8spr	0.55	Unpolluted	5.77	Heavy pollution
A9spr	0.66	Unpolluted	5.06	Heavy pollution
A10spr	0.54	Unpolluted	4.88	Heavy pollution
A1sum	0.63	Unpolluted	6.69	Heavy pollution
A2sum	0.55	Unpolluted	6.04	Heavy pollution
A3sum	0.55	Unpolluted	5.73	Heavy pollution
A4sum	0.56	Unpolluted	5.32	Heavy pollution
A5sum	0.53	Unpolluted	7.00	Heavy pollution
A6sum	0.63	Unpolluted	6.42	Heavy pollution
A7sum	0.69	Unpolluted	7.29	Heavy pollution
A8sum	0.73	Unpolluted	6.68	Heavy pollution
A9sum	0.56	Unpolluted	5.20	Heavy pollution
A10sum	0.56	Unpolluted	5.72	Heavy pollution
D1spr	1.45	Moderately polluted	134.17	Heavy pollution
D2spr	1.28	Moderately polluted	110.91	Heavy pollution
D3spr	1.31	Moderately polluted	103.79	Heavy pollution
D4spr	1.24	Moderately polluted	118.21	Heavy pollution
D5spr	1.30	Moderately polluted	118.25	Heavy pollution
D6spr	1.30	Moderately polluted	103.64	Heavy pollution
D1sum	1.19	Moderately polluted	24.66	Heavy pollution
D2sum	1.24	Moderately polluted	60.05	Heavy pollution
D3sum	1.20	Moderately polluted	59.75	Heavy pollution
D4sum	1.20	Moderately polluted	59.96	Heavy pollution
D5sum	1.03	Moderately polluted	59.79	Heavy pollution
D6sum	1.08	Moderately polluted	59.77	Heavy pollution

TABLE S7 The values of benthic indices and EcoQs at each station

Sampling stations	AMBI	EcoQs	MAMBI	EcoQs	BPI	EcoQs
A1spr	0.54	High	0.79	High	87.9	High
A2spr	0.87	High	0.67	Good	79.2	High
A3spr	0.55	High	0.75	Good	78.6	High
A4spr	1.91	Good	0.58	Good	52.3	Good
A5spr	2.87	Good	0.33	Poor	37.5	Moderate
A6spr	3.00	Good	0.27	Poor	34.4	Moderate
A7spr	0.65	High	0.70	Good	73.7	High
A8spr	2.93	Good	0.39	Moderate	36.3	Moderate
A9spr	1.51	Good	0.77	Good	62.2	High
A10spr	2.32	Good	0.55	Good	58.9	Good
A1sum	0.54	High	0.67	Good	90.9	High
A2sum	1.13	High	0.77	High	87.0	High
A3sum	1.40	Good	0.71	Good	81.9	High
A4sum	0.47	High	0.68	Good	92.1	High
A5sum	2.66	Good	0.51	Moderate	41.1	Good
A6sum	0.57	High	0.74	Good	91.8	High
A7sum	1.79	Good	0.62	Good	76.6	High
A8sum	3.34	Moderate	0.51	Moderate	35.1	Moderate
A9sum	2.00	Good	0.64	Good	62.5	High
A10sum	3.31	Moderate	0.43	Moderate	27.7	Poor
D1spr	1.96	Good	0.70	Good	14.8	Bad
D2spr	1.82	Good	0.91	High	34.3	Moderate
D3spr	1.89	Good	0.59	Good	20.6	Poor
D4spr	2.75	Good	0.55	Good	55.6	Good
D5spr	2.63	Good	0.65	Good	18.6	Bad
D6spr	6.00	Bad	0	Bad	0	Bad
D1sum	6.00	Bad	0	Bad	0	Bad
D2sum	2.50	Good	0.46	Moderate	11.1	Bad
D3sum	2.40	Good	0.49	Moderate	26.7	Poor
D4sum	2.37	Good	0.48	Moderate	26.3	Poor
D5sum	1.81	Good	0.57	Good	16.1	Bad
D6sum	1.75	Good	0.51	Moderate	19.4	Bad