Supplementary Material

Pollution characteristics and risk assessment of endocrine-disrupting chemicals in surface water of national (freshwater) aquatic germplasm resource reserves in Guangdong Province

Tao Zhou[a,b], Jie Li[b], Weizhen Zhang[a,*], Yanyi Zeng[b], Yuan Gao[b], Haiyan Li[b,*], Wanling Yang[b], Yongzhan Mai[b], Qianfu Liu[b], Caiqin, Hu[b], Chao Wang[b]

[a] College of Ecology and Environment, Chengdu University of Technology, Chengdu, 610059, PR China

[b] Pearl River Fisheries Research Institute, Chinese Academy of Fishery Sciences, Fishery Ecological Environment Monitoring Center of Pearl River Basin, Ministry of Agriculture and Rural Affairs, Guangdong Provincial Key Laboratory of Aquatic Animal Immune Technology, Guangzhou 510380, China

[*]Corresponding author:

Weizhen Zhang Email: zwz@cdut.edu.cn

Haiyan Li Email: lihaiyan@prfri.ac.cn

Mail address: Pearl River Fisheries Research Institute, Chinese Academy of Fishery Science. Guangzhou, 510380, China.

Table Legends:

Table S1 Basic information on the sampling sites in the Guangdong Province reserve

Table S2 Comparative analysis of EDCs concentrations in surface water and aquaculture germplasm conservation areas in China

Table S3 The PNEC and EEF of the six target compounds to the aquatic species

Table S4 Concentration of EDCs (ng/L) in Aquatic Germplasm Reserve during rainy season

Table S5 Concentration of EDCs (ng/L) in Aquatic Germplasm Reserve during dry season**Table**

Table S6 Water quality parameters during the rainy season in the Aquatic Germplasm Resource Conservation Area

Table S7 Water quality parameters during the dry season in the Aquatic Germplasm Resource Conservation Area

Table S8 Records of the surroundings of the sampling points in the protected area

Table S1 Basic information on the sampling sites in the Guangdong Province reserve

protected area	Sampling	Longitude (E)	Latitude (N)	Area (hectares)	Comments	Primary protected species
Xingfeng River	S1	114°19′8″	24°7′19″	490	The Xinfeng River National Aquatic Germplasm Reserve is situated in Shaoguan City's Xinfeng County.	*Silurus asotus; Megalobrama amblycephala; Squaliobarbus curriculus*
	S2	114°28′47″	24°7′16″			
	S3	114°12′43″	24°3′28″			
Liuxi River	S4	113°53′58″	23°47′39″	2260	Liuxi River *Spinibarbus hollandi* National Aquatic Germplasm Reserve is located in Conghua District, Guangzhou City.	*Spinibarbus hollandi; Tanichthys albonubes; Anguilla marmorata; Parazacco spilurus; Rasborasteineri*
	S5	113°46′59″	23°44′48″			
	S6	113°42′4″	23°41′29″			
Ling River	S7	114°5’52"	25°14’31"	523.3	The Ling River Endemic Fish (*Mauremys nigricans*) National Aquatic Germplasm Reserve is situated in Nanxiong City, Shaoguan City.	*Mauremys nigricans*
	S8	114°9’46"	25°17’24"			
	S9	114°9’50"	25°17’24"			
Lian River	S10	114°46’52"	24°33’6"	160	The Lian Rive *Mastacembelus armatus* and *Banded Catfish* National Aquatic Germplasm Reserve is located in the Heping County, Heyuan City.	*Mastacembelus armatus; Tachysurus fulvidraco; Silurus asotus; Anguilla marmorata; Mystus guttatus*
	S11	114°48’53"	24°30’51"			
	S12	114°54’11"	24°22’22"			
Yu nan	S13	111°32′35″	23°14′11″	2350	The West River *Megalobrama hoffmanni Herre et Mvers* National Aquatic Germplasm Reserve spans from Fengkai County in Zhaoqing City to Yunan County in Yunfu City.	*Megalobrama hoffmanni Herre et Mvers*
	S14	111°33′6″	23°12′13″			
	S15	111°34′59″	23°11′12″			
Deqing	S16	111°48′50″	23°8′0″	2300	The National Aquatic Germplasm Reserve for West River *Squaliobarbus*	*Squaliobarbus curriculus; Erythroculter pseudobrevicauda;*
	S17	111°51′30″	23°8′11″			

	S18	111°53′43″	23°7′25″		*curriculus* and *Erythroculter pseudobrevicauda* is situated at the Nanjiang River estuary in Yunfu City.	*Xenocypris davidi*
Youshu Lake	S19	115°51’55"	24°43’30"	510	The Yushu Lake *Channa maculata* National Aquatic Germplasm Reserve is located in the Pingyuan District of Meizhou City.	*Channa maculate; Silurus asotus; Tachysurus fulvidraco; Cirrhinus molitorella; Hypophthalmichthys molitrix; Aristichthys nobilis*
	S20	115°52’20"	24°42’56"			
	S21	115°52’44"	24°41’37"			
Shakou River	S22	113°35’32"	24°30’43"	860.5	The Yingde section of the North River houses the national-level aquatic germplasm resource reserve for *Siniperca kneri Garman*. It is situated in Qingyuan City's Yingde district.	*Siniperca kneri Garman*
	S23	113°34’50"	24°29’7"			
	S24	113°28’20"	24°22’30"			
Tian River	S25	112°30’38"	22°17’2"	640	The Tian River *Megalobrama hoffmanni Herre et Mvers* National Aquatic Germplasm Reserve is situated in Kaiping City, Jiangmen City, China.	*Cyprinus carpio; Carassius auratus; Anguilla japonica; Siniperca kneri Garman; Lateolabrax japonicus; Megalobrama skolkovii; Monopterus albus*
	S26	112°33’2"	22°16’13"			
	S27	112°34’30"	22°17’58"			
Zeng River	S28	113°50′34″	23°24′0″	438.7	Zeng River *Spinibarbus hollandi* and *Mastacembelus armatus* are found in the National Level area of Zengcheng District, Guangzhou, China.	*Spinibarbus hollandi; Mastacembelus armatus*
	S29	113°53′44″	23°26′32″			
	S30	113°53′23″	23°25′21″			
Rong River	S31	115°41’44"	23°15’0"	220	The Rong River Endemic Fish (*Channa maculata*) National Aquatic Germplasm Reserve is situated in Luhe County, Shanwei City.	*Mystus guttatus*
	S32	115°41’43"	23°17’0"			
	S33	115°42’28"	23°17’41"			

