

Ammonia influences the zooplankton assemblage and beta di-versity patterns in complicated urban river ecosystems

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Supplementary material

Table S1. Sampling sites in the rivers of Shanghai City.

Municipality	District	River	Sampling sites	Longitude	Latitude	Group	
						April	July
Shanghai	Jiading	Tangjiabang	S1	121°16'08.73"	31°24'39.15"	II	I
			S2	121°16'17.71"	31°24'40.94"	I	I
			S3	121°16'26.12"	31°24'42.72"	II	I
		Xiaoxinjing	S4	121°16'30.28"	31°25'17.20"	II	I
			S5	121°16'35.92"	31°25'04.14"	II	I
			S6	121°16'35.25"	31°24'45.43"	II	I
			S7	121°16'33.45"	31°24'27.32"	II	I
		Qianqiaocha	S8	121°16'14.96"	31°25'18.95"	II	I
			S9	121°16'27.66"	31°25'24.42"	II	I
			S10	121°16'40.42	31°25'26.85"	II	I

		S11	121°22'53.37"	30°53'11.87"	II	I
Feng Xian	Suojiagang	S12	121°22'56.36"	30°52'57.37"	II	I
		S13	121°22'55.36"	30°52'42.01"	II	I
		S14	121°20'15.0"	31°2'54.53"	II	I
	Songchang	S15	121°22'28.74"	31°2'57.23"	II	I
	bang	S16	121°21'16.20"	31°3'2.77"	II	I
Minhang	Sujiagang	S17	121°20'59.64"	31°2'5.93"	I	I
		S18	121°20'51.0"	31°2'3.73"	II	I
	Yuanjiagang	S19	121°20'59.64"	31°2'5.93"	I	I
	Beihaungni	S20	121°26'32.7"	121°26'32.7"	II	I
	tang	S21	121°26'19.2"	31°21'58.9"	I	I
Baoshan	Anmugang	S22	121°26'24.7"	31°23'29.3"	II	I
	Shenshibang	S23	121°25'56.8"	31°23'4.0"	II	I
	Yanghang	S24	121°26'38.0"	31°22'50.2"	II	I
	changbang					

Table S2. The relative abundances of the dominant zooplankton taxa and Beta diversity in Group I and Group II.

Species		Species code	Group I (NH ₃ -N < 1.03)	Group II (NH ₃ -N ≥ 1.03)
	Numbers		65	50
Dominant species and indicator species	Rotifera	<i>Polyarthra dolichoptera</i>	sp1	38.4**
		<i>P. trigla</i>	sp2	1.6
		<i>Brachionus angularis</i>	sp3	8.4#
		<i>B. calyciflorus</i>	sp4	3.7
		<i>B. forficula</i>	sp5	1.1*
		<i>B. falcatus</i>	sp6	0.7*
		<i>Keratella cochlearis</i>	sp7	7.9#
		<i>K. valga</i>	sp8	1.0*
		<i>K. quadrata</i>	sp9	-

	<i>Filinia longisela</i>	sp10	5.6 [#]	7.2 [#]
	<i>Anuraeopsis fissa</i>	sp11	5.4 ^{**}	0.2
	<i>Asplanchna</i> sp.	sp12	1.4	16.4 ^{**#}
	<i>A. priodonta</i>	sp13	0.6	3.6 [*]
	<i>Trichocercas</i> sp.	sp14	4.0 ^{**}	-
	<i>T. pusilla</i>	sp15	3.8 [*]	-
Copepoda	<i>Thermocyclops taihokuensis</i>	sp16	0.3 [#]	0.9 [#]
	<i>T. kawamurai</i>	sp17	0.2 [#]	0.1
	<i>Mesocyclops leuckarti</i>	sp18	0.2 ^{*#}	0.1
Cladocera	<i>Diaphanosoma leuchtenbergianum</i>	sp19	0.4 ^{**#}	0.01
	<i>Moina</i> sp.	sp20	0.1 ^{*#}	-
	<i>M. micrura</i>	sp21	0.1 ^{*#}	0.01
	<i>Bosmina coregoni</i>	sp22	0.1 [#]	0.9 ^{***}
	<i>B. longirostris</i>	sp23	-	0.3 ^{**#}
	<i>Bosminopsis deitersi</i>	sp24	-	0.1 [*]
	<i>Chydorus sphaericus</i>	sp25	-	0.1 ^{**}

Note: #, dominant species; * & **, indicator species, * $P < 0.05$, ** $P < 0.01$; -, not detected in the group.

