Supplementary Material

Table S1. Descriptions of studied wetlands around Lake Tana sub-basin during the dry and wet period of 2018

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Wetland name | Code | Hydrological connectivity | Location | Wetland type | Dominant vegetation type | References  |
| Ambo-Bahir | AB | Lake | Lake shore | Lacustrine  | *Cyperus papyrus* | Authors' field survey |
| Estumit | ES | Lake | Lake shore | Lacustrine  | *Potamogeton spp.* |
| Zegie-yiganda | ZI | Lake | Lake shore | Lacustrine  | *Cyperus papyrus, Naja spp., Potamogeton spp.* |
| Zewdie-girar | ZG | Lake  | Lake shore | Lacustrine  | *Typha latifolia* |
| Amba-giorgis | AG | River | 18km upstream of the lake | Riverine papyrus swamps | *Cyperus papyrus, Typha latifolia, other Cyperus sp., Nymphaea spp., Schoenoplectus corymbosus* | Authors' field survey and Wondie (2018)The distance between the wetland and the lake was calculated using Google earth pro |
| Dehna-mesenta | DE | River | 25km upstream of the lake | Riverine papyrus swamps  | *Cyperus papyrus, Typha latifolia, other Cyperus sp., Osmunda regalis* |
| Legdiya | LE | River |  20km upstream of the lake  | Riverine papyrus swamps  | *Cyperus papyrus, Typha latifolia, other Cyperus sp., Osmunda regalis* |
| Lata-mariyam | LA | River | 15km upstream of the lake | Riverine papyrus swamps | *Cyperus papyrus, Typha latifolia, other Cyperus sp., Lemna minor, Azolla spp,* |
| Dirma | DI | River &Lake | River mouth | River mouth wetlands | *Eichhornia crassipes,* poa spp. | Authors' field survey |
| Megech | ME | River&Lake | River mouth | River mouth wetlands | *Eichhornia crassipes,* Poa spp. |  |
| Gumara | GU | River&Lake | River mouth | River mouth wetlands | *Eichhornia crassipes,* Poa spp. |  |
| Gilgel-abay | GA | River&Lake | River mouth | River mouth wetlands | *Echinochloa crus-galli, Cyperus papyrus* |  |

