Table S1. Longitude and latitude of the sampling sites.

Sampling sites	corresponding water body	Longitude	Latitude
1	Qingfengling Reservoir	118º 50' 15.36"	35º 49' 7.61"
2	Qingfengling Reservoir	118º 49' 37.56"	35º 50' 51.25"
3	Qingfengling Reservoir	118º 46' 50.16"	35º 53' 24.86"
4	Qingfengling Reservoir	118º 52' 12.36"	35º 48' 5.87"
5	Rizhao Reservoir	119º 19' 32.16"	35º 26' 41.53"
6	Rizhao Reservoir	119º 18' 51.84"	35º 27' 31.25"
7	Rizhao Reservoir	119º 16' 3.72"	35º 28' 12.90"
8	Rizhao Reservoir	119º 11' 45.96"	35º 29' 14.64"
9	Futuan River	119º 16' 14.52"	35º 36' 55.69"
10	Futuan River	119º 16' 34.32"	35º 31' 30.94"
11	Futuan River	119º 20' 20.4"	35.26' 49.99"
12	Futuan River	119º 22' 35.4"	35º 24' 30.64"
13	Futuan River	119º 23' 34.08"	35º 22' 38.78"
14	Futuan River	119º 26' 21.12"	35º 21' 5.15"
15	Wei River	118º 57' 41.04"	35º 59' 38.22"
16	Wei River	118º 59' 15.36"	35º 56' 54.46"
17	Wei River	119º 00' 6.84"	35º 53' 26.81"
18	Wei River	119º 03' 53.28"	35º 53' 08.02"
19	Chaobai River	119º 27' 5.76"	35º 47' 38.58"
20	Chaobai River	119º 25' 30"	35º 44' 55.68"
21	Chaobai River	119º 25' 30"	35º 41' 33.36"
22	Chaobai River	119º 29' 38.4"	35º 38' 25.12"
23	Chaobai River	119º 36' 46.8"	35º 33' 39.38"
24	Xiuzhen Rive	119º 08' 55.32"	35º 11' 21.41"
25	Xiuzhen Rive	119º 10' 50.16"	35º 09' 23.65"
26	Xiuzhen Rive	119º 12' 38.16"	35º 08' 48.41"
27	Xiuzhen Rive	119º 15' 5.76"	35º 07' 31.55"

Table S2. Heavy metal concentrations (mg/kg) in fish from different rivers and reservoirs.

Sites	Habitat	Species	tissue	Cr	Ni	Cu	As	Pb
Xiuzhen River	Pelagic	*Hemiculter leucisculus*	Muscle	0.86±0.02	0.62±0.04	0.50±0.10	0.07±0.02	0.21±0.26
			Viscus	0.97±0.02	0.83±0.08	1.60±1.01	0.14±0.09	0.83±0.83
			Gill	0.97±0.55	0.68±0.38	0.28±0.04	0.05±0.04	0.06±0.02
		Pseudorasbora parva	Muscle	0.84±0.15	0.63±0.11	0.45±0.04	0.15±0.06	0.03±0.02
			Viscus	2.91±0.17	2.18±0.08	2.51±1.29	0.21±0.03	0.96±0.71
			Gill	8.56±1.94	6.39±0.98	2.96±2.67	1.61±0.93	0.53±0.36
		Rhodeus sinensis	Muscle	0.69	0.51	0.19	0.11	0.04
			Viscus	16.29	12.12	6.31	1.32	1.41
			Gill	6.85	6.46	8.38	1.67	6.20
		Aristichthys nobilis	Muscle	0.84	0.63	0.29	0.15	0.03
			Viscus	0.56	0.42	0.32	0.05	0.08
			Gill	6.72	6.70	13.05	1.47	6.68
		Chanodichthys erythropterus	Muscle	0.72	0.52	0.25	0.05	0.04
			Viscus	0.55	0.39	1.35	0.07	0.23
			Gill	0.47	0.32	0.36	0.04	0.18
	Demersal	*Carassius auratus*	Muscle	1.02	0.74	0.73	0.17	0.09
			Viscus	0.41	0.30	0.29	0.09	0.36
			Gill	1.20	1.17	2.22	0.30	2.04
		Tachysurus fulvidraco	Muscle	0.76	0.51	0.27	0.03	0.06
			Viscus	0.61	0.43	0.47	0.03	0.25
			Gill	0.68	0.47	0.78	0.07	0.10
Futuan River	Pelagic	*Rhodeus sinensis*	Muscle	0.86±0.43	0.61±0.33	0.28±0.15	0.22±0.07	0.03±0.03
			Viscus	2.45±1.15	1.73±0.78	2.10±1.22	0.60±0.07	2.27±2.06
			Gill	2.13±2.12	1.42±1.43	0.84±0.71	0.24±0.10	0.20±0.25
		Hemiculter leucisculus	Muscle	0.84±0.10	0.58±0.04	0.39±0.07	0.07±0.03	0.04±0.03
			Viscus	0.79±0.26	0.55±0.16	1.74±0.41	0.16±0.05	0.21±0.02

