

## Supporting materials

New insight into the spatiotemporal distribution and ecological risk assessment of endocrine-disrupting chemicals of Minjiang and Tuojiang rivers: Perspective of watershed landscape pattern

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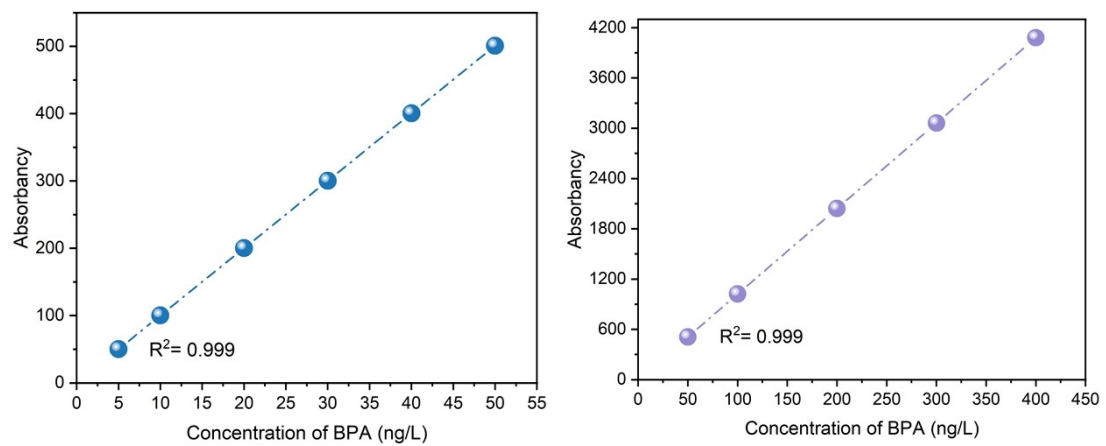


Fig.S1. Standard curve of 0 -50 ng/L (a), 50 - 500 ng/L (b) BPA.

Table S1. The Minimum Quantification Limit (MQL) of EDCs.

Type of EDCs	MQL
E1	0.1
E2	0.1
E3	0.1
EE2	0.1
DES	0.1
BPA	1
NP	0.1
OP	0.01

Note:1. The unit of MQL is ng/L.

Table S2. the recovery and matrixes effects of EDCs.

Type of EDCs	Recovery	Matrix effects
E1	89%	102%
E2	93%	99%
E3	95%	97%
EE2	88%	92%
DES	105%	108%
BPA	110%	101%
NP	100%	95%
OP	107%	104%

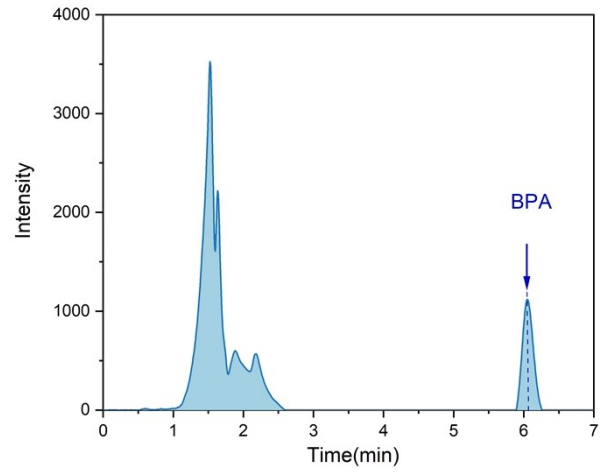
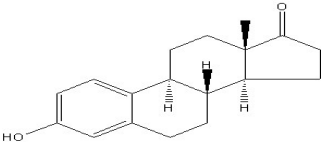
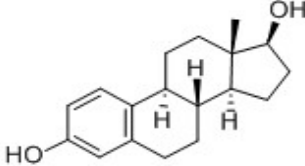
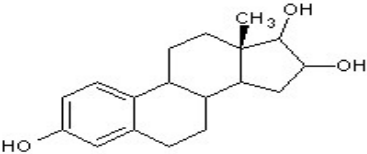
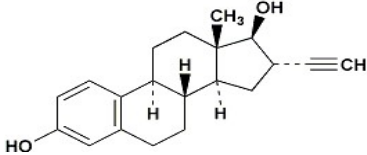
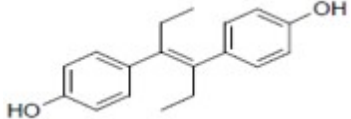
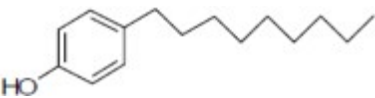
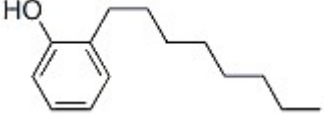
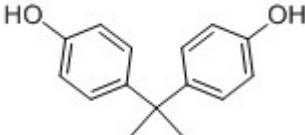


