

SUPPLEMENTARY DATA

Occurrence of toxic cyanobacteria, microcystin and saxitoxin in a mesotrophic subtropical reservoir

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Table S1. Main characteristics of the Lobo reservoir.

Characteristics	Lobo reservoir	
Surface area (km ²)	6.8	
Maximum volume (10 ⁶ m ³)	22.0	
Perimeter (km)	21.0	
Maximum water flow (m ³ s ⁻¹)	20.0	
Water residence time (days)	32	
Main tributaries	Itaqueri and Lobo rivers	
Hydrographic basin	Tietê-Jacaré	
Characteristics	Riverine zone	Dam zone
*Geographic location	22°12'36.9" S, 47°52'52.8" W	22°10'18.5" S, 47°54'11.2" W
*Maximum depth (m)	2.5	11.5
*Average depth (m)	2.0	10.5

Source: Motheo (2005); Delello (2008); *this study.

Table S2. Photosynthetically active radiation (PAR, $\mu\text{mol photons m}^{-2} \text{ s}^{-1}$) at surface (100% PAR) and at lower limit of euphotic zone (1% PAR) in the Lobo reservoir.

Samplings dates	Riverine zone		Dam zone	
	100% PAR	1% PAR	100% PAR	1% PAR
May 2017	533.00	5.50	406.60	3.55
August 2017	580.00	6.20	761.10	8.89
October 2017	654.00	11.00	304.00	3.22
January 2018	270.00	1.30	103.80	0.97

PAR = photosynthetically active radiation ($\mu\text{mol photons m}^{-2} \text{ s}^{-1}$); 100% = surface; 1% = lower limit of euphotic zone.

Table S3. Environmental variables summarised as the mean values and ranges, and statistical results (*p* values) of non-parametric Mann-Whitney test for spatial differences (riverine and dam zone) and non-parametric Kruskal-Wallis for temporal differences (months) of the environmental variables in Lobo reservoir.

Variables	Riverine zone (n = 8)	Dam zone (n = 8)	Spatial factor	Temporal factor
Water transparency (m)*	1.10 (1.00 - 1.20)	1.85 (1.20 - 2.30)	-	-
Z _{eu} (m)*	2.00 (2.00 - 2.00)	3.75 (2.50 - 5.00)	-	-
pH	6.59 (5.87 - 8.72)	6.38 (5.97 - 7.13)	ns	0.042
Dissolved oxygen (mg L ⁻¹)	6.27 (4.53 - 8.22)	6.67 (5.08 - 9.04)	ns	0.041
Electrical conductivity (µS cm ⁻¹)	20.38 (15.00 - 36.00)	17.25 (13.00 - 28.00)	0.023	0.030
Turbidity (NTU)	6.06 (4.70 - 7.50)	3.49 (1.70 - 6.40)	0.014	ns
Water temperature (°C)	21.11 (18.21 - 23.80)	21.97 (18.38 - 25.00)	ns	0.005
Total phosphorus (µg L ⁻¹)	25.92 (19.75 - 37.85)	18.08 (14.48 - 22.74)	0.006	ns
Soluble reactive phosphorus (µg L ⁻¹)	2.36 (nd - 3.69)	1.28 (nd - 3.01)	ns	ns
Total nitrogen (mg L ⁻¹)	0.80 (0.62 - 0.92)	0.70 (0.53 - 0.89)	0.042	ns
Nitrate (mg L ⁻¹)	0.67 (0.59 - 0.75)	0.52 (0.41 - 0.57)	0.001	ns
Nitrite (µg L ⁻¹)	3.85 (1.79 - 4.96)	2.70 (1.62 - 3.94)	0.027	ns
Ammonium (µg L ⁻¹)	6.54 (nd - 18.55)	14.62 (nd - 28.34)	ns	ns
TN:TP	64 (30 - 100)	87 (42 - 124)	ns	ns
Chlorophyll <i>a</i> (µg L ⁻¹)	6.82 (3.95 - 8.88)	11.10 (3.95 - 27.30)	ns	ns
Trophic state	Mesotrophic	Mesotrophic	-	-

*Water transparency and Z_{eu} (n = 4); TN:TP = total nitrogen and total phosphorus ratio; nd = not detected; ns = not significant.