Jian River	S34	110°39’36"	21°15’1"	1000	The Jian River Sanguinolaria acuta National Aquatic Germplasm Reserve is situated in Wuchuan City, Zhanjiang.	*Sanguinolaria acuta*
	S35	110°38’20"	21°14’16"			
	S36	110°38’19"	21°14’23"			
Xiaoxiang River (Zaoqing)	S37	112°21′39″	23°9′18″	1310	The National Aquatic Germplasm Reserve of the Zhaoqing Section of the West River (*Cyprinus carpio*) is located in the city of Zhaoqing.	*Cyprinus carpio*
	S38	112°24′31″	23°7′30″			
	S39	112°24′52″	23°3′14″			
Shiku Lake	S40	116°5’9"	24°50’15"	2248	The Shiku Lake *Channa maculata* National Aquatic Germplasm Reserve is situated in Jiaoling County, Meizhou City.	*Mystus guttatus; Mastacembelus armatus;*
	S41	116°7’39"	24°42’59"			
	S42	116°8’35"	24°41’41"			

Table S2 Comparative analysis of EDCs concentrations in surface water and aquaculture germplasm conservation areas in China

Chemicals	Sampling location	Range	Mean	Reference
Bisphenol A (BPA)	Aquatic germplasm reserves	5.31—921.7	254.9	this study
	Liuxi River	2.26-1385.3	359.3	1
	Luoma Lake	49-140	86.1	2
	Taihu Lake	16.4-565.4	62.5	3-5
	Pearl River	23.5-2189.9	252.5	6
	Liao River Basin	2.6-1131	139	7
	Xiangjiang River	5.6-3079.4	396	8
	Huaihe R.	413-3011	1543.5	9
Bisphenol F (BPF)	Aquatic germplasm reserves	ND—65.7	15.3	this study
	Liuxi River	ND-474	169.6	10
	Luoma Lake	3.5-14	6.82	11
	Taihu Lake	ND-1634	110.7	4, 11
Bisphenol S (BPS)	Aquatic germplasm reserves	ND—87.96	26.7	this study
	Liuxi River	19.9-65600	2342	10
	Luoma Lake	ND-94	20.2	11
	Taihu Lake	4.1-1600	79	4
	Yangtze River	0.18-14.9	1.39	12
EE2	Aquatic germplasm reserves	ND—5.71	1.2	this study
	Luoma Lake	4.25-12.9	7.97	13
	Taihu Lake	ND-8.3	2.77	14
	Liao River Basin	2.6-17112	596	15
	East Dongting Lake	ND-24.9	3.04	16
	Erhai Lake	0.5-16.1	3.03	17

	Xiangjiang River	ND-21.4	5.37	8
Estrone (E1)	Aquatic germplasm reserves	ND—2.44	0.2	this study
	Liuxi River	ND-27.8	4.17	18
	East Dongting Lake	2.26-41	5.63	19
	Erhai Lake	4.7-55	14.4	17
	Liao River Basin	2.6-1235	66.2	7
	Songhua River	ND-37.3	10.5	20
	Xiangjiang River	0.28-51.3	7.35	8
17-β-estradiol (E2)	Aquatic germplasm reserves	ND—3.89	0.52	this study
	Yangtze R. (Nanjing section)	2.5-4.1	3.2	21
	Luoma Lake	2.5-21.8	9.4	21
	Erhai Lake	1.1-3.0	1.7	22
	Jiulong R	25.6-60.3	36.3	23
	Songhua R.	15-29	20.8	24, 25
NP	Pearl R.	109.4-5046.9	1009.8	6, 26
	Aquatic germplasm reserves	29.7—1780.2	323.6	this study
	Yangtze R. (Nanjing section)	11.4-858	297.1	21
	Yellow R.	165.8-1187.6	577.9	27
	Huaihe R.	76.1-1532.6	563.7	9
	Haihe R. (Tianjin)	79.2-228.2	151.5	28
	Erhai Lake	6.6-17.9	13.3	22
	Songhua R.	25-1261	167.9	24, 25
OP	Aquatic germplasm reserves	5.11—243.6	72	this study
	Pearl R.	46.9-514.3	168.6	6, 26
	Yangtze R. (Nanjing section)	1.2-116	31.2	21

	Yellow R.	2.4-14.5	4.7	27
	Huaihe R.	21.1-63.6	37.5	9
	Haihe R. (Tianjin)	33.3-83.3	63.8	28
	Erhai Lake	2.0-15.8	6.3	22