Fig.S2. Chromatogram of BPA ( $C_{\text{BPA}} = 20 \text{ ng/L}$ ).

**Table S3.** Molecular structures and properties of the eight estrogens.

Estrogens name	Molecular formula	Molecular weight	$\log K_{ow}$	Structure
Estrone (E1)	$C_{18}H_{22}O_2$	270.37	3.43	
17 $\beta$ -Estradiol (E2)	$C_{18}H_{24}O_2$	272.38	4.01	
Estriol (E3)	$C_{18}H_{24}O_3$	288.38	2.6	
17 $\alpha$ -Ethinylestradiol (EE2)	$C_{20}H_{24}O_2$	296.41	4.15	
Diethylstilbestrol (DES)	$C_{18}H_{20}O_2$	268.36	5.07	
Nonyl Phenol (NP)	$C_{15}H_{24}O$	220.24	5.71	
Octyl phenol (OP)	$C_{14}H_{22}O$	206.32	4.12	
Bisphenol A (BPA)	$C_{15}H_{16}O_2$	228.29	3.64	

**Table S4.** The mass spectrum parameters of EDCs in MRM mode.

EDCs	Q <sub>1</sub> (m/z)	Q <sub>3</sub> (m/z)	DP <sup>a</sup> (V)	EP <sup>b</sup> (V)
E1	270.4	159.2	-70	-50
		183.3		
E2	272.4	145.1	-70	-57
		183.0		
E3	288	145.0	-70	-57
		171.1		
EE2	365.5	144.9	-65	-55
		158.8		
DES	268.4	222.2	-55	-47
		237.1		
BPA	228	133.0	-50	-38
		212.2		
NP	220.2	133.0	-45	-44
		147.0		
OP	206	106.1	-42	-43
		133.0		

a=Declustering Potential

b=Entrance Potential

**Table S5. 8** Landscape indicators used in the study.

Pointer type	English full name	Calculation formula	Definition of Indicator
CA	Class area	$CA = \sum_{i=1}^n A_i$	By calculating the total category area, one can understand the proportion of each category in the entire landscape.
NuP	Number of patches	$NuP = n_i$	$NuP \geq 1$ , NuP indicates the total number of patches that are equal to a specific type of patch.
PLAND	Percent of landscape	$PLAND = \sum_{i=1}^n a_i \times 1$	$0 < PLAND \leq 100$ , PLAND represents the percentage of the total landscape area occupied by a specific patch type. A higher PLAND value indicates a richer coverage of this patch type in the landscape.
Ci	Fragmentation index	$Ci = \frac{NP_i}{CA_i}$	$0 \leq Ci \leq 1$ , where a lower value of the fragmentation index indicates better connectivity among patches in the landscape and a more intact landscape structure.
LSI	Landscape shape index	$LSI = \frac{0.25E_i}{\sqrt{CA_i}}$	$0 \leq LSI \leq 1$ , When LSI approaches 1, it indicates that the patches in the landscape tend to have irregular shapes, complex boundaries, and a more intricate geometry.
Si	Significance index	$Si = CA_i/A$	$0 \leq Si \leq 1$ , Si is higher when the corresponding patch has greater importance or value in the landscape.
SHDI	Shannon's diversity index	$SHDI = - \sum_{i=1}^n (P_i \ln P_i)$	$SHDI \geq 0$ , SHDI is a measurement index based on information theory that reflects the diversity of the landscape.
SHEI	Shannon's evenness index	$SHEI = (H/H_{max})$	$0 \leq SHEI \leq 1$ , SHEI reflects the evenness and dominance of the landscape composition, and is an important aspect of diversity indices.