Among environmental variables, pH, electrical conductivity (EC), dissolved oxygen (DO) and water temperature varied significantly between sampling times (months; $p < 0.05$), while EC, turbidity, total phosphorus, total nitrogen, nitrate and nitrite showed significant spatial variations ($p < 0.05$) (Table page 2). None of the environmental variables differed between depths ($p > 0.05$). pH of the water ranged from a minimum of 6.04 ± 0.14 in summer (January) 2018 to 7.00 ± 1.00 in the fall (May) 2017. The oxygen content was lowest in summer (4.53 mg L^{-1} in January 2018) and highest in the fall (9.04 mg L^{-1} in May 2018). The mean EC value was highest in summer 2018 (January; 30.00 µS cm^{-1}) and had minimum in winter 2017 (August; 14.75 µS cm^{-1}). Turbidity was higher in the riverine zone ($6.06 \pm 0.98 \text{ NTU}$) than in the dam zone ($3.49 \pm 1.75 \text{ NTU}$), and therefore the water transparency and Z_{eu} were also lower in the riverine zone. The highest water temperature ($24.21 \pm 0.93 \text{ °C}$) was observed in summer 2018 (January), while the lowest was observed in winter 2017 (August; $18.41 \pm 0.13 \text{ °C}$).

Total phosphorus (TP), soluble reactive phosphorus (SRP), total nitrogen (TN), nitrate (NO₃⁻-N) and nitrite (NO₂⁻-N) concentrations were higher in the riverine zone than in the dam zone, which may be attributed to the discharge of untreated wastewater along the tributaries. The highest TP concentration was detected in October 2017 in the riverine zone (37.85 µg L^{-1}) and the lowest in August 2017 in the dam zone (14.48 µg L^{-1}). SRP and nitrite concentrations were always below 4.00 µg L^{-1} and 5.00 µg L^{-1} , respectively. In August and October 2017, the SRP concentrations were frequently below the detection limit of 0.7 µg L^{-1} in the dam zone. Nitrate made up 83% of TN in the riverine zone and 74% in the dam zone. Ammonium concentrations ranged from undetectable in May 2017 in the riverine zone, to a maximum of 28.34 µg L^{-1} in January 2018 in the dam zone. The average

TN:TP ratio was 64 in the riverine zone and 87 in the dam zone, indicating a limitation by phosphorus at both sites. Chlorophyll *a* (chl *a*) concentrations varied between 3.95 and 8.88 $\mu\text{g L}^{-1}$ in the riverine zone, while in the dam zone the range was between 3.95 and 27.30 $\mu\text{g L}^{-1}$. However, the variation observed was not significantly different ($p > 0.05$). The trophic state index (TSI) classified both sampling sites as mesotrophic.

Table S4. List of the phytoplankton taxa identified in Lobo reservoir.