Table S3 The PNEC and EEF of the six target compounds to the aquatic species

Compound	Taxon	Species	Endpoint	Value (μg/L)	AF	PNEC (μg/L)	Reference	EEF_i
BPA	Alga	/	EC_{50}	2700	1000	2.7	8	3.90×10^{-4} [29] 2.36×10^{-5} [30]
	Daphnid	D. magna	EC_{50}	10200	1000	10.2	31	
	Fish	/	EC_{50}	158	1000	0.158	32	
	Fish	D. rerio	21d-NOEC	500	100	5	33	
BPS	Daphnid	D. magna	EC_{50}·48h	55000	1000	55	34	1.06×10^{-6} [35]
	Fish	D. rerio	48 h-LC_{50}	199000	1000	199	36	
	Alga	C. vulgaris	EC_{50}	25190	1000	25.2	37	
BPF	Daphnia	D. magna	EC_{50}·48h	8700	1000	8.7	38	1.08×10^{-4} [35]
	Fish	D. rerio	96h-EC_{50}	7500	1000	7.5	39	
	Alga	D. subspicatus	48h-LC_{50}	22100	1000	22.1	38	
Estrone(E1)	Crustaceans	Acartia tonsa	LC_{50}	410	1000	0.41	40	0.272[30] 0.11[29]
	Fish	Oncorhynchus mykiss	NOEC·14d	0.00074	10	0.000074	40	
	Fish	Zebrafish	LC_{50}	6	1000	0.006	41	
	Alge	Microcystis aeruginosa	14d-EC_{50}	276680	1000	276.7	42	
17-β-estradiol (E2)	Alga	R. subcapitata	EC_{50} 48h	9600	1000	9.6	43	1.0[29]
	Daphnid	D. magna	EC_{50} 48h	2870	1000	2.87	44	
	Fish	D. rerio	EC_{50}	2140	1000	2.14	45	
	Fish	D. rerio	NOEC (reproduction)	0.0048	10	0.00048	46	
17-α-ethinylestradiol (EE2)	Alga	D. subspicatus	EC_{50}	12400	1000	12.4	47	1.76[48] 1.25[23]
	Daphnid	D. magna	EC_{50} 24h	6400	1000	6.4	49	
	Fish	D. rerio	LC_{50}	1700	1000	1.7	50	

	Fish	Threespine stickleback	N(L)OEC	0.00175	10	0.000175	51	
NP	Alga	R. subcapitata	EC_{50} 72h (population)	530	1000	0.53	52	6.49×10^{-4} [30]
	Daphnid	D. magna	48h-LC_{50}	180	1000	0.18	53	
	Fish	Xiphophorus helleri	96h-LC_{50}	206	1000	0.206	54	
OP	Algae	Microcystis aeruginosa	10d-EC_{50}	67	1000	0.067	55	8.73×10^{-4} [30]
	Daphnid	Daphnia magna	24h-EC_{50}	303	1000	0.303	56	
	Fish	Zoarces viviparus	48h-LC_{50}	180	1000	0.18	53	

Table S4 Concentration of EDCs (ng/L) in Aquatic Germplasm Reserve during rainy season

EDCs	Xinfeng River		Liuxi Lake		Ling River		Lian River		Yunan		Deqing		Youshu Lake	
	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median
OP	115.4±34.4	131.4	26.3±11.8	20.7	109.4±69	85.9	22.9±13.9	21	63.1±5.22	65.8	8.53±2.02	9.52	71.3±39.1	75.1
NP	342.5±157.7	258.7	676.2±324.9	751.2	167.5±40.9	154.1	174.3±18.9	164	147.4±23	152.4	140.3±103.7	81.4	222.7±39.5	221.7
BPF	42.5±20.1	36.7	18.1±4.41	24.7	2.79±0.03	2.8	3.24±0.69	3.5	27.6±9.77	25.1	7.49±6.07	10.4	9.35±4.17	9.95
BPA	248.7±393.4	25.1	62.2±53.9	61.4	74.7±17.7	72.7	81.5±25.6	81.1	323.2±308.7	167.5	121.1±23.1	123.7	106.7±51.7	86
BPS	35±12.2	36.1	8.7±2.78	9.44	26.1±4.45	26	18.5±2.74	19.8	36.9±2.55	36.3	27.1±2.22	28	31±6.05	28.3
E1	0.01±0.02	0.01	0.16±0.15	0.16	0.06±0.04	0.05	0.04±0.03	0.05	0.34±0.1	0.37	0.07±0.09	0.02	0.31±0.22	0.26
E2	0.03±0.02	0.02	0.11±0.13	0.06	0.14±0.22	0.03	0.37±0.07	0.4	0.96±0.14	0.94	0.26±0.05	0.24	0.96±0.57	0.93
EE2	0.97±0.21	0.91	1.81±0.87	1.49	0.38±0.66	0.0	0.34±0.6	0.0	1.17±0.67	1.31	0.69±0.43	0.47	1.69±0.83	2.11
	Tian River		Zen River		Rong River		Shakou		Jian River		Xiaoxiang River		Shiku Lake	
OP	99.8±16.8	95	107.5±82.4	119.1	71.7±31.6	77.7	76.1±21.9	75.4	19.5±11	15.7	45.9±30	57.5	23.1±9.5	18.9
NP	838.3±838.7	562.5	427.2±124.6	408.2	289.1±142.4	292.5	642.1±484.1	736.4	145.1±46.3	145.3	179.5±121.4	203.4	212.5±136.6	151.9
BPF	35.2±28.5	30.9	21.9±12.7	18	7.49±7.59	3.81	5.39±2.89	4.95	15.7±7.15	19.6	23.8±14.2	24.4	9.45±5.87	10
BPA	257.5±43.2	250.3	118.9±62.6	89.5	345.5±460.9	82.7	476±393.3	549.8	107.6±10.2	108.9	173±144.3	108.9	355±369.3	157.4
BPS	33.6±47.1	7.03	34.1±5.87	33.8	33.1±14.4	25.6	13.3±23	0.0	17±24.6	3.09	28.9±15.7	29.1	36.3±9.84	39.9
E1	0.15±0.04	0.12	0.24±0.12	0.3	0.07±0.07	0.07	0.81±1.41	0.0	0.34±0.2	0.29	0.23±0.03	0.24	0.03±0.05	0.0
E2	1.93±1.7	1.15	0.84±0.17	0.83	0.11±0.1	0.15	0.0±0.0	0.0	1.01±0.39	0.83	0.58±0.05	0.55	0.52±0.14	0.56
EE2	1.99±0.5	2.2	1.25±1.03	1.84	0.81±0.71	0.97	0.1±0.18	0.0	1.95±1.54	2.36	2.33±0.54	2.18	3.12±2.54	3.02

a standard deviation.