Table S2. Linear mixed-effect model ANOVA of the effect of wetland type, season and their interaction on environmental variables, plankton local taxa richness, and Reynolds functional groups abundance. Marginal R2 represents the fixed factors component of the model and conditional R2 represents both fixed and random factors component. Significant effects (\*\*\*< 0.000, \*\*p < 0.01, and \*p < 0 .05) are shown in bold.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | season | wetland type | wetland type x season |  |  |
| Environmental variables | F | df | *p* | F | df | *p* | F | df | *p* | *R2 marginal*  | *R2 conditional* |
| Chlorophyll-a (μg/l) | 0.75 | 1 | 0.4 | 1.66 | 2 | 0.24 | 1.71 | 2 | 0.23 | 0.184 | 0.668 |
| **DO (mg/l)** | 0.06 | 1 | 0.99 | 11.57 | 2 | **<0.000\*\*\*** | 0.53 | 2 | 0.59 | 0.510 | 0.535 |
| Water temperature (0°C) | 9.74 | 1 | **0.01\*** | 5.71 | 2 | **0.03\*** | 7.62 | 2 | **0.01\*** | 0.597 | 0.667 |
| pH | 9.24 | 1 | **0.01\*** | 13.79 | 2 | **0.001\*\*** | 1.09 | 2 | 0.37 | 0.643 | 0.695 |
| Specific conductance (µS/cm) | 0.92 | 1 | 0.36 | 3.47 | 2 | **0.05** | 1.12 | 2 | 0.36 | 0.339 | 0.628 |
| Water depth (cm) | 2.47 | 1 | 0.15 | 3.02 | 2 | **0.05** | 1.92 | 2 | 0.2 | 0.288 | 0.598 |
| Sediment depth (cm) | 0.62 | 1 | 0.45 | 3.95 | 2 | **0.05** | 1.03 | 2 | 0.39 | 0.336 | 0.463 |
| Turbidity (NTU) | 0.03 | 1 | 0.85 | 64.59 | 2 | **<0.000\*\*\*** | 0.82 | 2 | 0.45 | 0.851 | 0.862 |
| Total Phosphorus (mg/l) | 2.62 | 1 | 0.12 | 40.72 | 2 | **<0.000\*\*\*** | 0.19 | 2 | 0.82 | 0.786 | 0.799 |
| Total Nitrogen (mg/l) | 0.72 | 1 | 0.41 | 2.31 | 2 | 0.15 | 1.27 | 2 | 0.32 | 0.268 | 0.550 |
| RFGs abundance  |  |  |
| MP | 1.14 | 1 | 0.31 | 5.11 | 2 | **0.02\*** | 0.49 | 2 | 0.62 | 0.299 | 0.630 |
| TB | 21.96 | 1 | **0.001\*** | 2.52 | 2 | 0.12 | 13.19 | 2 | **0.002\*** | 0.520 | 0.821 |
| J | 0.21 | 1 | 0.65 | 6.25 | 2 | **0.01\*** | 0.04 | 2 | 0.95 | 0.312 | 0.473 |
| N | 0.23 | 1 | 0.63 | 3.94 | 2 | **0.05** | 0.09 | 2 | 0.91 | 0.294 | 0.508 |
| P | 0.08 | 1 | 0.77 | 4.32 | 2 | **0.02\*** | 1.54 | 2 | 0.24 | 0.265 | 0.266 |
| B | 2.24 | 1 | 0.17 | 6.52 | 2 | **0.01\*** | 1.46 | 2 | 0.29 | 0.345 | 0.888 |
| Plankton local taxa richness  |  |  |
| Phytoplankton  | 0.13 | 1 | 0.72 | 4 | 2 | **0.041\*** | 1.03 | 2 | 0.39 | 0.408 | 0.983 |
| Zooplankton  | 0.63 | 1 | 0.44 | 12.68 | 2 | **0.002\*\*** | 4.1 | 2 | **0.045\*** | 0.662 | 0.884 |
| LCBD |  |  |  |  |  |  |  |  |  |  |  |
| Phytoplankton | 0.004 | 1 | 0.98 | 5.12 | 2 | **0.037\*** | 075 | 2 | 0.5 | 0.415 | 0.703 |
| Zooplankton | 0.001 | 1 | 0.92 | 0.42 | 2 | 0.61 | 1.17 | 2 | 0.35 | 0.110 | 0.314 |