			Gill	0.64±0.41	0.40±0.26	0.45±0.18	0.05±0.05	0.04±0.01
			Muscle	0.74±0.28	0.53±0.19	0.42±0.08	0.07±0.04	0.03±0.02
		Opsariichthys bidens	Viscus	0.75±0.17	0.51±0.14	1.35±0.12	0.08±0.01	0.05±0.03
			Gill	0.61±0.33	0.42±0.26	0.37±0.21	0.05±0.05	0.03±0.01
			Muscle	4.14±5.13	1.59±1.37	0.51±0.68	0.14±0.03	0.04±0.03
		Pseudorasbora parva	Viscus	13.32±12.84	9.09±8.49	2.07±0.94	0.22±0.13	0.95±0.78
			Gill	20.97±17.31	14.53±12.21	1.16±1.14	0.03±0.03	2.54±4.36
			Muscle	0.78±0.04	0.61±0.05	0.33±0.05	0.11±0.08	0.02±0.00
		Carassius auratus	Viscus	2.40±1.54	1.52±1.10	2.50±1.36	0.53±0.50	1.27±0.71
			Gill	0.91±0.20	0.67±0.05	0.84±0.28	0.14±0.07	0.14±0.13
			Muscle	1.98±1.27	1.33±0.88	0.54±0.10	0.04±0.01	0.06±0.06
		Tachysurus fulvidraco	Viscus	3.60±4.38	2.35±2.91	1.37±0.44	0.09±0.04	0.26±0.28
			Gill	4.26±5.00	3.01±3.69	0.88±0.40	0.03±0.00	0.20±0.19
			Muscle	0.73±0.31	0.50±0.20	0.27±0.14	0.04±0.01	0.03±0.02
		Squalidus argentatus	Viscus	4.76±4.71	3.15±2.98	3.24±1.48	0.23±0.17	0.69±0.45
			Gill	4.13±4.64	2.64±2.84	0.95±0.62	0.06±0.02	0.19±0.18
	Demersal		Muscle	0.85	0.59	0.26	0.07	0.01
		Sarcocheilichthys nigripinnis	Viscus	6.03	4.00	0.77	0.04	0.13
			Gill	1.48	0.97	1.18	0.12	0.24
			Muscle	2.09	1.51	0.21	0.01	0.03
		Rhinogobius giurinus	Viscus	17.62	12.40	5.10	0.72	1.07
			Gill	15.79	11.42	1.86	0.12	0.14
			Muscle	0.61±0.24	0.40±0.20	0.20±0.13	0.03±0.02	0.02±0.01
		Saurogobio dabryi	Viscus	1.60±0.21	1.10±0.11	2.18±0.52	0.16±0.08	1.43±1.02
			Gill	1.00±0.29	0.63±0.13	0.51±0.04	0.05±0.01	0.07±0.00
			Muscle	0.68±0.12	0.49±0.07	0.35±0.13	0.11±0.09	0.03±0.02
Chaobai River	Pelagic	*Opsariichthys bidens*	Viscus	0.77±0.04	0.54±0.00	1.54±0.23	0.06±0.03	0.02±0.01
			Gill	0.67±0.16	0.46±0.10	0.42±0.10	0.06±0.04	0.02±0.00