Table S5 Concentration of EDCs (ng/L) in Aquatic Germplasm Reserve during dry season

EDCs	Xinfeng River		Liuxi Lake		Ling River		Lian River		Yunan		Deqing		Youshu Lake	
	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median
OP	162.4±73.3	142.7	40.7± 15.7	47.7	37.9± 21.6	31.9	45.1± 18.8	36.3	101.2± 24.4	105.2	6.41± 1.54	6.01	48± 54.3	22.6
NP	485.9±261.8	344.5	556.6± 152.1	518.4	424± 364.8	338.2	401.1± 202.8	446.2	286.2± 90.5	244.7	70± 46.3	59.8	274.6± 245.4	158.1
BPF	18.8±13.7	15.6	9.57± 3.89	8.58	6.35± 2.49	7.5	3.61± 0.55	3.32	31.8± 17.3	31.2	4.27± 0.4	4.49	22.2± 12.1	27.7
BPA	113.5±97.9	139.4	301± 14.8	299.7	511.6± 314.3	465.6	492.3± 372.4	297.3	206.4± 72.1	170.5	428.6± 118.3	394.7	276.9± 238.7	150.7
BPS	15±2.78	14	23.8± 3.89	24.7	32.8± 15.5	24.2	24.1± 5.67	21.1	23.5± 11.4	28.9	45.7± 34.4	32	28.1± 13.2	26.8
E1	0.2±0.11	0.15	0.06± 0.06	0.05	0.18± 0.15	0.16	0.06± 0.02	0.05	0.33± 0.26	0.29	0.04± 0.01	0.05	0.44± 0.49	0.3
E2	1.09±0.83	0.69	0.27± 0.11	0.27	0.42± 0.32	0.32	0.27± 0.01	0.27	0.72± 0.88	0.35	0.19± 0.07	0.19	0.98± 0.89	0.65
EE2	1.25±0.23	1.38	0.29± 0.5	0.0	0.25± 0.24	0.27	0.1± 0.16	0.0	0.5± 0.87	0.0	1.33± 1.2	1.08	1.56± 0.84	1.1
	Tian River		Zen River		Rong River		Shakou		Jian River		Xiaoxiang River		Shiku Lake	
OP	110.1± 25.4	104.6	172.9± 83.3	214.5	52.7± 42.4	29.7	142.2± 80.9	173.9	36.2± 15.6	33.2	68.1± 34.1	49.3	132.5± 106.6	124.3
NP	288.1± 107.9	250.5	349± 169.3	331.8	160.8± 43.3	137.9	400.7± 309.2	405.8	267.3± 118.6	272.8	256± 121.6	218.5	234.6± 129.9	187
BPF	14± 16.2	10.3	39.1± 10.4	38.5	3.47± 2.25	3.02	3.6± 0.95	3.34	7.69± 3.71	7.18	28.2± 19.1	24.8	6.89± 5.06	8.89
BPA	367.1± 9.01	364.9	184.2± 101.3	144.1	143± 84.1	152.4	182± 143.7	135.6	310± 103.3	278.3	577.4± 326.4	564.1	192.4± 48.8	203.7
BPS	14.2± 7.62	17	36.4± 12	38.7	26.6± 15.5	18.2	14.5± 9.27	13.4	12.5± 10.9	7.12	63.3± 26.9	76.7	8.79± 5.28	9.64
E1	0.21± 0.33	0.04	0.36± 0.52	0.09	0.17± 0.09	0.21	0.13± 0.21	0.01	0.22± 0.03	0.2	0.03± 0.01	0.04	0.06± 0.04	0.05
E2	0.61± 0.76	0.27	0.64± 0.41	0.79	0.37± 0.12	0.38	0.33± 0.06	0.36	0.29± 0.06	0.29	0.18± 0.1	0.17	0.29± 0.14	0.31
EE2	2.66± 0.98	2.96	0.78± 0.96	0.34	2.0± 0.86	1.86	0.41± 0.71	0.0	0.28± 0.3	0.23	0.91± 0.81	1.21	1.39± 0.7	1.73

a standard deviation.

Table S6 Water quality parameters during the rainy season in the Aquatic Germplasm Resource Conservation Area

EDCs	Xinfeng River		Liuxi Lake		Ling River		Lian River		Yunan		Deqing		Youshu Lake	
	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median
EC（us/cm）	105.6±39.1	111.7	100.6±32.2	83.4	48.5±5.96	49	98.3±24	91.8	315.9±22.6	325.9	312.1±13.4	311.6	87.6±3.43	89.4
WT(℃)	28.4±1.3	27.9	30.7±3.57	30.4	34.7±0.72	34.6	25±2.29	25.9	32.2±1.31	32.9	31.8±0.2	31.9	29.8±1.96	30.7
Salinity (pus)	0.05±0.02	0.05	0.04±0.02	0.03	0.02±0.0	0.02	0.05±0.01	0.04	0.14±0.0	0.14	0.13±0.01	0.13	0.04±0.0	0.04
pH	7.77±0.39	7.87	8.27±0.69	8.02	7.47±0.3	7.62	7.92±0.28	7.86	8.34±0.33	8.2	8.13±0.04	8.13	8.1±0.82	8.42
DO (mg/L)	5.8±1.02	6.38	7.35±0.84	7.76	6.77±0.28	6.81	6.83±0.74	6.48	7.35±1.59	6.62	6.41±0.1	6.43	6.79±1.82	6.95
	Tian River		Zen River		Rong River		Shakou		Jian River		Xiaoxiang River		Shiku Lake	
EC（us/cm）	199.2±18	193.9	106.3±5.97	107.8	55.8±12.1	59.1	230.8±38.6	213.6	40148.5±13456.6	45587.2	325.1±1.18	325.6	118.3±28.2	133.1
WT(℃)	30.5±0.97	31	28.8±0.91	28.4	31.4±2.35	32.4	32.6±1.03	32.8	29.9±0.4	30	30.3±0.35	30.5	28.9±3.92	29.3
Salinity (pus)	0.08±0.01	0.08	0.05±0.01	0.05	0.02±0.01	0.02	0.1±0.01	0.09	23.6±8.67	27	0.14±0.0	0.14	0.05±0.01	0.05
pH	7.32±0.03	7.32	7.42±0.19	7.4	7.74±0.24	7.69	8.03±0.03	8.04	8.17±0.21	8.05	8.21±0.01	8.21	8.12±0.86	7.66
DO (mg/L)	5.06±0.89	5.53	4.94±0.21	5.04	7.73±0.53	7.76	7.08±0.68	6.71	5.98±0.44	6.19	6.7±0.08	6.75	6.92±3.93	5.17

a standard deviation.