Table S3. List of phytoplankton species, RFG' s with their mean densities(cells/L) in different wetland type (L=lacustrine, R= riverine papyrus swamps, and RL= river mouth wetlands)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Bacillariophyta*** | code | RFG | L | R | RL | ***Chlorophyta*** | code | RFG | L | R | RL |
| *Achnanthes sp.* | AH | Tb | 0 | 0 | 16711 | *Actinotaenium sp* | ACT | J | 0 | 148 | 0 |
| *Amphora copulata* | *AC* |  | 86 | 0 | 519 | *Ankistrodesmus angustus* | AA | X1 | 333 | 0 | 0 |
| *Asterionella formosa* | AF | C | 5382 | 609 | 292 | *Ankistrodesmus falcatus*  | AF | X1 | 537 | 0 | 0 |
| *Aulacoseira granulata* | AG | P | 7204 | 46 | 2397 | *Ankistrodesmus sp* | AS | X1 | 52 | 0 | 0 |
| *Aulacoseira italica* | AI | B | 80837 | 4494 | 15951 | *Chlamydomonas sp* | CHS | X2 | 9887 | 0 | 0 |
| *Cyclotella comta* | CC | B | 5909 | 0 | 0 | *Chlorella sp.* | CHL | X3 | 70 | 0 | 0 |
| *Cyclotella radiosa*  | CR | B | 0 | 0 | 0 | *Closterium acutum*  | CA | P | 26241 | 548 | 1747 |
| *Cymbella minuta*  | CM | MP | 0 | 189 | 20650 | *Closterium kuetzingii* | CK | P | 58745 | 750 | 7016 |
| *Cymbella sp* | CS | MP | 0 | 132 | 2517 | *Closterium limneticum* | CL | P | 2430 | 76 | 4952 |
| *Cymbella ventricosa*  | CV | MP | 0 | 0 | 720 | *Coelastrum microporum* | COM | J | 17407 | 12 | 506 |
| *Eunotia pectinalis*  | EP | MP | 87 | 938 | 6718 | *Cosmarium circulare* | COC | N | 15606 | 1 | 117 |
| *Fragilaria capucina* | FC | MP | 0 | 194 | 4089 | *Cosmarium quadrum* | CQ | N | 10902 | 0 | 109 |
| *Gomphonema gracile* | GG | MP | 0 | 7 | 13943 | *Cosmarium sexangulare* | CS | N | 8515 | 0 | 111 |
| *Gomphonema minutum* | GM | MP | 0 | 42 | 34298 | *Euastrum sp* | ES |  | 26 | 15 | 10 |
| *Navicula cryptocephala* | NC | MP | 0 | 54 | 0 | *Eudorina elegans* | EE | G | 0 | 21 | 0 |
| *Navicula cuspidata* | NAC | MP | 0 | 76 | 4603 | *Gonatozygon aculeatum* | GA |  | 0 | 37 | 0 |
| *Nitzschia closterium* |  | Tb | 78 | 473 | 2923 | *Gonatozygon kinahanii*  | *GK* |  | 0 | 0 | 153 |
| *Nitzschia minuta* | NM | Tb | 91 | 381 | 656 | *Gonatozygon monotaenium*  | *GOM* |  | 2784 | 3088 | 359 |
| *Nitzschia palea* | NP | Tb | 56 | 45 | 144 | *Micrasterias radiata*  | *MR* |  | 0 | 0 | 834 |
