Supplementary Material

Table S1. Ecological risk values of metals in sediment and corresponding criteria.

Geo-accumulation index (I_{geo})		Concentration factor (CF)		Pollution load index (PLI)		Potential ecological risk index (RI)	
≤ 0	Unpolluted	CF < 1	Low degree	0 < PLI ≤ 1	Unpolluted	RI < 65	Low risk
$0 < I_{geo} \leq 1$	Unpolluted to moderately polluted	1 ≤ CF < 3	Moderate degree	1 < PLI ≤ 2	Slightly polluted	65 ≤ RI < 130	Moderate risk
$1 < I_{geo} \leq 2$	Moderately polluted	3 ≤ CF < 6	Considerable degree	2 < PLI ≤ 3	Moderately polluted	130 ≤ RI < 260	Considerable risk
$2 < I_{geo} \leq 3$	Moderately to strongly polluted	CF ≥ 6	High degree	3 < PLI ≤ 4	Moderately to highly polluted	RI ≥ 260	Very high risk
$3 < I_{geo} \leq 4$	Strongly polluted			4 < PLI ≤ 5	Highly polluted		
$4 < I_{geo} \leq 5$	Strongly to extremely polluted			PLI > 5	Extremely polluted		
$I_{geo} > 5$	Extremely polluted						

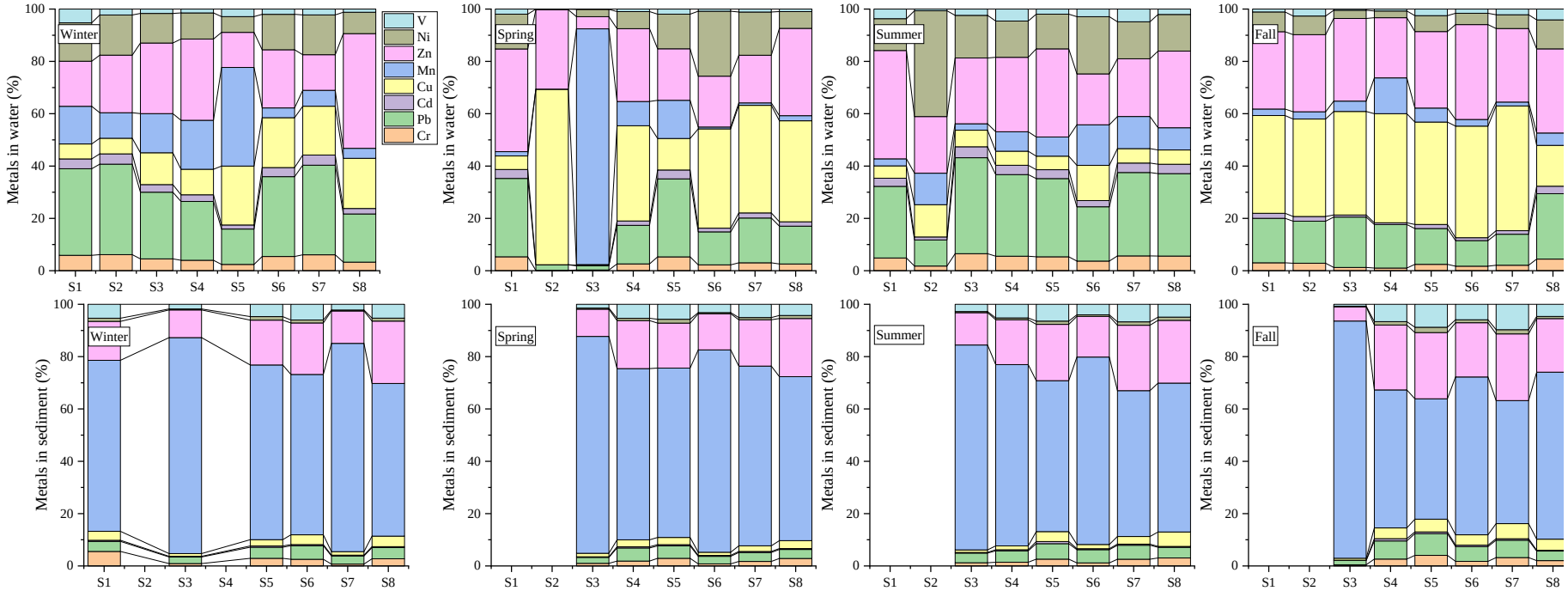

Figure S1. Spatial distribution of eight metals in water and sediment samples collected in Yeongrang Lake.