Table S7 Water quality parameters during the dry season in the Aquatic Germplasm Resource Conservation Area

a standard deviation.

EDCs	Xinfeng River		Liuxi Lake		Ling River		Lian River		Yunan		Deqing		Youshu Lake	
	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median	Mean ± SD[a]	Median
EC（us/cm）	123.1±29.7	117.4	97.4±54.5	73.4	47.5±14.4	46.1	128.4±38.9	120.1	298.9±5.69	300.8	294.7±5.59	293	90.5±8.0	88.8
WT(℃)	22.8±3.14	22.1	17.2±1.15	17.4	13.7±0.91	13.9	17±0.68	16.7	18.6±0.34	18.8	17.7±1.28	17.1	19.2±0.87	19.1
Salinity (pus)	0.06±0.02	0.06	0.05±0.03	0.04	0.03±0.01	0.03	0.07±0.02	0.06	0.17±0.01	0.17	0.17±0.01	0.17	0.05±0.01	0.05
pH	7.46±0.14	7.53	7.09±0.64	7.33	7.51±0.3	7.48	7.8±0.44	7.68	7.5±0.52	7.31	7.85±0.2	7.81	7.85±0.42	7.7
DO (mg/L)	8.01±1.56	8.23	9.35±0.3	9.33	9.88±0.24	9.82	9.01±0.45	8.85	10.4±0.06	10.4	10.5±0.19	10.4	10.9±0.12	10.9
	Tian River		Zen River		Rong River		Shakou		Jian River		Xiaoxiang River		Shiku Lake	
EC（us/cm）	304.9±61.4	296.9	112.8±4.11	110.9	75.4±11.7	71.4	263±4.84	260.8	42451±5199	43433	292.2±1.41	292.8	138±15.3	129.9
WT(℃)	25.1±1.03	25.4	23.8±1.7	23.1	19±0.19	18.9	20.2±1.67	19.3	26.6±0.46	26.5	19±0.89	18.9	21.8±4.98	20.9
Salinity (pus)	0.17±0.02	0.17	0.05±0.01	0.05	0.04±0.01	0.04	0.14±0.01	0.14	26.8±3.57	27.2	0.16±0.0	0.16	0.08±0.01	0.07
pH	7.82±0.24	7.71	7.55±0.35	7.74	7.55±0.04	7.54	8.05±0.62	7.94	8.5±0.04	8.48	8.07±0.18	8.06	7.72±0.45	7.81
DO (mg/L)	8.93±0.51	9.14	8.11±1.21	7.79	7.77±0.52	7.58	11.7±3.34	10	6.12±0.11	6.13	11±0.47	10.8	9.5±1.37	9.88

a standard deviation.

Table S8 Records of the surroundings of the sampling points in the protected area

protected area	Sampling	Town	Village	Farmland	Factory	Ship	road and bridge
Xingfeng River	S1	✘	✔	✘	✘	✘	✔
	S2	✘	✔	✘	✘	✘	✔
	S3	✘	✔	✘	✘	✘	✔
Liuxi River	S4	✘	✔	✘	✘	✘	✘
	S5	✔	✘	✘	✘	✔	✘
	S6	✔	✘	✔	✘	✘	✔
Ling River	S7	✘	✘	✘	✘	✘	✔
	S8	✘	✘	✘	✘	✘	✔
	S9	✔	✔	✔	✘	✘	✔
Lian River	S10	✔	✔	✔	✘	✘	✔
	S11	✘	✔	✘	✘	✘	✔
	S12	✘	✔	✔	✘	✘	✔
Yu nan	S13	✘	✔	✘	✘	✔	✘
	S14	✘	✔	✘	✘	✔	✔
	S15	✔	✔	✔	✘	✔	✘
Deqing	S16	✔	✘	✘	✘	✔	✔
	S17	✘	✔	✔	✔	✔	✘
	S18	✘	✔	✔	✘	✔	✘
Youshu Lake	S19	✘	✘	✘	✘	✘	✘
	S20	✘	✘	✘	✘	✘	✘
	S21	✔	✔	✔	✘	✘	✔

Shakou River	S22	✘	✔	✔	✘	✘	✘
	S23	✘	✔	✘	✘	✔	✘
	S24	✘	✔	✘	✘	✘	✘
Tian River	S25	✔	✔	✔	✘	✘	✔
	S26	✔	✔	✔	✔	✔	✔
	S27	✔	✔	✔	✔	✔	✔
Zeng River	S28	✔	✘	✘	✘	✘	✘
	S29	✘	✘	✘	✘	✘	✔
	S30	✔	✘	✘	✘	✘	✔
Rong River	S31	✔	✔	✔	✘	✘	✔
	S32	✔	✔	✔	✘	✘	✔
	S33	✔	✔	✔	✘	✘	✔
Jian River	S34	✘	✘	✘	✘	✔	✘
	S35	✘	✘	✘	✘	✔	✘
	S36	✘	✘	✘	✘	✔	✘
Xiaoxiang River (Zaoqing)	S37	✘	✔	✘	✘	✔	✘
	S38	✘	✔	✘	✘	✔	✔
	S39	✔	✔	✔	✘	✔	✘
Shiku Lake	S40	✘	✔	✔	✘	✘	✘
	S41	✘	✔	✘	✘	✘	✘
	S42	✘	✔	✔	✘	✘	✔

✓ (have), ✗ (no have)

