Supplementary data

Ecological integrity assessment of alpine lotic ecosystems: a case study a high altitude national park in Northern Pakistan

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Table S1: Pearson/ (R) correlation among environmental variables & biotic indices

Variables	Temp/℃	Air Temp/℃	pH	Turbidity/NTU	DO/(mg/L)	EC/(µS/cm)	TDS/(mg/L)	TSS/(mg/L)
EPT index	0.245	0.452	0.032*	0.114	0.038*	0.192	0.437	0.354
ASPT index	0.212	0.084	0.076	0.324	0.244	0.237	0.349	0.431
BMWP index	0.127	0.058*	0.289	0.159	0.372	0.449	0.368	0.174
NEPBIOS index	0.081	0.002**	0.363	0.403	0.194	0.059*	0.213	0.46
EPT/%	0.277	0.205	0.35	0.404	0.159	0.286	0.078	0.357
Diptera/%	0.461	0.469	0.332	0.456	0.482	0.493	0.381	0.356
Family biotic_1-D	0.486	0.352	0.221	0.356	0.422	0.044	0.158	0.035*
Dominance_d	0.404	0.417	0.249	0.456	0.332	0.303	0.181	0.371
Simpson_1-D	0.093	0.059*	0.331	0.349	0.274	0.378	0.269	0.473
Shannon_H	0.066	0.039*	0.499	0.203	0.141	0.425	0.205	0.326
Evenness_e^H/S	0.125	0.404	0.201	0.378	0.206	0.398	0.224	0.266
Margalef index	0.062	0.039*	0.027*	0.012*	0.011*	0.096	0.095	0.134
Fisher_alpha	0.062	0.073	0.007**	0.002**	0.001**	0.046*	0.073	0.121
Berger-Parker	0.263	0.165	0.161	0.495	0.348	0.369	0.185	0.359
Equitability_J	0.109	0.075	0.242	0.491	0.361	0.236	0.339	0.291

* Pearson correlations matrix between environmental variables, community and biotic indices among two seasons (**=P<0.01;*=P<0.05)

Table S2: Factor loading for selected metals, biological and physicochemical parameters in water samples of the study area