		Rhodeus sinensis	Muscle	0.76	0.52	0.26	0.24	0.02
			Viscus	0.60	0.37	0.27	0.10	0.06
			Gill	0.61	0.40	0.34	0.27	0.29
		Pseudorasbora parva	Muscle	0.77±0.01	0.57±0.00	0.44±0.08	0.06±0.04	0.02±0.00
			Viscus	2.86±1.41	1.94±0.67	2.57±3.33	0.15±0.09	0.35±0.34
			Gill	21.92±25.29	13.23±14.85	6.77±7.74	0.34±0.41	0.82±1.06
	Demersal	*Tachysurus fulvidraco*	Muscle	0.77±0.18	0.58±0.12	0.49±0.10	0.02±0.01	0.02±0.00
			Viscus	0.99±0.34	0.86±0.37	1.25＋0.84	0.08±0.23	0.28±0.37
			Gill	1.26±0.84	0.92±0.59	0.58±0.35	0.021±0.01	0.18±0.06
		Carassius auratus	Muscle	0.72±0.03	0.53±0.03	0.71±0.59	0.09±0.06	0.16±0.19
			Viscus	1.12±0.45	0.95±0.46	2.53±2.13	0.38±0.25	0.79±0.01
			Gill	0.78±0.16	0.55±0.01	0.58±0.13	0.10±0.02	0.30±0.34
		Silurus asotus	Muscle	0.83	0.61	0.25	0.02	0.05
			Viscus	0.85	0.55	0.21	0.01	0.10
			Gill	0.65	0.44	0.71	0.02	0.02
		Rhinogobius giurinus	Muscle	0.40	0.29	0.20	0.12	0.02
			Viscus	3.71	2.51	0.64	0.07	0.10
			Gill	4.44	3.15	1.47	0.18	0.45
		Channa argus	Muscle	0.90	0.66	0.51	0.08	0.03
			Viscus	13.86	9.92	3.22	0.31	0.23
			Gill	3.86	2.85	1.56	0.16	0.08
Wei River	Pelagic	*Rhodeus sinensis*	Muscle	1.61±1.50	1.22±1.19	0.57±0.48	0.30±0.16	0.06±0.05
			Viscus	6.50±2.72	5.22±2.39	3.03±0.65	1.36±0.57	1.26±0.31
			Gill	14.15±11.09	10.40±8.27	3.50±2.79	1.55±1.73	0.36±0.22
		Chanodichthys erythropterus	Muscle	0.79±0.08	<0.000	0.50±0.17	0.19±0.09	0.02±0.01
			Viscus	0.74±0.05	<0.000	0.80±0.51	0.28±0.23	0.02±0.01
			Gill	0.79±0.22	<0.000	1.30±1.30	0.18±0.09	0.06±0.06
		Pseudorasbora parva	Muscle	1.04±0.07	0.76±0.04	0.36±0.22	0.14±0.10	0.03±0.02