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Table S2. Pearson correlation coefficients between 10 metals in water and sediment samples .

	Sediment	Cr	Pb	Cd	Cu	Mn	Zn	Ni	V	Al	Fe
Water	Cr	-	-	-	-	-	-	-	-	-	-
	Pb	0.160	0.034	0.019	0.122	0.033	0.323	0.207	0.095	0.033	-0.009
	Cd	-	-	-	-	-	-	-	-	-	-
	Cu	0.166	0.028	0.009	0.124	0.023	0.319	0.209	0.092	0.027	-0.017
	Mn	-0.114	-0.236	-0.183	-0.174	-0.184	-0.259	-0.187	-0.175	-0.161	-0.193
	Zn	0.150	0.010	-0.003	0.111	0.010	0.301	0.194	0.076	0.012	-0.029
	Ni	-0.225	-0.354	-0.339	-0.203	-0.347	-0.375	-0.287	-0.218	-0.318	-0.343
	V	0.601**	0.487*	0.332	0.442*	0.450*	0.307	0.525**	0.498*	0.469*	0.239
	Al	0.519**	0.054	0.070	0.129	0.152	0.101	0.186	0.125	0.156	0.016
	Fe	-0.057	-0.230	-0.173	-0.159	-0.173	-0.252	-0.160	-0.158	-0.145	-0.189
	Water	Cr	Pb	Cd	Cu	Mn	Zn	Ni	V	Al	Fe
Water	Cr	-									
	Pb	-	1								
	Cd	-	-	-							
	Cu	-	0.774**	-	1						
	Mn	-	-0.040	-	-0.050	1					
	Zn	-	0.779**	-	0.998**	-0.013	1				
	Ni	-	-0.102	-	-0.062	0.266	-0.046	1			
	V	-	-0.108	-	-0.112	-0.107	-0.121	-0.205	1		
	Al	-	0.295	-	0.174	0.438*	0.188	0.103	0.160	1	
	Fe	-	0.015	-	-0.055	0.987**	-0.018	0.247	-0.076	0.514**	1
	Sediment	Cr	Pb	Cd	Cu	Mn	Zn	Ni	V	Al	Fe
Sediment	Cr	1									
	Pb	0.677**	1								
	Cd	0.613**	0.937**	1							
	Cu	0.777**	0.809**	0.710**	1						
	Mn	0.231	0.406*	0.275	0.228	1					
	Zn	0.696**	0.854**	0.773**	0.909**	0.353	1				
	Ni	0.854**	0.850**	0.781**	0.918**	0.239	0.856**	1			
	V	0.810**	0.884**	0.844**	0.893**	0.114	0.842**	0.942**	1		
	Al	0.741**	0.928**	0.923**	0.780**	0.310	0.785**	0.887**	0.924**	1	
	Fe	0.535**	0.868**	0.951**	0.622**	0.230	0.706**	0.687**	0.777**	0.899**	1

*: p-value < 0.01; **: p-value < 0.05.

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Table S3. The distribution of 10 metals in fish samples collected at eight sampling sites in Yeongrang Lake across four seasons.