Parameters	FI	F2	F3	F4	F5	F6	F7	F8	F9	F10
Temp/℃	.380	.534	**.553**	-.082	-.081	-.386	.174	.053	-.064	-.021
Air Temp/℃	.476	.447	**.338**	-.186	.144	-.475	.033	-.043	-.009	.082
pH	-.411	.340	-.079	-.504	.204	-.096	-.126	-.382	-.074	-.273
Turbidity/NTU	-.360	.460	.070	.393	-.072	.171	**.587**	-.023	.230	-.044
DO/(mg/L)	.525	-.046	.401	.264	.127	.105	-.252	-.286	**.258**	.100
EC/(μS/cm)	-.162	**.893**	-.274	-.018	-.127	.091	-.183	-.103	-.015	.015
TDS/(mg/L)	-.705	**.653**	-.053	-.029	-.061	.075	-.076	-.109	-.006	.059
TSS/(mg/L)	-.162	**.689**	-.260	.309	-.093	-.052	**.443**	.149	.105	-.029
River width/m	.384	.211	.510	-.231	-.081	.292	-.214	.203	-.334	-.066
Velocity m/sec	.380	-.135	-.051	.095	.240	.712	.175	-.136	.167	.086
Boulders/%	.204	-.250	-.441	.266	.025	.149	-.193	.440	.031	-.538
Cobbles/%	**.605**	-.059	-.437	-.173	-.209	.406	-.021	-.068	.032	**.414**
Pebbles/%	.510	**.648**	.261	-.100	.032	-.351	.050	-.268	-.053	.128
Vegetation/%	**.636**	-.229	-.082	**.523**	.322	-.025	.208	-.133	-.178	.071
Elevation/m	-.581	-.573	-.516	-.032	-.067	.120	-.031	.027	.118	-.070
PSI	.577	.584	-.356	-.298	-.188	-.016	-.074	-.063	.058	-.045
Macroinvertebrates abundance	**.678**	-.238	-.064	**.547**	.231	.036	.119	-.037	-.162	.122
Taxa richness	**.812**	-.031	.272	-.352	.042	.171	.216	.144	.109	-.072
Diptera abundance	.024	.198	-.260	-.343	**.713**	.203	-.181	.178	.183	.223
EPT/%	**.678**	-.019	-.260	.334	-.493	.011	.115	-.102	.022	-.093
BMWP _1-D	**.820**	-.093	.437	-.162	-.065	.138	.164	.087	-.050	-.038
ASPT _1-D	**.851**	.004	.096	.334	-.165	.117	-.004	.077	-.270	.045
NEPBIOS_1-D	**.745**	.145	.130	-.507	-.008	.066	.226	.093	**.203**	-.072
Diptera _1-D	-.033	.270	-.294	-.427	.689	.034	-.134	.107	.064	.192
EPT_1-D	**.665**	-.375	-.004	.503	.184	.059	.082	-.092	-.225	.106
Family biotic_1-D	.495	.497	-.508	.095	.366	-.103	-.043	-.058	.109	-.207
Dominance_d	.315	.143	-.830	-.281	-.221	-.163	.039	-.047	-.093	-.005
Simpson_1-D	**.867**	.337	.207	.167	.058	.140	-.132	.038	.054	.019
Shannon_H	**.862**	.239	.376	.032	.084	.139	-.069	.074	.070	.007
Evenness_e^H/S	**.611**	.449	-.016	.464	-.038	-.077	-.401	-.015	-.025	-.068
Margalef index	**.724**	.047	.310	-.522	-.036	.150	.180	.158	.092	-.088
Fisher_alpha	**.656**	.053	.327	-.593	-.093	.112	.167	.176	.064	-.141
Berger-Parker	.417	.191	-.747	-.366	-.177	-.145	.039	-.062	-.107	-.063
Equitability_J	**.784**	.415	.028	.307	-.016	.014	-.298	.017	.008	-.069
Al/(mg/L)	-.880	-.353	.292	.019	.075	-.024	.086	-.005	.008	-.013
Ba/(mg/L)	-.855	-.293	.314	-.054	-.038	-.015	.023	-.042	.153	-.032

Parameters	FI	F2	F3	F4	F5	F6	F7	F8	F9	F10
Ca/(mg/L)	-.579	.499	-.351	.196	-.145	**.319**	-.179	.114	.144	.022
K/(mg/L)	-.796	-.115	.471	.053	-.080	.079	.024	**.251**	.147	-.029
Mg/(mg/L)	-.731	.499	.241	-.097	.136	.000	.166	-.100	-.217	.052
Na /(mg/L)	-.450	.522	.363	.115	.023	.314	-.187	.178	-.240	-.177
SO_4 /(mg/L)	.085	**.840**	-.174	.272	-.188	.211	-.048	.169	.191	.063
Si /(mg/L)	-.468	**.737**	.183	.310	-.096	-.040	.204	.107	.086	.043
Sr /(mg/L)	-.674	.477	.277	.117	.125	**.269**	.102	.039	-.231	.164
Zn/(mg/L)	.236	.055	-.599	.163	**.301**	-.217	.513	.224	.042	.037
Hardness	-.775	.579	-.008	.030	.021	.156	.024	-.012	-.076	.045
As/(mg/L)	.171	-.111	.369	.342	-.121	-.407	-.295	.062	.624	.149
Hg /(mg/L)	.012	-.186	-.133	-.388	-.636	.148	-.043	.019	-.029	.441
Se/(mg/L)	.123	.014	.155	-.046	-.023	**.436**	.147	-.751	.187	-.331
Eigen values	16.049	7.83	5.66	4.37	2.58	2.39	1.94	1.59	1.33	1.22
Variance/%	33.44	16.32	11.79	9.09	5.37	4.97	4.03	3.31	2.77	2.54
Cumulative/%	33.440	49.760	61.550	70.670	76.010	80.980	85.020	88.330	91.100	93.640

Significant values are presented in bold