Reference：

1. C. Huang, L.-H. Wu, G.-Q. Liu, L. Shi and Y. Guo, Occurrence and Ecological Risk Assessment of Eight Endocrine-Disrupting Chemicals in Urban River Water and Sediments of South China, *Archives of Environmental Contamination and Toxicology*, 2018, **75**, 224-235.
2. Z. Yan, Y. Liu, K. Yan, S. Wu, Z. Han, R. Guo, M. Chen, Q. Yang, S. Zhang and J. Chen, Bisphenol analogues in surface water and sediment from the shallow Chinese freshwater lakes: Occurrence, distribution, source apportionment, and ecological and human health risk, *Chemosphere*, 2017, **184**, 318-328.
3. J. Liu, J. Guo, Y. Cai, J. Ren, G. Lu, Y. Li and Y. Ji, Multimedia distribution and ecological risk of bisphenol analogues in the urban rivers and their bioaccumulation in wild fish with different dietary habits, *Process Safety and Environmental Protection*, 2022, **164**, 309-318.
4. M. H. Chen, M. Guo, H. Z. Xu, D. Liu, J. Cheng, J. Li, S. H. Zhang and L. L. Shi, [Distribution Characteristics and Potential Risk of Bisphenol Analogues in Surface Water and Sediments of Lake Taihu], *Huan Jing Ke Xue*, 2017, **38**, 2793-2800.
5. D. Liu, J. N. Liu, M. Guo, H. Z. Xu, S. H. Zhang, L. L. Shi and C. Yao, Occurrence, distribution, and risk assessment of alkylphenols, bisphenol A, and tetrabromobisphenol A in surface water, suspended particulate matter, and sediment in Taihu Lake and its tributaries, *Marine Pollution Bulletin*, 2016, **112**, 142-150.
6. F.-J. Peng, C.-G. Pan, M. Zhang, N.-S. Zhang, R. Windfeld, D. Salvito, H. Selck, P. J. Van den Brink and G.-G. Ying, Occurrence and ecological risk assessment of emerging organic chemicals in urban rivers: Guangzhou as a case study in China, *Science of the Total Environment*, 2017, **589**, 46-55.
7. R. Tan, R. Liu, B. Li, X. Liu and Z. Li, Typical Endocrine Disrupting Compounds in Rivers of Northeast China: Occurrence, Partitioning, and Risk Assessment, *Archives of Environmental Contamination and Toxicology*, 2018, **75**, 213-223.
8. Z. Luo, Y. Tu, H. Li, B. Qiu, Y. Liu and Z. Yang, Endocrine-disrupting compounds in the Xiangjiang River of China: Spatio-temporal distribution, source apportionment, and risk assessment, *Ecotoxicology and Environmental Safety*, 2019, **167**, 476-484.
9. Y.-Z. Zhang, X.-F. Song, A. Kondoh, J. Xia and C.-Y. Tang, Behavior, mass inventories and modeling evaluation of xenobiotic endocrine-disrupting chemicals along an urban receiving wastewater river in Henan Province, China, *Water Research*, 2011, **45**, 292-302.
10. C. Huang, L. H. Wu, G. Q. Liu, L. Shi and Y. Guo, Occurrence and Ecological Risk Assessment of Eight Endocrine-Disrupting Chemicals in Urban River Water and Sediments of South China, *Archives of Environmental Contamination and Toxicology*, 2018, **75**, 224-235.
11. Z. Y. Yan, Y. H. Liu, K. Yan, S. M. Wu, Z. H. Han, R. X. Guo, M. H. Chen, Q. L. Yang, S. H. Zhang and J. Q. Chen, Bisphenol analogues in surface water and sediment from the shallow Chinese freshwater lakes: Occurrence, distribution, source apportionment, and ecological and human health risk, *Chemosphere*, 2017, **184**, 318-328.
12. Y. J. Wan, W. Xia, S. Y. Yang, X. Y. Pan, Z. Y. He and K. Kannan, Spatial distribution of bisphenol S in surface water and human serum from Yangtze River

watershed, China: Implications for exposure through drinking water, *Chemosphere*, 2018, **199**, 595-602.