**Table S6.** Land landscape pattern index around Minjiang River.

Sampling location	land use type	CA	Number	PLAND	$C_i$	LSI	$S_i$	SHDI	SHEI
M1	Cultivated land	3344.67	72	10.65	2.27	12.79	0.11	1.01	0.63
	Forest	14882.04	33	47.37	7.20	12.26	0.47		
	Grassland	12884.85	44	41.01	3.28	12.29	0.41		
	Water area	261.27	7	0.83	14.29	13.01	0.01		
	Unused land	42.48	1	0.14	0.00	1.77	0.00		
	Urban land	0	0	0.00	0.00	0.00	0.00		
	Rural residential land	0	0	0.00	0.00	0.00	0.00		
	Other construction land	0	0	0.00	0.00	0.00	0.00		
M2	Cultivated land	2328.66	31	7.41	3.23	9.89	0.07	0.92	0.51
	Forest	12003.48	74	38.21	3.52	15.62	0.38		
	Grassland	16962.93	20	53.99	11.58	14.81	0.54		
	Water area	0	0	0.00	0.00	0.00	0.00		
	Unused land	0	0	0.00	0.00	0.00	0.00		
	Urban land	50.04	1	0.16	0.00	2.52	0.00		
	Rural residential land	22.95	3	0.07	0.00	2.28	0.00		
	Other construction land	48.06	6	0.16	20.00	3.55	0.00		
M3	Cultivated land	1213.2	46	3.86	3.38	9.45	0.04	0.91	0.44
	Forest	17320.23	27	55.13	6.27	8.37	0.55		
	Grassland	12402.36	31	39.48	6.67	12.16	0.39		
	Water area	208.17	5	0.66	50.00	15.60	0.01		
	Unused land	11.16	1	0.04	0.00	1.39	0.00		
	Urban land	84.51	2	0.27	100.00	3.13	0.00		
	Rural residential land	45.45	9	0.14	16.67	3.58	0.00		
	Other construction land	131.31	7	0.42	4.76	4.43	0.00		
M4	Cultivated land	10420.83	56	33.17	3.83	13.86	0.33	1.33	0.64

	Forest	14052.96	20	44.7 3	10.53	8.32	0.45		
	Grassland	87.84	9	0.28	2.78	3.92	0.00		
	Water area	1349.1	1	4.29	0.00	5.44	0.04		
	Unused land	104.58	9	0.33	5.56	4.49	0.00		
	Urban land	3918.33	2	12.4 7	100.0 0	5.68	0.12		
	Rural residential land	1124.91	51	3.58	2.67	12.47	0.04		
	Other construction land	356.58	24	1.14	3.26	7.36	0.01		
	Cultivated land	25962.57	10	82.6 4	20.00	16.04	0.83		
	Forest	364.86	55	1.16	3.84	13.16	0.01		
	Grassland	0	0	0.00	0.00	0.00	0.00		
	Water area	857.43	8	2.73	3.57	3.83	0.03	0.6	0.3
M5	Unused land	0	0	0.00	0.00	0.00	0.00	3	5
	Urban land	51.48	1	0.16	0.00	3.13	0.00		
	Rural residential land	3768.48	618	12.0 0	0.93	33.64	0.12		
	Other construction land	410.04	12	1.31	1.52	5.36	0.01		
	Cultivated land	24570.45	13	78.2 1	24.36	11.99	0.78		
	Forest	2852.91	38	9.08	7.97	12.43	0.09		
	Grassland	29.16	3	0.09	0.00	2.11	0.00		
	Water area	28.44	5	0.09	30.00	4.22	0.00	0.7	0.4
M6	Unused land	0	0	0.00	0.00	0.00	0.00	8	0
	Urban land	1424.07	7	4.53	33.33	5.49	0.05		
	Rural residential land	2341.08	247	7.45	1.75	21.77	0.07		
	Other construction land	169.92	18	0.54	3.27	5.94	0.01		
	Cultivated land	21755.43	23	69.2 5	11.86	20.13	0.69		
	Forest	1352.52	107	4.31	2.72	18.65	0.04		
	Grassland	27.63	2	0.09	100.0 0	2.00	0.00		
M7	Water area	744.84	56	2.37	1.88	13.10	0.02	1.0	0.5
	Unused land	0	0	0.00	0.00	0.00	0.00	2	2
	Urban land	173.34	4	0.55	16.67	2.90	0.01		
	Rural residential land	12191	410	12.1 9	0.83	30.85	0.12		
	Other construction land	3532.41	19	11.2	3.51	10.39	0.11		

