Ecological health status of the Yitong River, China, assessed with the Planktonic Index of Biotic Integrity

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Table S1. Candidate metrics for the phytoplankton index of biotic integrity (Phyto−IBI).

Level	Candidate metric and abbreviation	Formula	Reference
Biomass	**P1** Phytoplankton biomass (−)		[1]
Abundance	**P2** Phytoplankton abundance (−)		[1]
	P3 Cyanophyta abundance (−)		[1]
	P4 Chlorophyta abundance (−)		[1]
	P5 Bacillariophyta abundance (−)		[2]
	P6 % cyanophyta abundance (−)		[1]
	P7 % chlorophyta abundance (−)		[1]
	P8 % bacillariophyta abundance (+)		[2]
	P9 % navicula abundance (+)		[1]
	P10 % cymbella abundance (+)		[1]
	P11 % dominant species abundance (−)		[1]
	P12 % total abundance of cyanophyta and chlorophyta (−)		[1]
	P13 % total abundance of chlorophyta and bacillariophyta (+)		[2]
Diversity index	**P14** Phytoplankton species number (−)		[1]
	P15 Margalef richness index (−)	$d_M = (S - 1) / Ln\ N$	[1,3]
	P16 Pielou evenness index (+)	$J = H' / Ln\ S$	[1,4]
	P17 Simpson diversity index (−)	$D = 1 - Sum\ ((N_i * (N_i - 1)) / (N * (N - 1)))$	[1,5]
	P18 Shannon−Wiener diversity index (+)	$H' = - \Sigma(n_i/N) * ln(n_i/N)$	[1,6]
Trophic status	**P19** Trophic diatom index (+)	$TDI = \Sigma(a_j v_j i_j) / \Sigma(a_j v_j)$	[1,7]
	P20 Diatom quotient (−)	Centrales abundance/pennales abundance	[1,8]
	P21 Palmer algal genus pollution index (+)	Sum of biological pollution index values	[1,9]
	P22 Generic diatom index (−)	Abundances of (achnanthes + cocconeis + cyclotella) / abundances of (cymbella + melosira + nitzschia)	[1,10]

Note: + indicates a positive response to environmental factors; − indicates a negative response.

Table S2. Candidate metrics for the zooplankton index of biotic integrity (Z−IBI).

Level	Candidate metric and abbreviation	Formula	Reference
Biomass	**Z1** Zooplankton biomass (−)		[1]
	Z2 Zooplankton biomass/phytoplankton biomass (−)		[1]
Abundance	**Z3** Zooplankton abundance (−)		[1]
	Z4 Rotifer abundance (−)		[1]
	Z5 Protozoa abundance (−)		Current research
	Z6 Cladocera abundance (+)		[1]
	Z7 Copepod abundance (−)		[1]
	Z8 Copepod nauplii abundance (−)		[1]
	Z9 % rotifer abundance (−)		[1]
	Z10 % protozoa abundance (+)		Current research
	Z11 % total abundance of cladocera and copepod (−)		[1]
	Z12 % dominate species abundance (−)		[1]
Diversity index	**Z13** Zooplankton species number (−)		[1]
	Z14 Rotifer species (−)		[1]
	Z15 Margalef richness index (−)	$d_M = (S-1) / \ln N$	[1,3]
	Z16 Pielou evenness index (−)	$J = H' / \ln S$	[1,4]
	Z17 Simpson diversity index (+)	$D = 1 - \mathrm{Sum}\,((N_i * (N_i-1)) / (N * (N-1)))$	[1,5]
	Z18 Shannon−Wiener diversity index (−)	$H' = -\Sigma(n_i/N) * \ln(n_i/N)$	[1,6]
Trophic status	**Z19** B/T (−)	B/T = Brachionus abundance / Trichocera abundance	[1,11]
	Z20 E/O index (+)	E/O = Eutrophic−mesotrophic indicators species number / Oligotrophic−mesotrophic indicators species number	[1,12]
	Z21 Fertility of zooplankton (−)	$E' = (K(x+1)) / ((A+Y)(y+1))$	[1,13]

Note: + indicates a positive response to environmental factors; − indicates a negative response.