Table S3. Linear regression relationship between beta diversity and environmental factors in the rivers of Shanghai City.

Environmental variables	Btotal		Brich		BrepI	
	R ²	P	R ²	P	R ²	P
NH ₃ -N	0.082	0.03*	-0.018	0.70	0.104	0.01*
TN	0.118	0.01*	-0.020	0.81	0.118	0.01*
TP	-0.021	0.87	-0.004	0.37	-0.007	0.42
Chla	0.048	0.07	-0.021	0.89	0.018	0.18
COD	0.055	0.06	-0.020	0.79	0.017	0.17

DO	0.036	0.10	-0.006	0.40	-0.008	0.45
Cond	-0.006	0.41	-0.012	0.51	-0.021	0.86
pH	-0.001	0.34	-0.004	0.38	-0.022	0.95
WT	0.012	0.21	-0.020	0.80	0.030	0.12

Table S4. Variations of environmental factors in the nutrient addition experiment.

Variables	0d							10d						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
TN (mg·L ⁻¹)	0.6	0.9	1.4	2.0	2.8	3.6	5.6	0.7	0.8	1.1	1.4	1.8	2.1	3.5
	± 0.07	± 0.07	± 0.13	± 0.11	± 0.07	± 0.04	± 0.14	± 0.10	± 0.01	± 0.09	± 0.18	± 0.15	± 0.14	± 0.25
NH ₃ -N(mg·L ⁻¹)	0.2	0.6	0.9	1.8	2.6	3.4	5.0	0.2	0.4	0.4	0.7	1.3	1.4	2.8
	± 0.01	± 0.03	± 0.07	± 0.01	± 0.02	± 0.07	± 0.02	± 0.05	± 0.06	± 0.08	± 0.02	± 0.23	± 0.16	± 0.25
NO ₂ -N(mg·L ⁻¹)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.004	0.005	0.006	0.006
	± 0	± 0	± 0	± 0	± 0	± 0	± 0	± 0	± 0	± 0	± 0	± 0.002	± 0	± 0
NO ₃ -N(mg·L ⁻¹)	0.03	0.05	0.07	0.07	0.06	0.06	0.05	0.05	0.04	0.10	0.16	0.15	0.32	0.26
	± 0.01	± 0.01	± 0.02	± 0	± 0.01	± 0.02	± 0.01	± 0	± 0.01	± 0.01	± 0.04	± 0.02	± 0.02	± 0.04
TP (mg·L ⁻¹)	0.14 ±	0.14	0.15	0.14	0.15	0.14	0.14	0.1	0.09	0.10	0.09	0.11	0.12	0.12
	0.01	± 0.01	± 0.01	± 0.01	± 0.01	± 0	± 0	± 0.03	± 0.01	± 0.01	± 0.01	± 0.01	± 0.01	± 0.03
TDP (mg·L ⁻¹)	0.09	0.09	0.09	0.09	0.09	0.09	0.8	0.04	0.02	0.03	0.03	0.04	0.06	0.06
	± 0	± 0	± 0.01	± 0.01	± 0	± 0.01	± 0	± 0.01	± 0	± 0.	± 0.01	± 0.01	± 0.01	± 0
Chla (ug·L ⁻¹)	21.9	24.1	29.0	29.0	26.0	28.4	29.1	10.4	22.7	34.5	29.4	33.6	45.0	52.5
	± 0.51	± 2.24	± 0.43	± 0.43	± 2.27	± 0.70	± 2.01	± 3.82	± 1.88	± 2.45	± 17.08	± 4.00	± 8.86	± 8.98
pH	8.1	8.3	8.3	8.3	8.2	8.2	8.2	8.6	8.8	8.9	8.9	8.9	8.9	8.8
	± 0.10	± 0.04	± 0.01	± 0.01	± 0.01	± 0.01	± 0.08	± 0.12	± 0.08	± 0.04	± 0.02	± 0.01	± 0.06	± 0.03

DO (mg·L ⁻¹)	9.2	9.6	9.7	9.7.	9.6	9.7	9.7	9.1	9.8	9.6	9.6	9.7	10.1	10.2
	± 0.47	± 0.08	± 0.02	± 0.02	± 0.02	± 0.03	± 0.04	± 0.12	± 0.27	± 0.16	± 0.34	± 0.07	± 0.27	± 0.23
Cond (uS·cm ⁻¹)	728.59	736.08	745.09	754.39.	766.49	773.8	789.20	790.92	792.17	796.63	779.63	792.15	806.17	822.31
	± 4.14	± 1.20	± 1.70	± 1.26	± 1.82	± 2.20	± 2.98	± 3.58	± 2.93	± 4.28	± 4.66	± 10.91	± 10.93	± 6.62

Table S5. The relative abundance of dominant zooplankton taxa in the different treatments.