	land			4					
M8	Cultivated land	21607.2	50	68.78	6.61	17.26	0.69		
	Forest	4377.6	91	13.94	2.30	17.49	0.14		
	Grassland	76.68	4	0.24	16.67	3.17	0.00		
	Water area	1433.97	30	4.56	2.30	11.19	0.05	1.0	0.5
	Unused land	182.61	8	0.58	21.43	5.70	0.01	8	2
	Urban land	867.78	1	2.76	0.00	3.62	0.03		
	Rural residential land	2314.89	195	7.37	1.50	21.03	0.07		
	Other construction land	553.23	18	1.76	2.61	5.12	0.02		
M9	Cultivated land	23494.05	19	74.79	18.71	12.80	0.75		
	Forest	657.54	70	2.09	1.61	13.05	0.02		
	Grassland	0	0	0.00	0.00	0.00	0.00		
	Water area	1239.48	27	3.95	3.13	10.31	0.04		
	Unused land	179.37	14	0.57	9.89	6.84	0.01	0.9	0.4
	Urban land	2236.86	2	7.12	0.00	2.78	0.07	6	9
	Rural residential land	2566.35	201	8.17	1.27	20.86	0.08		
	Other construction land	1041.3	22	3.31	2.60	8.17	0.03		
M10	Cultivated land	18615.33	69	59.26	4.77	18.85	0.59		
	Forest	6276.15	149	19.98	1.63	21.02	0.20		
	Grassland	4.77	1	0.02	0.00	1.53	0.00		
	Water area	2439	12	7.76	6.06	11.37	0.08	1.2	0.5
	Unused land	7.74	2	0.02	0.00	1.84	0.00	2	9
	Urban land	2512.8	9	8.00	16.67	7.25	0.08		
	Rural residential land	859.77	112	2.74	1.54	15.81	0.03		
	Other construction land	699.12	28	2.23	3.97	7.75	0.02		
M11	Cultivated land	23886.18	23	76.03	10.67	15.53	0.76		
	Forest	4359.6	181	13.88	1.60	26.23	0.14	0.8	0.4
	Grassland	8.91	1	0.03	0.00	1.25	0.00	0	1
	Water area	1945.08	21	6.19	4.76	10.28	0.06		
	Unused land	7.2	1	0.02	0.00	1.78	0.00		
	Urban land	0	0	0.00	0.00	0.00	0.00		