			Viscus	4.22±0.20	3.17±0.17	3.06±1.18	0.44±0.12	0.28±0.17
			Gill	8.92±2.43	6.29±1.71	3.59±1.18	0.63±0.39	0.21±0.09
	Demersal	*Cyprinus carpio*	Muscle	1.09±0.14	0.80±0.09	0.44±0.24	0.20±0.09	0.03±0.00
			Viscus	1.37±0.04	1.02±0.01	0.94±0.13	0.44±0.04	0.27±0.13
			Gill	0.98±0.13	0.70±0.09	0.30±0.18	0.08±0.04	0.03±0.02
		Rhinogobius giurinus	Muscle	1.84±0.71	1.43±0.42	0.80±0.39	0.25±0.07	0.04±0.02
			Viscus	8.20±2.77	6.08±1.97	2.37±1.48	0.24±0.20	0.20±0.07
			Gill	24.90±15.20	18.42±10.80	2.67±1.22	0.32±0.21	0.58±0.28
		Abbottina rivularis	Muscle	1.14±0.13	0.88±0.11	0.50±0.19	0.11±0.03	0.04±0.04
			Viscus	5.82±4.96	4.45±3.38	1.75±0.72	0.52±0.35	0.28±0.07
			Gill	3.34±1.95	2.49±1.26	1.19±0.18	0.16±0.03	0.20±0.14
		Tachysurus fulvidraco	Muscle	1.46	1.05	0.53	0.07	0.03
			Viscus	1.43	1.19	44.85	0.75	0.20
			Gill	1.02	0.73	0.81	0.05	0.04
		Squalidus argentatus	Muscle	1.14	0.93	0.72	0.07	0.04
			Viscus	5.52	4.07	1.38	0.01	0.02
			Gill	5.13	4.45	2.82	0.46	0.99
Rizhao Reservoir	Pelagic	*Aristichthys nobilis*	Muscle	1.46	1.02	0.15	0.05	0.03
			Viscus	1.20	0.81	0.62	0.12	0.08
			Gill	1.33	1.11	1.31	0.74	0.07
		Pseudorasbora parva	Muscle	0.61±0.09	0.43±0.02	0.23±0.05	0.04±0.01	0.02±0.01
			Viscus	1.84±0.05	1.28±0.17	0.87±0.06	0.05±0.03	0.14±0.02
			Gill	6.96±2.09	3.13±0.39	0.82±0.11	0.04±0.01	0.15±0.12
	Demersal	*Cyprinus carpio*	Muscle	1.15	0.85	0.34	0.02	0.02
			Viscus	0.99	0.76	0.73	0.07	0.05
			Gill	1.37	0.98	5.04	0.06	0.04
Qingfengling Reservoir	Pelagic	*Hemiculter leucisculus*	Muscle	0.50	0.36	0.28	0.01	0.01
			Viscus	1.08	0.78	0.48	0.02	0.03

			Gill	0.91	0.68	0.99	0.06	0.07
		Pseudorasbora parva	Muscle	0.66±0.08	0.48±0.05	0.30±0.07	0.05±0.01	0.01±0.00
			Viscus	1.70±1.46	1.46±1.35	2.06±2.20	0.35±0.40	0.44±0.60
			Gill	7.41±1.84	5.31±1.27	2.69±2.67	0.17±0.14	0.25±0.21
	Demersal	*Rhinogobius giurinus*	Muscle	1.58	1.11	0.35	0.12	0.03
			Viscus	31.86	23.18	3.12	0.22	0.26
			Gill	8.17	5.97	2.90	0.22	0.36
		Aristichthys nobilis	Muscle	0.59±0.04	<0.000	0.25±0.03	0.33±0.38	0.01±0.00
			Viscus	0.67±0.06	<0.000	0.51±0.03	0.25±0.15	0.01±0.01
			Gill	0.79±0.21	<0.000	0.66±0.33	0.11±0.10	0.26±0.23

Table S3. The measured values and recovery data of three certified reference materials.

Heaay metal	CFGG-160032			GBW 07309			GBW 10024		
	Measurd value	Certified value	Recovey (%)	Measurd value	Certifid value	Recovey (%)	Measurd value	Certified value	Recovey (%)
Cr	0.08±0.01	0.1	80	83.7±7.6	85±10.0	98.5	0.29±0.04	0.28±0.07	103.6
Ni	0.09±0.02	0.1	90	30.9±1.8	32±4.0	96.6	0.32±0.06	0.29±0.08	110.3
Cu	0.10±0.02	0.1	100	27.8±2.4	32±3.0	86.9	1.17±0.14	1.34±0.18	87.3
As	0.11±0.01	0.1	110	8.6±0.7	8.4±1.4	102.4	3.5±0.4	3.6±0.6	97.2
Pb	0.09±0.01	0.1	90	20.2±3.1	23±4.0	87.8	0.13±0.02	(0.12)	108.3

Table S4. Classification of heavy metal pollution in sediment based on the I_{geo} value.