Species		Species code	A	B, C, D, E, F	G
Dominant species	Rotifera	<i>Trichocerca stylata</i>	sp1	14.6 [#]	1.9
		<i>Colurella obtusa</i>	sp2	17.9 [#]	9.6 [#]
		<i>Polyarthra dolichoptera</i>	sp3	21.1 [#]	1.7
		<i>Brachionus falcatus</i>	sp4	-	2.2
		<i>B. urceus</i>	sp5	-	0.8
		<i>B. forficula</i>	sp6	-	2.1
		<i>B. angularis</i>	sp7	1.6	5.6 [#]
		<i>B. calyciflorus</i>	sp8	1.6	40.1 [#]
	Copepoda	<i>Thermocyclops taihokuensis</i>	sp9	3.2 [#]	2.1 [#]
		<i>T. vermifer</i>	sp10	0.7 [#]	0.5 [#]
		<i>T. hyalinus</i>	sp11	2.5 [#]	1.8 [#]
		<i>Mesocyclops leuckarti</i>	sp12	8.8 [#]	3.7 [#]
	Cladocera	<i>Daphnia carinata</i>	sp13	0.9 [#]	0.5 [#]
		<i>Scapholeberis aurita</i>	sp14	-	-
		<i>Simocephalus Vetulus</i>	sp15	0.3 [#]	0.1 [#]
		<i>Bosmina longirostris</i>	sp16	-	0.1 [#]
		<i>B. coregoni</i>	sp17	0.2 [#]	0.1 [#]



Figure S1. Conceptual diagram (a) and experimental simulation device (b) of nutrient addition experiment.

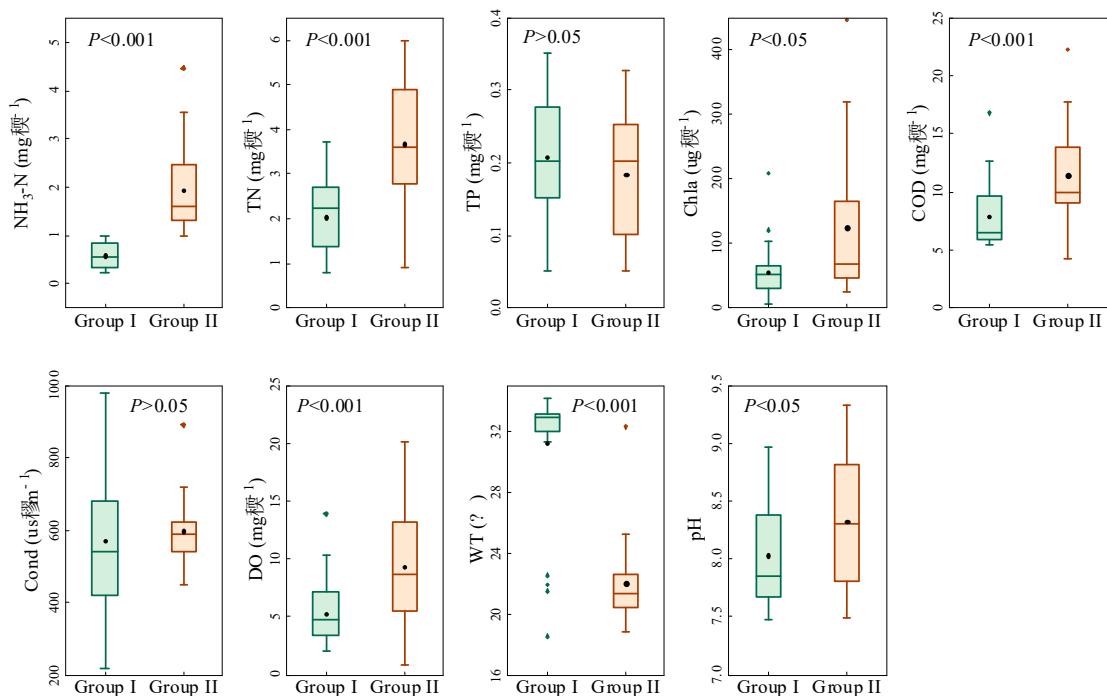


Figure S2. Characteristics of environmental factors in the different groups.