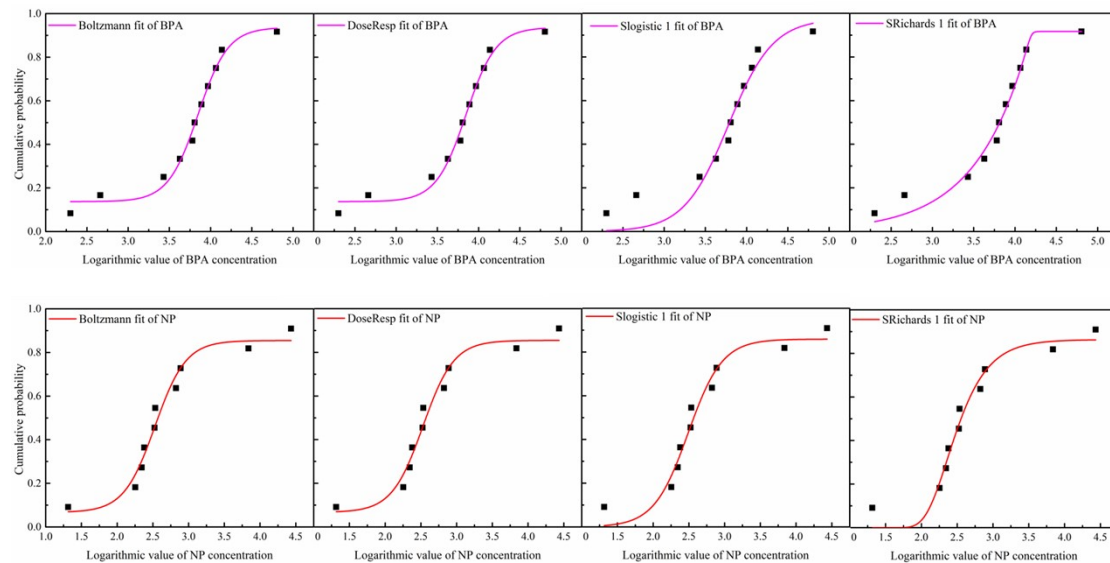
	Rural residential land	1079.1	41	3.43	2.20	8.75	0.03		
	Other construction land	129.24	5	0.41	0.00	3.86	0.00		
M12	Cultivated land	23727.42	18	75.5 3	13.07	13.58	0.76		
	Forest	3488.85	165	11.1 1	1.39	25.02	0.11		
	Grassland	143.91	4	0.46	16.67	4.49	0.00		
	Water area	1562.85	11	4.97	1.82	8.58	0.05	0.9	0.4
	Unused land	0	0	0.00	0.00	0.00	0.00	0	6
	Urban land	1586.61	6	5.05	26.67	4.77	0.05		
	Rural residential land	166.05	10	0.53	4.44	5.85	0.01		
	Other construction land	739.26	13	2.35	1.28	6.05	0.02		

**Table S7.** The physiochemical parameters on sampled water.

Sample sit	Month		BPA	NP	EDCs	pH	TUB	DO	COD <sub>Mn</sub>	NH <sub>3</sub> -N
T4	Aug	1	23.95	4.14	28.284	8.35	20.6	7.57	0.755	0.76
T5	Aug	2	35.95	4.915	40.865	8.51	158	7.04	0.755	0.099