13. D. Liu, S. M. Wu, H. Z. Xu, Q. Zhang, S. H. Zhang, L. L. Shi, C. Yao, Y. H. Liu and J. Cheng, Distribution and bioaccumulation of endocrine disrupting chemicals in water, sediment and fishes in a shallow Chinese freshwater lake: Implications for ecological and human health risks, *Ecotoxicology and Environmental Safety*, 2017, **140**, 222-229.
14. Z. X. Xie, G. H. Lu, Z. H. Yan, J. C. Liu, P. F. Wang and Y. H. Wang, Bioaccumulation and trophic transfer of pharmaceuticals in food webs from a large freshwater lake, *Environmental Pollution*, 2017, **222**, 356-366.
15. R. J. Tan, R. X. Liu, B. Li, X. L. Liu and Z. S. Li, Typical Endocrine Disrupting Compounds in Rivers of Northeast China: Occurrence, Partitioning, and Risk Assessment, *Archives of Environmental Contamination and Toxicology*, 2018, **75**, 213-223.
16. Y. Y. Yang, X. H. Cao, M. M. Zhang and J. Wang, Occurrence and distribution of endocrine-disrupting compounds in the Honghu Lake and East Dongting Lake along the Central Yangtze River, China, *Environmental Science and Pollution Research*, 2015, **22**, 17644-17652.
17. B. Huang, D. Xiong, H. He, X. Li, W. Sun and X. Pan, Characteristics and Bioaccumulation of Progestogens, Androgens, Estrogens, and Phenols in Erhai Lake Catchment, Yunnan, China, *Environmental Engineering Science*, 2017, **34**, 321-332.
18. J. J. Fan, S. Wang, J. P. Tang, Y. N. Dai, L. Wang, S. X. Long, W. X. He, S. L. Liu, J. X. Wang and Y. Yang, [Spatio-Temporal Patterns and Environmental Risk of Endocrine Disrupting Chemicals in the Liuxi River], *Huan Jing Ke Xue*, 2018, **39**, 1053-1064.
19. Y. Yang, X. Cao, M. Zhang and J. Wang, Occurrence and distribution of endocrine-disrupting compounds in the Honghu Lake and East Dongting Lake along the Central Yangtze River, China, *Environmental Science and Pollution Research*, 2015, **22**, 17644-17652.
20. S. He, D. Dong, X. Zhang, C. Sun, C. Wang, X. Hua, L. Zhang and Z. Guo, Occurrence and ecological risk assessment of 22 emerging contaminants in the Jilin Songhua River (Northeast China), *Environmental Science and Pollution Research*, 2018, **25**, 24003-24012.
21. Y.-H. Liu, S.-H. Zhang, G.-X. Ji, S.-M. Wu, R.-X. Guo, J. Cheng, Z.-Y. Yan and J.-Q. Chen, Occurrence, distribution and risk assessment of suspected endocrine-disrupting chemicals in surface water and suspended particulate matter of Yangtze River (Nanjing section), *Ecotoxicology and Environmental Safety*, 2017, **135**, 90-97.
22. B. Huang, X. Li, W. Sun, D. Ren, X. Li, X. Li, Y. Liu, Q. Li and X. Pan, Occurrence, removal, and fate of progestogens, androgens, estrogens, and phenols in six sewage treatment plants around Dianchi Lake in China, *Environmental Science and Pollution Research*, 2014, **21**, 12898-12908.
23. M. Ashfaq, Q. Sun, C. Ma, A. Rashid, Y. Li, S. I. Mulla and C.-P. Yu, Occurrence, seasonal variation and risk evaluation of selected endocrine disrupting compounds and their transformation products in Jiulong river and estuary, China, *Marine Pollution Bulletin*, 2019, **145**, 370-376.
24. X. Shao and J. Ma, Preliminary investigation on 13 endocrine disrupting chemicals in the Songhua River, *Huanjing Kexue Xuebao / Acta Scientiae Circumstantiae*,

2008, **28**, 1910-1915.

25. Z. Zhang, N. Ren, K. Kannan, J. Nan, L. Liu, W. Ma, H. Qi and Y. Li, Occurrence of Endocrine-Disrupting Phenols and Estrogens in Water and Sediment of the Songhua River, Northeastern China, *Archives of Environmental Contamination and Toxicology*, 2014, **66**, 361-369.
26. C. Liu, W. Zhang and B. Shan, Spatial distribution and risk assessment of endocrine disrupting chemicals in the typical station of Pearl River, *Huanjing Kexue Xuebao/Acta Scientiae Circumstantiae*, 2018, **38**, 115-124.
27. L. Wang, G.-G. Ying, F. Chen, L.-J. Zhang, J.-L. Zhao, H.-J. Lai, Z.-F. Chen and R. Tao, Monitoring of selected estrogenic compounds and estrogenic activity in surface water and sediment of the Yellow River in China using combined chemical and biological tools, *Environmental Pollution*, 2012, **165**, 241-249.
28. K. Lei, H.-Y. Pan, Y. Zhu, W. Chen and C.-Y. Lin, Pollution characteristics and mixture risk prediction of phenolic environmental estrogens in rivers of the Beijing-Tianjin-Hebei urban agglomeration, China, *Science of the Total Environment*, 2021, **787**.
29. T. Vega-Morales, Z. Sosa-Ferrera and J. J. Santana-Rodríguez, Evaluation of the Presence of Endocrine-Disrupting Compounds in Dissolved and Solid Wastewater Treatment Plant Samples of Gran Canaria Island (Spain), *Biomed Research International*, 2013, **2013**.
30. S. W. Jin, F. X. Yang, T. Liao, Y. Hui, S. Wen and Y. Xu, Enhanced effects by mixtures of three estrogenic compounds at environmentally relevant levels on development of Chinese rare minnow (Gobiocypris rarus), *Environmental Toxicology and Pharmacology*, 2012, **33**, 277-283.
31. H. C. Alexander, D. C. Dill, L. W. Smith, P. D. Guiney and P. Dorn, Bisphenol a: Acute aquatic toxicity, *Environmental Toxicology and Chemistry*, 1988, **7**, 19-26.
32. J. V. Brian, C. A. Harris, M. Scholze, T. Backhaus, P. Booy, M. Lamoree, G. Pojana, N. Jonkers, T. Runnalls, A. Bonfà, A. Marcomini and J. P. Sumpter, Accurate prediction of the response of freshwater fish to a mixture of estrogenic chemicals, *Environmental Health Perspectives*, 2005, **113**, 721-728.
33. A. G. Little and F. Seebacher, Temperature determines toxicity: Bisphenol A reduces thermal tolerance in fish, *Environmental Pollution*, 2015, **197**, 84-89.
34. M. Y. Chen, M. Ike and M. Fujita, Acute toxicity, mutagenicity, and estrogenicity of bisphenol-A and other bisphenols, *Environmental Toxicology*, 2002, **17**, 80-86.
35. Y. Liu, S. Zhang, N. Song, R. Guo, M. Chen, D. Mai, Z. Yan, Z. Han and J. Chen, Occurrence, distribution and sources of bisphenol analogues in a shallow Chinese freshwater lake (Taihu Lake): Implications for ecological and human health risk, *Science of the Total Environment*, 2017, **599**, 1090-1098.
36. J. Moreman, O. Lee, M. Trznadel, A. David, T. Kudoh and C. R. Tyler, Acute Toxicity, Teratogenic, and Estrogenic Effects of Bisphenol A and Its Alternative Replacements Bisphenol S, Bisphenol F, and Bisphenol AF in Zebrafish Embryo-Larvae, *Environmental Science & Technology*, 2017, **51**, 12796-12805.
37. J. Y. Li, W. Li, X. T. Huang and T. D. Ding, Comparative study on the toxicity and removal of bisphenol S in two typical freshwater algae, *Environmental Science and Pollution Research*, 2021, **28**, 36861-36869.
38. T. Tisler, A. Krel, U. Gerzelj, B. Erjavec, M. S. Dolenc and A. Pintar, Hazard identification and risk characterization of bisphenols A, F and AF to aquatic organisms, *Environmental Pollution*, 2016, **212**, 472-479.