| *Nitzschia reversa* | NR | Tb | 0 | 230 | 1295 | *Mougeotia laetevirens* | ML | T | 0 | 5261 | 0 |
| *Pinnularia sp* | PS | Tb | 395 | 648 | 0 | *Oedogonium sp* | OS |  | 3819 | 1501 | 0 |
| *Pleurosigma elongatum* | PE | MP | 4091 | 0 | 5609 | *Oocystis eremosphaeria* | OE | F | 33 | 0 | 0 |
| *Rhoicosphenia abbreviata* | RA | Tb | 0 | 319 | 2661 | *Oocystis lacustris* | OL | F | 21 | 0 | 0 |
| *Rhopalodia gibba* | RG | Tb | 0 | 165 | 15297 | *Pediastrum boryanum* | PB | J | 91 | 0 | 0 |
| *Ulnaria/Synedra ulna*  | SU | MP | 0 | 13054 | 12314 | *Pediastrum duplex*  | PD | J | 8229 | 1302 | 6470 |
| **Cryptophyta** |  |  |  |  |  | *Pediastrum simplex*  | PS | J | 0 | 1380 | 8636 |
| *Cryptomonas sp* | CRS | B | 190 | 0 | 0 | *Pleurotaenium nodulosum* | PN | N | 1768 | 246 | 0 |
| **Cyanophyta** |  |  |  |  |  | *Pleurotaenium trabecula* | PT | N | 506 | 31 | 0 |
| *Anabaena sp1* | ANS | H1 | 0 | 0 | 0 | *Scenedesmus sp* | SS | J | 72 | 0 | 0 |
| *Anabaena sp2* | H1 | 0 | 0 | 94 | *Selenastrum sp* | SES |  | 0 | 0 | 0 |
| *Anabaena sp3* | H1 | 9 | 0 | 20 | *Spirogyra fluviatilis* | SF | N | 2106 | 16774 | 5829 |
| *Anabaena sp4* | H1 | 17 | 0 | 12 | *Spirogyra lutetiana* |  | N | 4354 | 6 | 130 |
| *Chroococcus sp* |  | Lo | 176 | 0 | 89 | *Spirogyra sp* | SP | N | 6521 | 121 | 0 |
| *Leptolyngbya sp* | LS | S1 | 0 | 120 | 0 | *Staurastrum gracile*  | SG | N | 0 | 155 | 0 |
| *Microcystis aeruginosa*  | MIA | M | 0 | 0 | 2700 | *Staurastrum johnsonii* | SJ | N | 3645 | 79 | 0 |
| *Oscillatoria brevis* | OB | MP | 89 | 0 | 365 | *Staurastrum teliferum* | SJ | N | 1134 | 268 | 0 |
| *Oscillatoria limosa* | OL | MP | 74 | 5 | 920 | *Staurodesmus convergens* | SC | N | 1407 | 0 | 0 |
| *Oscillatoria tenuis* | OT | MP | 211 | 235 | 0 | *Staurodesmus sp* | STS | N | 19045 | 69 | 0 |
| **Dinoflagellates** |  |  |  |  |  | *Teilingia granulata* | TG | N | 0 | 264 | 0 |
| *Peridinium gatunense* | PG | Lo | 0 | 61 | 0 | *Tetraedron sp* | TS | J | 0 | 123 | 287 |
|  |  |  |  |  |  | *Treubaria crassispina* | TC | X1 | 0 | 0 | 238 |
|  |  |  |  |  |  | *Treubaria triappendiculata* | TT | X1 | 2376 | 0 | 99 |
|  |  |  |  |  |  | *Zygnema sp* | ZS | MP | 0 | 928 | 0 |