Metals	Concentration (mg/kg)	Winter	Spring	Summer	Fall
Cr	Sample size (n)	14	10	12	13
	Detection number[a)]	14	8	12	12
	Average (SD)	1.77 (1.79)	0.187 (0.106)	0.304 (0.081)	0.215 (0.081)
	Range	0.550–6.04	<MDL –0.308	0.180–0.413	<MDL–0.345
Pb	Detection number[a)]	14	-	-	3
	Average (SD)	0.0940 (0.0796)	<MDL	<MDL	0.164 (0.395)
	Range	0.0277–0.282	-	-	<MDL–1.12
Cd	Detection number[a)]	14	-	-	-
	Average (SD)	0.0182 (0.0167)	<MDL	<MDL	<MDL
	Range	0.00324–0.0524	-	-	-
Cu	Detection number[a)]	4	10	12	13
	Average (SD)	1.11 (2.34)	1.35 (0.49)	3.00 (0.55)	2.97 (0.66)
	Range	<MDL–7.35	0.685–2.09	2.25–4.15	1.59–3.83
Mn	Detection number	14	10	12	13
	Average (SD)	51.2 (71.8)	7.85 (3.87)	12.7 (13.9)	9.40 (5.42)
	Range	6.11–277	2.76–14.3	2.77–47.6	1.38–16.1
Zn	Detection number	14	10	12	13
	Average (SD)	55.7 (47.5)	30.1 (8.0)	32.0 (14.0)	36.9 (19.6)
	Range	17.7–193	17.1–43.0	20.2–74.1	22.1–84.9
Ni	Detection number	14	-	-	-
	Average (SD)	0.751 (0.703)	<MDL	<MDL	<MDL
	Range	0.211–2.27	-	-	-
V	Detection number	14	9	12	13
	Average (SD)	4.43 (7.52)	0.137 (0.146)	0.230 (0.174)	0.133 (0.075)
	Range	0.224–26.3	<MDL –0.523	0.0800–0.553	<MDL–0.290
Al	Detection number	4	10	12	13
	Average (SD)	84.7 (166.8)	28.4 (42.7)	38.8 (48.6)	20.7 (14.0)
	Range	<MDL–552	3.53–144	7.07–153	5.15–60.2
Fe	Detection number	14	10	12	13
	Average (SD)	19.3 (17.6)	34.1 (44.3)	85.3 (123)	35.4 (18.0)
	Range	7.40–59.1	3.45–157	16.6–434	13.1–71.6

[a)] Detection number: This is the number of samples greater than the method detection limit.

Table S4. Pearson correlation coefficients between 10 metals in water and fish samples. (*: p-value < 0.01; **: p-value < 0.05)