Table S3. Weights and normalization factors of the parameters used in the WQI.

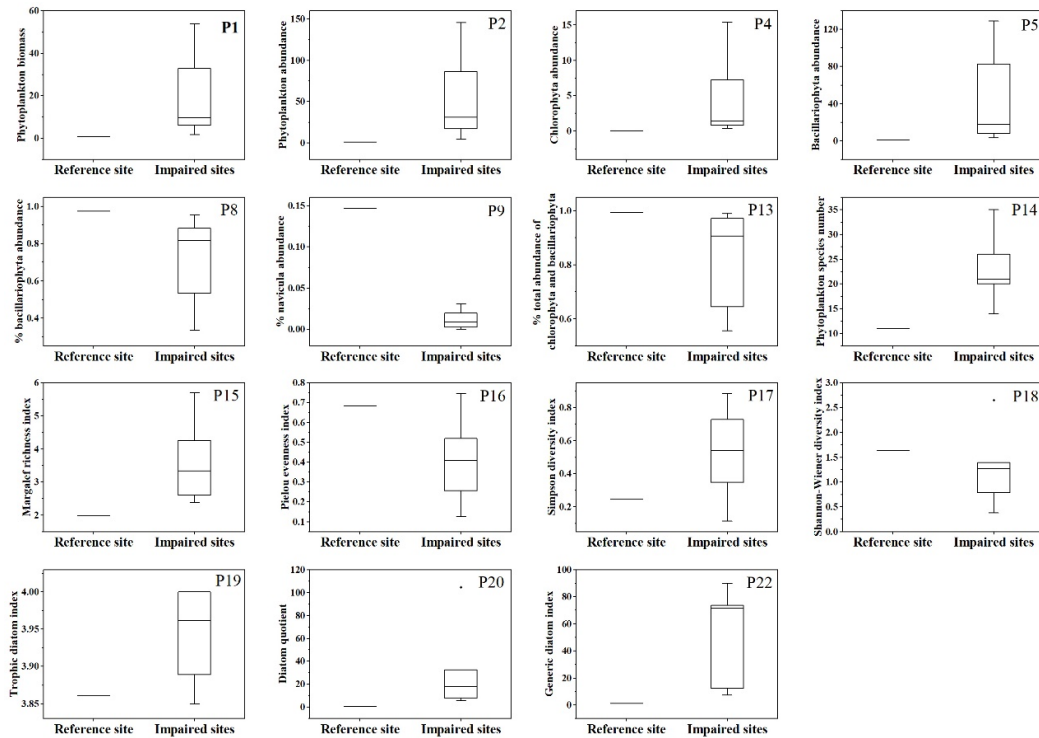| Variables	Weight	Normalization factor (C_i)										
	(P_i)	100	90	80	70	60	50	40	30	20	10	0
WT	1	21/16	22/15	24/14	26/12	28/10	30/5	32/0	36/−2	40/−4	45/−6	>45/−6
pH	1	7	7−8	7−8.5	7−9	6.5−7	6−9.5	5−10	4−11	3−12	2−13	1−14
DO	4	≥7.5	> 7	> 6.5	> 6	> 5	> 4	> 3.5	> 3	> 2	≥1	< 1
TN	2	< 0.1	< 0.2	< 0.35	< 0.5	< 0.75	< 1	< 1.25	< 1.5	< 1.75	≤2	> 2
NH_4^+-N	3	< 0.01	< 0.05	< 0.1	< 0.2	< 0.3	< 0.4	< 0.5	< 0.75	< 1	≤1.25	> 1.25
NO_3^--N	2	< 0.5	< 2	< 4	< 6	< 8	< 10	< 15	< 20	< 50	≤100	> 100
TP	1	< 0.01	< 0.02	< 0.05	< 0.1	< 0.15	< 0.2	< 0.25	< 0.3	< 0.35	≤0.4	> 0.4
COD_{Cr}	3	<5	<10	<20	<30	<40	<50	<60	<80	<100	≤150	> 150
COD_{Mn}	3	<1	<2	<3	<4	<5	<8	<10	<12	<14	≤15	> 15