Taxa		Riverine zone								Dam zone							
		May-17		Aug-17		Oct-17		Jan-18		May-17		Aug-17		Oct-17		Jan-18	
		100	1	100	1	100	1	100	1	100	1	100	1	100	1	100	1
Chrysophytes		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	<i>Chromulina elegans</i> Doflein 1921											.					
2	<i>Dinobryon bavaricum</i> Imhof 1890	.	.					.							.
3	<i>Lagynion ampullaceum</i> (A. Stokes) Pascher 1912											.					
4	<i>Mallomonas</i> sp. 1								.							.	
5	<i>Mallomonas</i> sp. 2		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	<i>Synura</i> sp.				.	.		.	.	.		.	.	.	.	.	.
Cryptophytes		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7	<i>Cryptomonas brasiliensis</i> A. Castro, C.E.M. Bicudo & D. Bicudo 1992	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
8	<i>Cryptomonas erosa</i> Ehrenberg 1832	.	.	.			.	.		.						.	.
9	<i>Cryptomonas marssonii</i> Skuja 1948									.							
10	<i>Cryptomonas ovata</i> Ehrenberg 1832	.	.	.					.	.				.	.
11	<i>Cryptomonas tenuis</i> Pascher 1913		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
12	<i>Rhodomonas lacustris</i> Pascher & Ruttner 1913							.		.	.	.		.	.		.
Cyanobacteria		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
13	<i>Anathece</i> sp.	.				.	.	.	.		.			.	.	.	.
14	<i>Aphanizomenon gracile</i> Lemmermann 1907				.	.					.						
15	<i>Aphanocapsa delicatissima</i> West & G. S. West 1912	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
16	<i>Aphanocapsa elachista</i> West & G.S. West 1894														.		
17	<i>Chroococcus limneticus</i> Lemmermann 1898									.							
18	<i>Chroococcus minimus</i> (Keissler) Lemmermann 1904	.		.			.			.	.	.	.	.
19	<i>Chroococcus minor</i> (Kützing) Nägeli 1849					.						.	.	.
20	<i>Geitlerinema amphibium</i> (C.Agardh ex Gomont) Anagnostidis 1989		.							.						.	
21	<i>Microcystis protocystis</i> W. B. Crow 1923										.	.					
22	<i>Phormidium</i> sp.		.							.	.						
23	<i>Pseudanabaena catenata</i> Lauterborn 1915	.	.	.	.						.	.
24	<i>Pseudanabaena galeata</i> Böcher 1949									.							
25	<i>Raphidiopsis raciborskii</i> (Woloszynska) Aguilera et al. 2018	.	.							.	.	.	.	.	.
26	<i>Synechocystis aquatilis</i> Sauvageau 1892	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.
Diatoms		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
27	<i>Aulacoseira distans</i> (Ehrenberg) Simonsen 1979	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.
28	<i>Aulacoseira granulata</i> (Ehrenberg) Simonsen 1979	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
29	<i>Aulacoseira granulata</i> var. <i>angustissima</i> (O.Müller) Simonsen 1979							.				.	.	.		.
30	<i>Cocconeis</i> sp.				.					.							
31	<i>Discostella stelligera</i> (Cleve & Grunow) Houk & Klee 2004	.	.	.			.	.	.	.	.	.	.			.	.
32	<i>Eolimna minima</i> (Grunow) Lange-Bertalot, nom. illeg. 1998													.			

Taxa	Riverine zone								Dam zone							
	May-17		Aug-17		Oct-17		Jan-18		May-17		Aug-17		Oct-17		Jan-18	
	100	1	100	1	100	1	100	1	100	1	100	1	100	1	100	1
33 <i>Eunotia sudetica</i> O. Müller 1898					.											
34 <i>Fragilaria</i> sp.															.	
35 <i>Gomphonema</i> sp.								.								
36 <i>Navicula</i> sp.	.															
37 <i>Pinnularia</i> sp.			.													
38 <i>Rhizosolenia</i> sp.
Dinoflagellates																
39 <i>Ceratium furcoides</i> (Levander) Langhans 1925		
40 <i>Peridinium</i> sp. 1	.															
41 <i>Peridinium</i> sp. 2															.	
42 <i>Peridinium</i> sp. 3									.	.						
43 <i>Peridinium</i> sp. 4	
Euglenophytes																
44 <i>Euglena</i> sp.						
45 <i>Lepocinclis</i> sp.									.	.						
46 <i>Trachelomonas abrupta</i> Svirenko 1914			.													
47 <i>Trachelomonas curta</i> var. <i>subpunctata</i> Bourrelly 1950								.	.	.						
48 <i>Trachelomonas lacustris</i> Drezepolski 1925									.	.						
49 <i>Trachelomonas volvocina</i> (Ehrenberg) Ehrenberg 1834									.	.						.
Green algae																
50 <i>Ankistrodesmus fusiformis</i> Corda 1838	.								.							
51 <i>Carteria</i> sp.						.										
52 <i>Chaetosphaeridium globosum</i> (Nordstedt) Klebahn 1893			.													
53 <i>Characium</i> sp.											.					
54 <i>Chlamydomonas</i> sp. 1
55 <i>Chlamydomonas</i> sp. 2
56 <i>Chlamydomonas</i> sp. 3					
57 <i>Chlamydomonas</i> sp. 4																
58 <i>Chlorella minutissima</i>	
59 <i>Chlorella vulgaris</i>
60 <i>Chlorolobion</i> sp.	
61 <i>Choricystis minor</i> (Skuja) Fott 1976	.				.								.			
62 <i>Closteriopsis longissima</i> (Lemmermann) Lemmermann 1899						
63 <i>Coccomonas</i> sp.															.	
64 <i>Coelastrum</i> sp.	.															
65 <i>Cosmarium</i> sp.		.														.
66 <i>Desmodesmus denticulatus</i> (Lagerheim) An, Friedl & Hegewald 1999						