Fish		Water										
		Cr	**Pb**	**Cd**	**Cu**	**Mn**	**Zn**	**Ni**	**V**	**Al**	**Fe**	**Sum**
Benthic fish	Cr	-	-0.125	-	-0.135	0.465*	-0.127	-0.026	0.107	0.300	0.456*	0.383
	Pb	-	0.218	-	0.221	0.022	0.228	0.319	-0.124	-0.312	-0.035	0.046
	Cd	-	0.183	-	0.183	-0.069	0.185	0.241	-0.096	-0.320	-0.109	-0.040
	Cu	-	-0.113	-	-0.110	-0.224	-0.117	0.115	-0.204	-0.495*	-0.239	-0.286
	Mn	-	-0.100	-	-0.107	0.177	-0.102	-0.069	-0.049	0.071	0.224	0.162
	Zn	-	-0.085	-	-0.096	0.366	-0.090	-0.001	0.304	0.007	0.346	0.284
	Ni	-	-0.127	-	-0.137	0.450*	-0.131	-0.037	0.150	0.257	0.439*	0.365
	V	-	-0.098	-	-0.106	0.278	-0.106	-0.043	0.095	0.254	0.264	0.217
	Al	-	-0.031	-	-0.020	-0.124	-0.018	0.660**	-0.187	-0.278	-0.155	-0.155
	Fe	-	-0.121	-	-0.110	0.137	-0.110	0.550**	-0.102	-0.092	0.106	0.059
	Sum	-	-0.157	-	-0.161	0.314	-0.155	0.272	0.031	-0.025	0.317	0.230
Floating fish	Cr	-	-0.052	-	-0.059	-0.080	-0.055	-0.066	-0.330	-0.295	-0.025	-0.069
	Pb	-	-0.020	-	0.017	-0.029	0.024	-0.037	0.453*	-0.029	-0.074	-0.056
	Cd	-	0.055	-	0.064	0.046	0.060	0.102	0.182	0.105	-0.038	0.006
	Cu	-	0.080	-	0.101	-0.188	0.095	0.225	0.185	-0.322	-0.251	-0.199
	Mn	-	0.055	-	0.054	-0.141	0.040	-0.018	-0.001	0.032	-0.134	-0.102
	Zn	-	-0.127	-	-0.113	-0.068	-0.102	-0.130	-0.044	-0.290	-0.084	-0.133
	Ni	-	-0.049	-	-0.057	-0.039	-0.051	-0.090	-0.161	-0.065	0.054	0.013
	V	-	0.164	-	0.153	-0.030	0.146	0.003	-0.321	-0.015	0.031	0.077
	Al	-	-0.038	-	-0.044	-0.034	-0.059	-0.062	0.258	0.379	-0.007	-0.007
	Fe	-	-0.024	-	-0.031	-0.068	-0.044	-0.031	0.016	0.167	-0.058	-0.058
	Sum	-	-0.038	-	-0.043	-0.076	-0.056	-0.055	0.087	0.190	-0.063	-0.066
Total	Cr	-	-0.111	-	-0.043	-0.052	-0.057	-0.112	-0.280	-0.066	-0.073	-0.086
	Pb	-	-0.059	-	-0.235	-0.271	-0.235	0.047	0.232	-0.422*	-0.289	-0.372*
	Cd	-	-0.123	-	-0.294	-0.300	-0.299	-0.008	0.158	-0.490**	-0.307	-0.417*
	Cu	-	0.037	-	-0.129	-0.171	-0.130	0.114	0.074	-0.248	-0.156	-0.203
	Mn	-	-0.136	-	-0.091	-0.063	-0.098	-0.117	-0.155	-0.144	-0.036	-0.080
	Zn	-	-0.131	-	-0.133	-0.096	-0.144	-0.115	-0.215	-0.081	-0.107	-0.153
	Ni	-	-0.128	-	-0.077	-0.078	-0.091	-0.128	-0.299	-0.107	-0.100	-0.127
	V	-	-0.093	-	-0.051	-0.068	-0.068	-0.100	-0.231	-0.104	-0.090	-0.108
	Al	-	-0.109	-	-0.071	-0.104	-0.079	-0.016	0.188	-0.215	-0.126	-0.153
	Fe	-	-0.110	-	-0.059	-0.088	-0.064	-0.065	0.285	-0.171	-0.107	-0.129
	Sum	-	-0.186	-	-0.128	-0.135	-0.139	-0.121	0.096	-0.245	-0.146	-0.197

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Table S5. Pearson correlation coefficients between 10 metals in sediment and fish samples. (*: *p*-value < 0.01; **: *p*-value < 0.05)