Sample sit	Month		BPA	NP	EDCs	pH	TUB	DO	COD <sub>Mn</sub>	NH <sub>3</sub> -N
T6	Aug	3	9.215	3.485	12.700	8.58	24.4	7.82	3.774	0.067
T7	Aug	4	11.7	5.835	17.535	8.53	43.7	7.54	3.774	0.094
M7	Aug	5	43.8	6.545	50.515	8.15	41.9	5.33	3.774	0.658
M8	Aug	6	50.6	4.81	55.586	8.46	34.7	7.18	2.642	0.158
M9	Aug	7	41.5	4.4	65.900	8.51	18.2	7.09	3.396	0.185
M10	Aug	8	17.6	4.265	21.989	8.28	19.3	7.06	0.755	0.078
M11	Aug	9	16.1	6.455	22.763	8.57	95.1	8.83	1.509	0.094
M12	Aug	10	18.15	5.625	23.866	8.58	96.9	9.53	3.774	0.061
M1	Aug	11	15.45	5.44	21.157	8.7	18.5	7.93	2.264	0.11
T1	Aug	12	61.7	7.3	71.161	7.85	20.6	7.2	4.528	0.5235
T2	Aug	13	74.6	8.025	82.812	7.94	21.87	7.36	4.906	0.3193
T3	Aug	14	40.4	4.835	45.399	7.96	15.03	7.39	3.774	0.1957
M4	Aug	15	9.91	3.88	13.935	8.3	22.4	8.61	0.377	0.0345
M5	Aug	16	6.93	4.41	11.955	8.22	15.57	8.53	2.264	0.056
M2	Aug	17	7.705	4.035	11.955	8.35	7.96	7.91	0.377	0.0614
M3	Aug	18	10.1	6.69	15.265	8.32	22.57	7.92	7.17	0.0292
M5	Sep	19	14.95	2.06	17.010	8.29	14	8.95	1.96	0.08
M2	Sep	20	20	3.065	23.065	8.41	64	8.52	4.85	0.09
M3	Sep	21	15.95	3.52	26.294	8.43	61	8.72	7.74	0.86
T4	Sep	22	27.15	6.755	33.905	7.98	28	7.79	8.08	0.841
T5	Sep	23	53	2.35	55.350	8.06	19.7	7.5	7.81	0.217
T6	Sep	24	18.7	2.295	20.995	8.17	16.8	7.8	5.18	0.083
T7	Sep	25	17.9	3.6	21.500	8.12	18.6	7.56	5.71	0.244
M7	Sep	26	38.65	6.915	45.865	7.73	13.8	5.97	8.34	0.991
M8	Sep	27	54.65	4.655	59.305	8.04	15.9	7.85	8.08	0.567
M9	Sep	28	56	2.965	58.965	7.91	10	7.21	11.5	0.153
M10	Sep	29	34.45	1.975	36.425	8.2	61	8.6	5.81	0.147
M11	Sep	30	25.7	2.505	28.366	8.18	37.2	8.6	10.44	0.137
M12	Sep	31	22.5	2.925	25.425	8.3	200	8.36	15.71	0.099
T4	Oct	32	16.6	3.48	22.718	7.5	10	7.15	22.72	2.25
T5	Oct	33	36.45	2.38	39.504	7.12	9.1	7.71	20.41	0.33
T6	Oct	34	23.25	3.16	26.625	6.85	11.5	7.63	35.71	0.14
T7	Oct	35	21	3.605	25.395	7.41	6.4	7.6	23.65	0.25
M2	Oct	36	5.1	3.11	8.390	6.75	9.21	8.88	20.87	0.12
M3	Oct	37	6.09	2.345	11.158	8.03	9.73	7.15	22.72	0.15
M1	Oct	38	13.04	2.385	15.615	8.17	88.2	8.79	18.09	0.34
M4	Oct	39	11.03 5	2.18	13.258	8.22	10.8	8.89	20.41	0.046
M5	Oct	40	5.635	2.495	10.196	8	13.5	8.79	19.48	0.171
M6	Oct	41	8.61	2.685	11.471	8.06	15.8	9.14	19.48	0.082
T1	Oct	42	203.5	11.8	215.300	7.56	7.6	7.81	0.94	2.206
T2	Oct	43	92.2	9.565	102.088	7.27	7.61	7.76	0.63	1.509

Sample sit	Month		BPA	NP	EDCs	pH	TUB	DO	COD <sub>Mn</sub>	NH <sub>3</sub> -N
T3	Oct	44	101.5	8.93	111.564	7.78	9.22	8.55	0.63	0.872
M7	Oct	45	42.7	9.785	58.345	7.91	59.3	8.07	2.51	0.937
M8	Oct	46	39.7	3.27	43.227	8.02	9.97	9.45	2.82	0.272
M9	Oct	47	35.6	4.635	40.418	7.53	17.3	8.56	1.88	0.248
M10	Oct	48	24.7	2.07	28.242	8.03	23.6	8.97	1.25	0.2
M11	Oct	49	22.15	2.595	24.872	7.85	19.2	8.72	2.82	0.27



**Fig. S3.** Comparison of different models fitting for acute toxicity data of BPA and NP.