Taxa		Riverine zone								Dam zone							
		May-17		Aug-17		Oct-17		Jan-18		May-17		Aug-17		Oct-17		Jan-18	
		100	1	100	1	100	1	100	1	100	1	100	1	100	1	100	1
67	<i>Desmodesmus magnus</i> (Meyen) Tsarenko 2000		•				•					•					
68	<i>Desmodesmus</i> sp.		•														
69	<i>Dictyosphaerium pulchellum</i> H. C. Wood 1873	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•
70	<i>Dictyosphaerium tetrachotomum</i> Printz 1914		•							•							
71	<i>Didymocystis fina</i> Komárek 1975	•	•	•	•	•	•			•	•	•	•	•	•	•	•
72	<i>Elakatothrix</i> sp.			•													
73	<i>Eutetramorus fottii</i> (Hindák) Komárek 1979															•	•
74	<i>Eutetramorus planctonicus</i> (Korshikov) Bourrelly 1964									•	•	•	•				
75	<i>Eutetramorus</i> sp.						•										
76	<i>Micractinium pusillum</i> Fresenius 1858									•	•						
77	<i>Monoraphidium contortum</i> (Thuret) Komárková-Legnerová 1969		•	•								•					
78	<i>Monoraphidium minutum</i> (Nägeli) Komárková-Legnerová 1969											•					
79	<i>Monoraphidium nanum</i> (Ettl) Hindák 1980	•						•			•					•	
80	<i>Monoraphidium tortile</i> (West & G. S. West) Komárková-Legnerová 1969		•	•		•	•			•	•						
81	<i>Mougeotia</i> sp.	•															•
82	<i>Oocystis lacustris</i> Chodat 1897	•				•	•			•		•	•	•	•	•	•
83	<i>Oocystis solitaria</i> Wittrock 1879		•							•		•		•			
84	<i>Quadrigula</i> sp.						•										
85	<i>Scenedesmus arcuatus</i> (Lemmermann) Lemmermann 1899	•															
86	<i>Scenedesmus obtusus</i> Meyen 1829	•						•		•	•						•
87	<i>Scenedesmus quadricauda</i> (Turpin) Brébisson 1835														•		
88	<i>Scenedesmus</i> sp.					•						•	•	•			
89	<i>Staurastrum paradoxum</i> Meyen ex Ralfs 1848											•					
90	<i>Stauridium tetras</i> (Ehrenberg) E. Hegewald 2005											•					
91	<i>Tetraëdron minimum</i> (A. Braun) Hansgirg 1889		•														
92	<i>Tetrallantos lagerheimii</i> Teiling 1916									•							
93	<i>Tetrastrum heteracanthum</i> (Nordstedt) Chodat 1895									•							
94	<i>Tetrastrum komarekii</i> Hindák 1977									•							
Xanthophytes		•															•
95	<i>Characiopsis</i> sp.	•															•

100 = surface; 1 = lower limit of euphotic zone; • = presence of the taxon at the sampling point.