Fish		Sediment										
		Cr	**Pb**	**Cd**	**Cu**	**Mn**	**Zn**	**Ni**	**V**	**Al**	**Fe**	**Sum**
Benthic fish	Cr	-0.015	0.259	0.230	0.132	0.400	0.165	0.118	0.125	0.244	0.127	0.186
	Pb	-0.265	-0.148	-0.142	-0.106	-0.424	-0.118	-0.205	-0.100	-0.162	-0.007	-0.081
	Cd	-0.264	-0.038	-0.046	-0.080	-0.145	-0.032	-0.177	-0.091	-0.078	0.061	-0.003
	Cu	-0.281	-0.168	-0.166	-0.220	-0.165	-0.185	-0.314	-0.250	-0.213	-0.023	-0.112
	Mn	-0.045	-0.026	-0.010	-0.148	0.336	-0.072	-0.118	-0.166	-0.035	-0.053	-0.043
	Zn	0.111	0.431	0.382	0.381	0.387	0.322	0.404	0.402	0.470*	0.255	0.361
	Ni	0.010	0.293	0.257	0.167	0.424	0.193	0.165	0.170	0.285	0.145	0.215
	V	-0.041	0.269	0.243	0.111	0.424	0.175	0.086	0.110	0.235	0.158	0.200
	Al	-0.310	-0.297	-0.314	-0.301	-0.460*	-0.376	-0.357	-0.250	-0.318	-0.220	-0.273
	Fe	-0.292	-0.085	-0.154	-0.220	-0.169	-0.256	-0.269	-0.166	-0.141	-0.105	-0.125
	Sum	-0.150	0.098	0.059	-0.061	0.263	-0.059	-0.064	-0.036	0.083	0.007	0.044
Floating fish	Cr	-0.215	-0.285	-0.207	-0.201	-0.066	-0.202	-0.151	-0.259	-0.213	-0.203	-0.213
	Pb	0.083	0.157	0.096	0.201	-0.046	0.156	0.101	0.198	0.102	0.098	0.102
	Cd	0.078	0.160	0.095	0.198	-0.031	0.160	0.092	0.194	0.101	0.097	0.101
	Cu	-0.202	-0.039	-0.126	0.044	-0.148	0.015	-0.114	-0.044	-0.217	-0.129	-0.173
	Mn	-0.060	-0.213	-0.178	-0.247	0.015	-0.196	-0.190	-0.183	-0.145	-0.180	-0.169
	Zn	-0.009	0.309	0.307	0.321	-0.065	0.321	0.178	0.202	0.120	0.214	0.177
	Ni	-0.047	-0.162	-0.084	-0.168	-0.053	-0.164	-0.040	-0.153	-0.087	-0.085	-0.089
	V	-0.084	-0.329	-0.270	-0.263	-0.143	-0.186	-0.177	-0.258	-0.243	-0.251	-0.255
	Al	0.375	0.060	0.081	0.034	0.063	-0.016	0.107	0.156	0.157	0.065	0.108
	Fe	0.045	-0.168	-0.097	-0.169	-0.054	-0.172	-0.141	-0.082	-0.091	-0.092	-0.094
	Sum	0.138	-0.074	-0.019	-0.083	-0.023	-0.097	-0.055	0.002	-0.011	-0.031	-0.024
Total	Cr	0.063	0.028	-0.052	0.077	-0.056	0.117	0.118	0.081	0.032	-0.079	-0.031
	Pb	-0.166	0.052	0.025	0.040	-0.158	-0.044	-0.090	-0.003	-0.101	0.080	-0.001
	Cd	-0.132	0.081	0.027	0.077	-0.105	0.026	-0.049	0.018	-0.071	0.069	0.007
	Cu	-0.237	-0.082	-0.152	-0.204	-0.024	-0.190	-0.269	-0.232	-0.177	-0.057	-0.113
	Mn	-0.022	-0.027	-0.045	-0.089	0.117	-0.032	-0.006	-0.085	-0.001	-0.070	-0.039
	Zn	0.072	0.088	0.015	0.069	-0.006	0.056	0.084	0.101	0.079	0.009	0.041
	Ni	0.027	0.014	-0.053	0.056	-0.042	0.094	0.088	0.062	0.023	-0.075	-0.033
	V	0.075	0.060	-0.032	0.140	-0.082	0.182	0.134	0.126	0.039	-0.052	-0.013
	Al	-0.119	-0.172	-0.231	-0.135	-0.327	-0.238	-0.110	-0.135	-0.198	-0.208	-0.212
	Fe	-0.045	-0.046	-0.144	-0.074	-0.298	-0.164	0.008	-0.024	-0.104	-0.161	-0.143
	Sum	-0.049	-0.061	-0.166	-0.094	-0.227	-0.154	-0.003	-0.055	-0.097	-0.181	-0.150