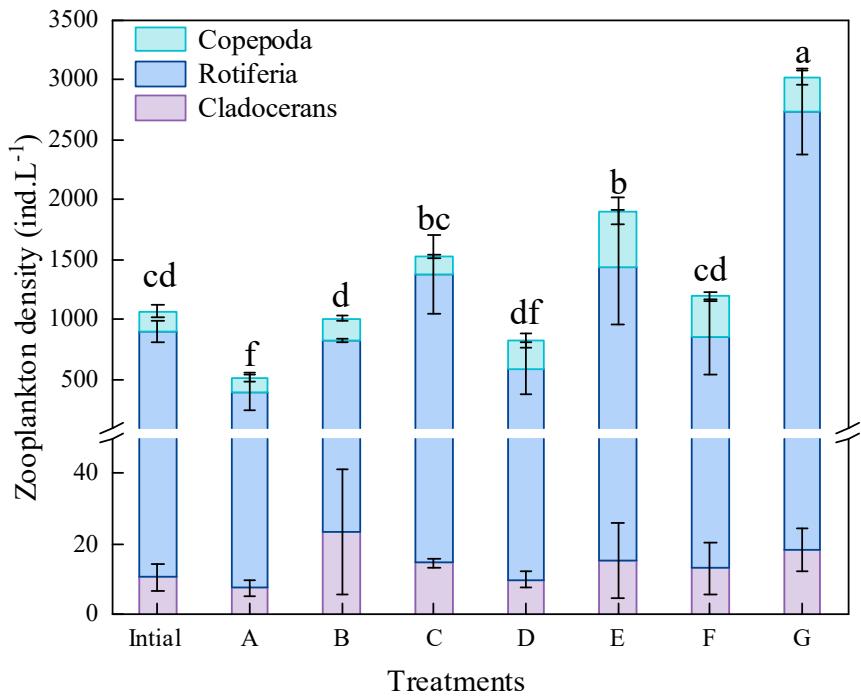


Figure S3. Zooplankton density and relative abundance in the nutrient addition experiment. Different letters represent significant differences ($P < 0.05$).

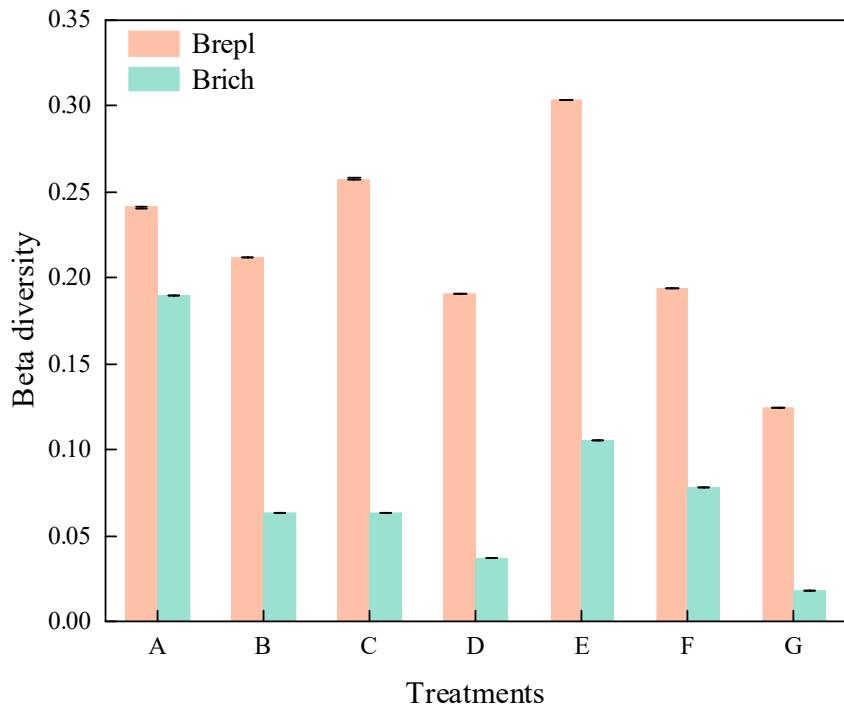


Figure S4. Beta diversity of zooplankton assemblages in the nutrient addition experiment.