Table S4. Zooplankton species list and their mean densities (ind. /L) in the different wetland types (L=lacustrine wetlands, R=riverine papyrus swamps, and LR=river mouth wetlands)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cladoceran** | code | L | R | RL | **Calanoid copepods** | code | L | R | RL |
| Acroperus harpae Baird 1834 | AH | 4 | 8 | 14 | *Thermodiaptomus galebi lacustris* Defaye 1988 | TG | 82 | 4 | 82 |
| Alona sp1 | AL | 5 | 8 | 0 | *Thermodiaptomus galebi lacustris copepodites* |  | 46 | 2 | 22 |
| Alona sp2 | 7 | 35 | 18 | **Rotifers** |  |  |  |  |
| Alona sp3 | 0 | 63 | 3 | *Asplanchna brightwelli* Harring 1913 | AB | 7 | 3 | 0 |
| Alona sp4 | 0 | 9 | 3 | *Brachionus angularis* Gosse 1851 | BA | 51 | 139 | 390 |
| Alona sp5 | 0 | 2 | 0 | *Brachionus budapestinensis* Daday1885 | BB | 112 | 0 | 0 |
| *Bosmina longirostris* Müller 1785 | BL | 22 | 0 | 25 | *Brachionus caudatus* Barrois & Daday 1894 | BC | 74 | 0 | 15 |
| *Ceriodaphnia cornuta* Sars 1885 | CC | 11 | 9 | 2 | *Brachionus diversicornis* Daday 1883 | BD | 21 | 12 | 198 |
| *Ceriodaphnia dubia* Richard 1894 | CD | 2 | 3 | 20 | *Brachionus falcatus* Zacharias1898 | BF | 358 | 12 | 100 |
| *Chydorus sp1* | CH | 4 | 40 | 78 | *Brachionus havanaensis* Rousselet 1911 | BH | 24 | 24 | 24 |
| *Chydorus sp2* | 5 | 20 | 34 | *Brachionus patulus* Muller 1786 | BP | 475 | 0 | 186 |
| *Chydorus sp3* | 3 | 79 | 0 | *Brachionus quadridentatus* Hermann 1783 | BQ | 635 | 15 | 195 |
| *Chydorus sp4* | 1 | 10 | 0 | *Brachionus calyciflorus* Pallas 1766 | BC | 63 | 24 | 89 |
| *Chydorus sp5* | 3 | 6 | 0 | *Euchlanis dilatata* Ehrenberg 1832 | ED | 192 | 0 | 0 |
| *Chydorus sp6* | 0 | 3 | 0 | *Filinia longiseta* Ehrenberg 1834 | FL | 5 | 16 | 0 |
| *Diaphanosoma excisum* Sars 1885 | DE | 2 | 0 | 0 | *Keratella cochlearis* Gosse 1851 | KC | 654 | 80 | 360 |
| *Diaphanosoma sp* | DS | 12 | 0 | 14 | *Keratella lenzi* Hauer 1953 | KL | 15 | 2 | 0 |
| *Kurzia longirostris* Daday 1898 | KL | 0 | 5 | 0 | *Keratella tropica* Apstein 1907 |  | 322 | 33 | 79 |
| *Leydigia sp* | LS | 0 | 29 | 0 | *Lecane bulla* Gosse 1851 | KT | 210 | 14 | 45 |
| *Macrothrix triserialis* Brady 1886 | MT | 42 | 235 | 14 | *Lecane luna* Müller 1776 | LL | 297 | 13 | 135 |
| *Moina micrura* Kurz 1875 | MM | 50 | 0 | 45 | *Lecane lunaris* Ehrenberg 183 | LLU | 12 | 7 | 38 |
| *Pleuroxus laevis Sars 1862* | PL | 0 | 12 | 16 | *Lecane stenroosi* Meissncer 1908 | LS | 12 | 0 | 12 |
| *Simocephalus vetulus* Müller 1776 |  | 6 | 0 | 7 | *Lecane ungulata* Gosse 1887 | LU | 1 | 0 | 2 |
| **Cyclopoid copepods** |  | 20 | 6 | 0 | *Trichocerca cylindrica* Imhof 1891 | TC | 1 | 0 | 0 |
| *Afrocyclops gibsoni* Defaye 1988 | AG | 6 | 19 | 0 | *Trichocerca similis* Wierzejski 1893 | TS | 6 | 13 | 0 |
| Ectocyclops rubescens Defaye 1988 | ER | 5 | 0 | 0 | *Trichocerca longiseta* Gosse 1851 | TL | 7 | 1 | 0 |
| *Eucyclops agiloides* Sars 1909 | EA | 0 | 8 | 0 |  |  |  |  |  |
| *Megacyclops viridis* Jurine 1820 |  | 1250 | 29 | 66 |  |  |  |  |  |
| *Mesocyclops aequatorialis similis* Van de Velde 1984 | MA | 0 | 57 | 0 |  |  |  |  |  |
| *Mesocyclops kieferi* Van de Velde 1984 | MK | 33 | 7 | 5 |  |  |  |  |  |
| *Microcyclops varicans* Defaye 1988 | MV |  |  |  |  |  |  |  |  |
| *Thermocyclops ethiopiensis* Defaye 1988 | TE | 506 | 70 | 239 |  |  |  |  |  |
| Cyclopoid copepodites |  | 5 | 0 | 5 |  |  |  |  |  |
| Nauplii |  | 28 | 3 | 182 |  |  |  |  |  |