Figure S1. Boxplots of 15 candidate metrics between the reference site and impaired sites in spring.

Table S4. Correlation analysis among 15 candidate metrics in spring

	P1	P2	P4	P5	P8	P9	P13	P14	P15	P16	P17	P18	P19	P20	P22
P1	1														
P2	**0.997****	1													
P4	0.746	**0.767***	1												
P5	**0.997****	**0.990****	0.717	1											
P8	0.307	0.242	−0.119	0.367	1										
P9	−0.437	−0.454	−0.268	−0.412	0.285	1									
P13	0.339	0.274	0.105	0.400	**0.916****	0.302	1								
P14	−0.050	−0.025	0.346	−0.063	−0.584	−0.395	−0.263	1							
P15	−0.226	−0.198	0.273	−0.245	−0.659	−0.292	−0.343	**0.973****	1						
P16	−0.711	−0.675	−0.170	−0.742	−0.586	0.582	−0.506	0.146	0.328	1					
P17	0.708	0.666	0.172	0.744	0.658	−0.503	0.596	−0.175	−0.355	**−0.993****	1				
P18	−0.639	−0.596	−0.023	−0.674	**−0.754***	0.344	−0.576	0.485	0.636	**0.935****	**−0.942****	1			
P19	0.431	0.438	0.200	0.418	0.096	−0.551	−0.089	−0.174	−0.222	−0.504	0.429	−0.500	1		
P20	0.596	0.578	0.005	0.625	0.355	−0.420	0.259	−0.108	−0.323	**−0.783***	**0.771***	−0.724	0.168	1	
P22	0.730	0.704	0.261	0.743	0.440	−0.651	0.484	−0.177	−0.343	**−0.891***	**0.903***	**−0.818***	0.319	0.740	1

Note: * indicates significant correlation at 0.05 level; ** indicates significant correlation at 0.01 level.

Table S5. Water quality parameters of Yitong River in different seasons.

Parameters	Water quality parameters in different seasons			
	Spring	Summer	Autumn	Winter
TN (mg/L)	3.25 ± 1.82	4.05 ± 2.10	3.78 ± 1.60	4.78 ± 2.40
NH_4^+-N (mg/L)	0.64 ± 0.32	0.71 ± 0.75	1.09 ± 1.65	0.26 ± 0.32
NO_3^--N (mg/L)	1.63 ± 1.58	1.70 ± 1.33	2.05 ± 1.45	3.44 ± 2.21
TP (mg/L)	0.17 ± 0.09	0.31 ± 0.07	0.18 ± 0.13	0.12 ± 0.06
COD_{Cr} (mg/L)	24.62 ± 7.84	43.16 ± 17.25	27.41 ± 13.49	20.00 ± 8.17
COD_{Mn} (mg/L)	6.17 ± 1.41	6.30 ± 1.84	5.73 ± 1.43	4.84 ± 1.94
WT (°C)	10.71 ± 2.66	22.11 ± 2.34	13.91 ± 0.67	1.29 ± 0.88
DO (mg/L)	10.63 ± 1.75	7.18 ± 2.04	8.32 ± 1.48	10.18 ± 1.54
pH	8.29 ± 0.52	7.81 ± 0.60	7.76 ± 0.32	7.94 ± 0.40
SD (m)	54.31 ± 21.91	49.29 ± 12.78	44.43 ± 15.66	52.57 ± 19.73

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