Risk level	Range of I_{geo}	Pollution degree
0	$I_{geo} \leq 0$	uncontaminated
1	$0 < I_{geo} \leq 1$	uncontaminated to moderately contaminated
2	$1 < I_{geo} \leq 2$	moderately contaminated
3	$2 < I_{geo} \leq 3$	moderately to heavily contaminated
4	$3 < I_{geo} \leq 4$	heavily contaminated
5	$4 < I_{geo} \leq 5$	heavily to extremely contaminated
6	$5 < I_{geo} \leq 10$	extremely contaminated

Table S5. Average background content of heavy metals for A-layer soil in Shandong Province, China. (mg/kg)

Heavy metal	Average	Standard error
Cr	64.24	33.31
Ni	30.31	17.0
Cu	22.27	15.04
As	8.23	3.83
Pb	25.02	10.44

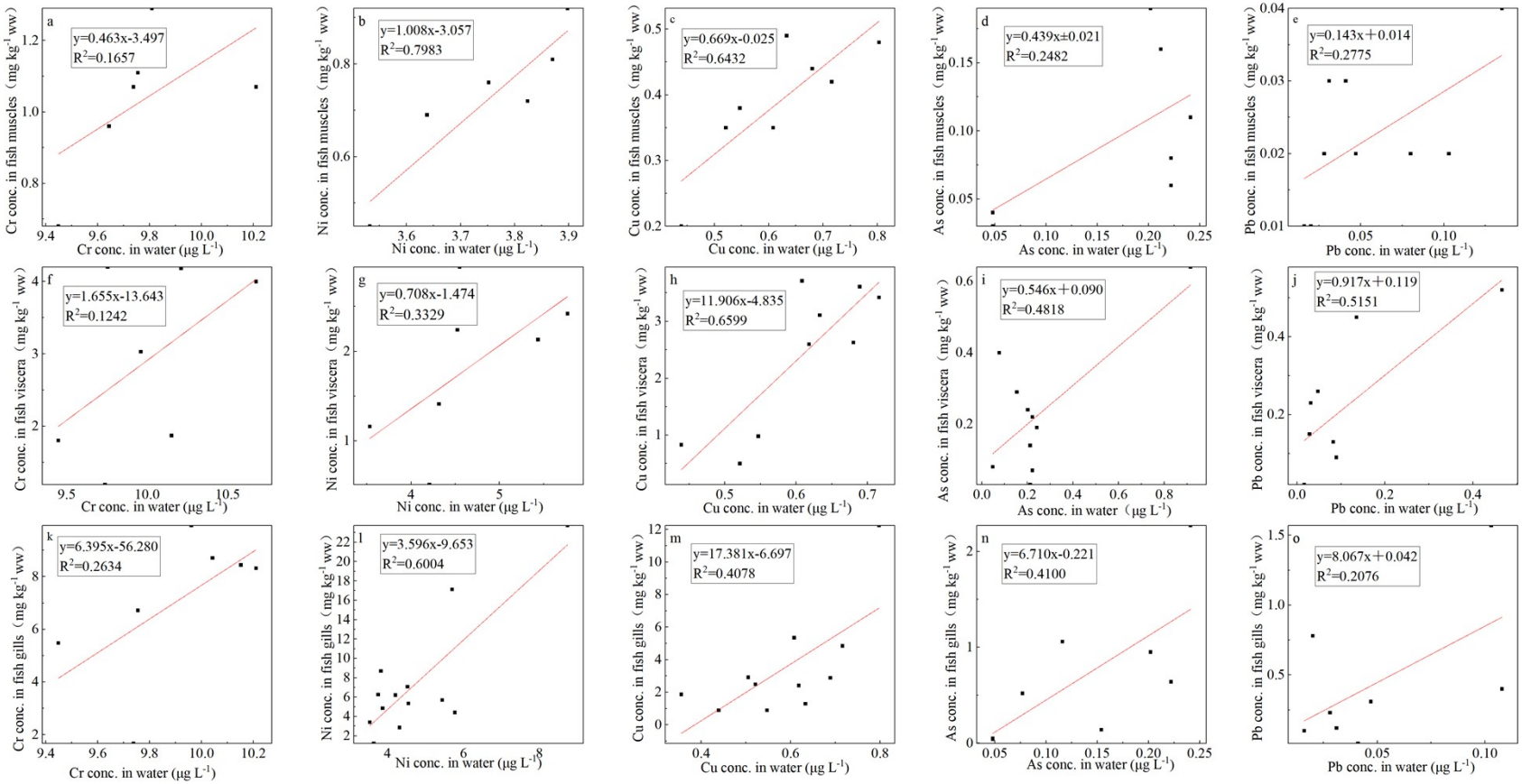

Figure S1. Correlation between metal accumulation in fish and metal concentrations in water.