Table S5. Overview of the explanatory variables, covariates, and the restriction of permutations in the redundancy analyses testing for the effect of wetland types, season, and their interactions on the environmental variables, plankton community composition and Reynolds functional groups

|  |  |  |
| --- | --- | --- |
| explanatory variables | covariates (as dummy variables) | permutation restricted to |
| wetland type | dummies of season-wetland combinations | all covariates |
| season | dummies of two season combinations | all covariates |
| wetland type\*season | wetland type, season, wetland | wetland |

Table S6. Plankton overall abundance-based BDTotal, total sum of squares ( SSTotal), and SCBD during the dry and wet seasons of 2018

|  |  |
| --- | --- |
| Phytoplankton | Zooplankton |
| Dry season (n=12) |  Wet season (n=12)  | Dry season (n=12) | Wet season (n=12) |
| BDTotal =0.61 | BDTotal =0.62 | BDTotal =0.56 | BDTotal =0.47 |
| SSTotal =6.80 | SSTotal =6.84 | SSTotal =6.21 | SSTotal =5.19 |
| Species  | SCBD | Species  | SCBD | Species  | SCBD |  | SCBD |
| *Synedra ulna* | 0.109 | *Gomphonema minutum* | 0.123 | *Brachionus quadridentatus* | 0.09 | *Mesocyclops aequatorialis* | 0.07 |
| *Tribonema minus* | 0.056 | *Synedra ulna* | 0.098 | *Mesocyclops aequatorialis* | 0.06 | *Brachionus patulus* | 0.07 |
| *Gomphonema minutum* | 0.036 | *Staurastrum teliferum* | 0.044 | *Brachionus diversicornis* | 0.06 | *Keratella cochlearis cochlearis* | 0.06 |
| *Fragilaria capucina* | 0.032 | *Aulacoseira granulata* | 0.032 | *Keratella cochlearis cochlearis* | 0.06 | *Lecane luna* | 0.06 |
| *Mougeotia laetevirens* | 0.032 | *Nitzschia closterium* | 0.032 | *Brachionus angularis* | 0.05 | *Thermocyclops ethiopiensis* | 0.06 |
| *Aulacoseira italica* | 0.030 | *Microcystis aeruginosa* | 0.030 | *Brachionus falcatus falcatus* | 0.05 | *Thermodiaptomus galebi* | 0.05 |
| *Pleurosigma elongatum* | 0.027 | *Asterionella formosa* | 0.029 | *Brachionus patulus* | 0.04 | *Keratella tropica tropica* | 0.05 |
| *Cymbella minuta* | 0.024 | *Closterium limneticum* | 0.028 | *Moina micrura* | 0.04 | *Brachionus quadridentatus* | 0.03 |
| *Eunotia pectinalis* | 0.023 | *Cosmarium circulare* | 0.026 | *Thermocyclops ethiopiensis* | 0.04 | *Brachionus falcatus falcatus* | 0.03 |
| *Gomphonema gracile* | 0.022 | *Cymbella minuta* | 0.026 | *Lecane luna* | 0.03 | *Brachionus angularis* | 0.03 |
| *Phacus longicauda* | 0.022 | *Aulacoseira italica* | 0.024 | *Macrothrix triserialis* | 0.03 | *Lecane bulla*  | 0.03 |
| *Nitzschia closterium* | 0.021 | *Pediastrum simplex* | 0.018 | *Keratella tropica.tropica* | 0.02 |  |  |
| *Closterium limneticum* | 0.020 | *Closterium kuetzingii* | 0.018 | *Brachionus havanaensis* | 0.02 |  |  |
| *Aulacoseira granulata* | 0.018 | *Rhopalodia gibba* | 0.018 | *Thermodiaptomus galebi* | 0.02 |  |  |
| *Treubaria triappendiculata* | 0.016 | *Cosmarium sexangulare* | 0.018 | *Brachionus caudatus* | 0.02 |  |  |
|  |  | *Pleurotaenium nodulosum* | 0.018 |  |  |  |  |
|  |  | *Staurastrum johnsonii* | 0.017 |  |  |  |  |
|  |  | *Coelastrum microporum* | 0.016 |  |  |  |  |
|  |  | *Gomphonema minutum* | 0.016 |  |  |  |  |
|  |  | *Cyclotella Comta* | 0.015 |  |  |  |  |
|  |  | *Pediastrum duplex* | 0.013 |  |  |  |  |

Table S7.Results of beta regression analyses when the local contributions to beta diversity (LCBD), was explained by community metrics and their quadratic terms

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Estimate | SE | z | p | Model pseudoR2 |
| Phytoplankton | (Intercept) | -2.19 | 0.45 | -4.86 | **<0.001\*\*\*** | 0.04 |
|  | TotAbu | 0.00 | 0.00 | -0.63 | 0.53 |
|  | TotAbu ^2 | 0.00 | 0.00 | 0.78 | 0.44 |
|  | (Intercept) | -2.06 | 0.20 | -10.05 | <0.001\*\*\* | 0.14 |
|  | Richness | -0.01 | 0.01 | -1.92 | 0.05 |
|  | Richness^2 | 0.00 | 0.00 | 0.55 | 0.58 |
| Zooplankton | (Intercept) | -2.26 | 0.10 | -23.49 | <0.001\*\*\* | 0.19 |
|  | TotAbu | 0.00 | 0.00 | -1.27 | 0.2 |
|  | TotAbu ^2 | 0.00 | 0.00 | 0.66 | 0.51 |
|  | (Intercept) | -1.83 | 0.37 | -4.96 | **<0.001\*\*\*** | 0.09 |
|  | Richness | -0.06 | 0.04 | -1.41 | 0.159 |
|  | Richness^2 | 0.00 | 0.00 | 1.25 | 0.211 |

TotAbu community abundance in each wetland, Richness species number in each wetland. Significant statistical values are indicated by bold font.