39. W. J. Ren, Z. Wang, X. H. Yang, J. N. Liu, Q. Yang, Y. W. Chen and S. B. Shen, Acute toxicity effect of bisphenol a and its analogues on adult and embryo of Zebrafish, *Journal of Ecology and Rural Environment*, 2017, **33**, 372-378.
40. N. Liu, X. Jin, C. Feng, Z. Wang, F. Wu, A. C. Johnson, H. Xiao, H. Hollert and J. P. Giesy, Ecological risk assessment of fifty pharmaceuticals and personal care products (PPCPs) in Chinese surface waters: A proposed multiple-level system, *Environment International*, 2020, **136**.
41. D. J. Caldwell, F. Mastrocco, P. D. Anderson, R. Länge and J. P. Sumpter, Predicted-no-effect concentrations for the steroid estrogens estrone, 17β-estradiol, estriol, and 17α-ethinylestradiol, *Environmental Toxicology and Chemistry*, 2012, **31**, 1396-1406.
42. K. Czarny, D. Szczukocki, B. Krawczyk, R. Gadzala-Kopciuch and S. Skrzypek, Toxicity of single steroid hormones and their mixtures toward the cyanobacterium Microcystis aeruginosa, *Journal of Applied Phycology*, 2019, **31**, 3537-3544.
43. K. O. Kusk, A. M. Christensen and N. Nyholm, Algal growth inhibition test results of 425 organic chemical substances, *Chemosphere*, 2018, **204**, 405-412.
44. S. J. Brennan, C. A. Brougham, J. J. Roche and A. M. Fogarty, Multi-generational effects of four selected environmental oestrogens on Daphnia magna, *Chemosphere*, 2006, **64**, 49-55.
45. D. E. Haggard, P. D. Noyes, K. M. WaterS and R. L. Tanguay, Transcriptomic and phenotypic profiling in developing zebrafish exposed to thyroid hormone receptor agonists, *Reproductive Toxicology*, 2018, **77**, 80-93.
46. J. P. Nash, D. E. Kime, L. T. M. Van der Ven, P. W. Wester, F. Brion, G. Maack, P. Stahlschmidt-Allner and C. R. Tyler, Long-term exposure to environmental concentrations of the pharmaceutical ethynylestradiol causes reproductive failure in fish, *Environmental Health Perspectives*, 2004, **112**, 1725-1733.
47. B. I. Escher, N. Bramaz, R. I. L. Eggen and M. Richter, In vitro assessment of modes of toxic action of pharmaceuticals in aquatic life, *Environmental Science & Technology*, 2005, **39**, 3090-3100.
48. S. Jin, F. Yang, T. Liao, Y. Hui, S. Wen and Y. Xu, Enhanced effects by mixtures of three estrogenic compounds at environmentally relevant levels on development of Chinese rare minnow (Gobiocypris rarus), *Environmental Toxicology and Pharmacology*, 2012, **33**, 277-283.
49. S. F. Webb, in *Pharmaceuticals in the Environment: Sources, Fate, Effects and Risks*, ed. K. Kümmerer, Springer Berlin Heidelberg, Berlin, Heidelberg, 2001, DOI: 10.1007/978-3-662-04634-0_16, pp. 203-219.
50. C. Schaefers, M. Teigeler, A. Wenzel, G. Maack, M. Fenske and H. Segner, Concentration- and time-dependent effects of the synthetic estrogen, 17α-ethinylestradiol, on reproductive capabilities of the zebrafish, Danio rerio, *Journal of Toxicology and Environmental Health-Part a-Current Issues*, 2007, **70**, 768-779.
51. S. Lu, C. Y. Lin, K. Lei, M. Xin, B. D. Wang, W. Ouyang, X. T. Liu and M. C. He, Endocrine-disrupting chemicals in a typical urbanized bay of Yellow Sea, China: Distribution, risk assessment, and identification of priority pollutants, *Environmental Pollution*, 2021, **287**, 8.

52. L. Graff, P. Isnard, P. Cellier, J. Bastide, J. P. Cambon, J. F. Narbonne, H. Budzinski and P. Vasseur, Toxicity of chemicals to microalgae in river and in standard waters, *Environmental Toxicology and Chemistry*, 2003, **22**, 1368-1379.
53. M. Hirano, H. Ishibashi, N. Matsumura, Y. Nagao, N. Watanabe, A. Watanabe, N. Onikura, K. Kishi and K. Arizono, Acute toxicity responses of two crustaceans, Americamysis bahia and Daphnia magna, to endocrine disrupters, *Journal of Health Science*, 2004, **50**, 97-100.
54. H. I. Kwak, M. O. Bae, M. H. Lee, Y. S. Lee, B. J. Lee, K. S. Kang, C. H. Chae, H. J. Sung, J. S. Shin, J. H. Kim, W. C. Mar, Y. Y. Sheen and M. H. Cho, Effects of nonylphenol, bisphenol A, and their mixture on the viviparous swordtail fish (Xiphophorus helleri), *Environmental Toxicology and Chemistry*, 2001, **20**, 787-795.
55. M. S. Baptista, T. Stoichev, M. C. P. Basto, V. M. Vasconcelos and M. Vasconcelos, Fate and effects of octylphenol in a Microcystis aeruginosa culture medium, *Aquatic Toxicology*, 2009, **92**, 59-64.
56. M.-H. Ha and J. Choi, Effects of Environmental Contaminants on Hemoglobin Gene Expression in Daphnia magna: A Potential Biomarker for Freshwater Quality Monitoring, *Archives of Environmental Contamination and Toxicology*, 2009, **57**, 330-337.