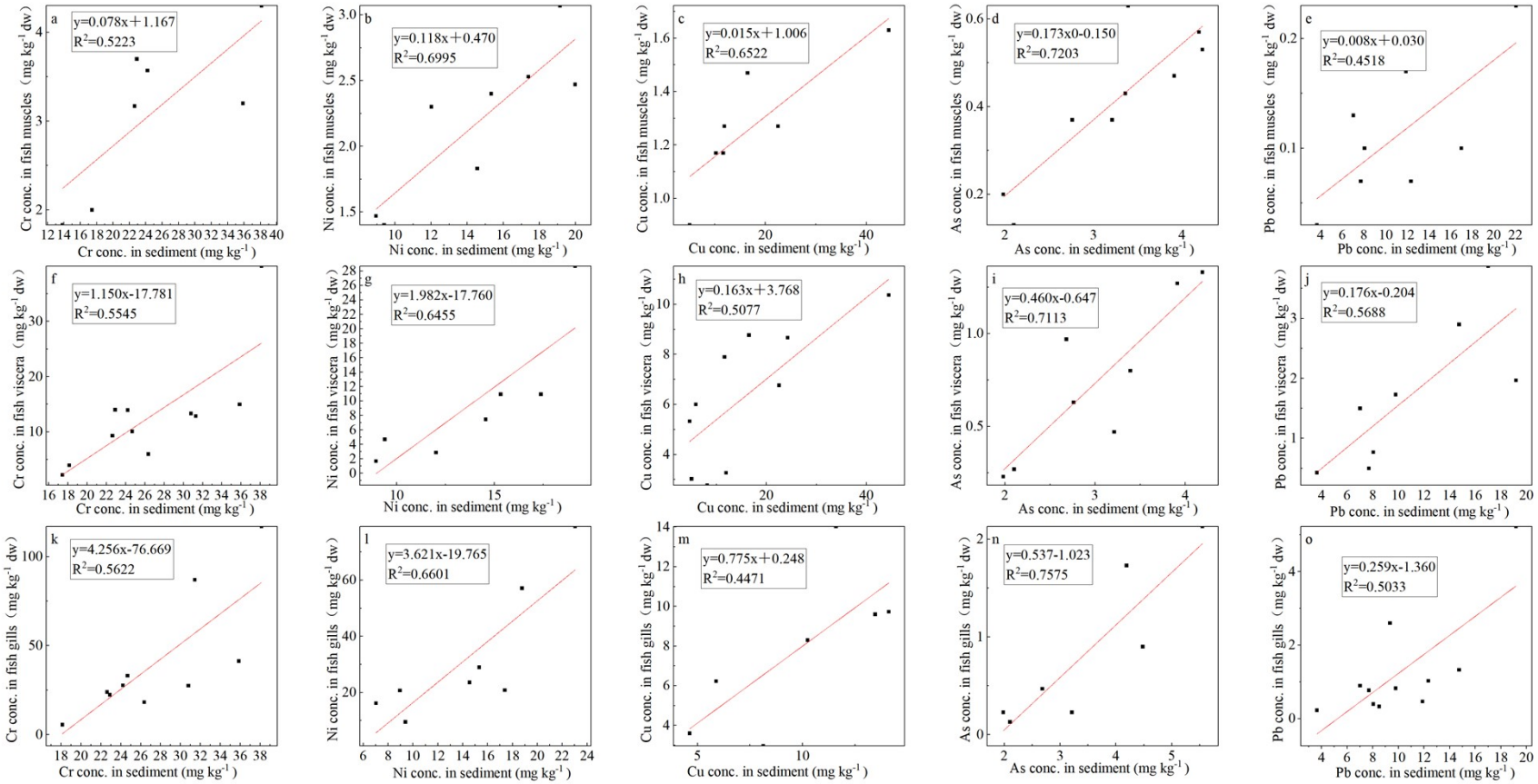

Figure S2. Correlation between metal accumulation in fish and metal concentrations in sediments.