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Zooplankton trajectory before, during and after a hydropower dam construction

Trajetória do zooplâncton antes, durante e depois da construção de uma barragem de hidroelétrica

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Abstract: Aim: Understanding the impact of anthropogenic activities is central for supporting management and conservation efforts. In aquatic ecosystems, the construction of dams for hydroelectric power plants is a major environmental change that turns the riverine ecosystem into a reservoir lake. Such environmental deep alteration causes profound impacts in biota. The goal of this study is to make a comprehensive description of zooplankton trajectory following the construction of a reservoir in the transition from the hotspot Cerrado to Amazon, Central Brazil. **Methods:** We used data sampled before, during and after the formation of the reservoir lake in 10 sampling units each period. We evaluated compositional changes, shifts in spatial organization, and a variation in beta-diversity from before to after the dam constructions using a set of multivariate analyses. We evaluated effects for Rotifers, Copepods and Cladocerans separately. **Results:** Compositional changes were evident for all zooplankton groups: Rotifers, Copepods and Cladocerans. Besides, spatial community organization was also affected but depending on the beta-diversity facet and data resolution – mainly turnover using abundance data, except for Copepods. Finally, an increase in nestedness occurred for all groups during the formation of the reservoir lake. **Conclusions:** In summary, our study showed the deep impacts for zooplankton that the formation of a reservoir lake causes. We innovate by making a complete assessment, which indicate clearly the complexity of evidencing impacts in aquatic communities. We also suggest that long-term monitoring should continue in reservoirs for scientific purposes. The changes in biota also make clear that the construction of dams should be accompanied by preservation of other pristine riverine ecosystems.

Keywords: metacommunity; beta-diversity; biotic homogenization; microcrustaceans; reservoirs; Anthropocene.

Resumo: Objetivo: O entendimento do impacto de atividades antrópicas é essencial para subsidiar esforços de manejo e conservação. Em ecossistemas aquáticos, a construção de barragens para usinas hidroelétricas é uma das principais alterações ambientais que tornam o ecossistema fluvial em um reservatório. Tal alteração ambiental causa uma alteração profunda na biota. O objetivo desse estudo é fazer uma descrição completa da trajetória da comunidade zooplanctônica devido à construção de um reservatório na transição entre o hostpot brasileiro Cerrado e a Amazônia, no Brasil Central. **Métodos:** Foram utilizados dados amostrados antes durante e depois da formação do lago

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do reservatório coletados em 10 pontos em cada um desses períodos. Foram avaliadas as mudanças composicionais, as alterações na organização especial e as variações da diversidade-beta entre antes e depois da construção do reservatório usando um conjunto de análises multivariadas. Efeitos em Rotíferos, Copépodos e Cladóceros foram avaliados separadamente. **Resultados:** Mudanças na composição de espécies foram evidentes para todos os grupos zooplanctônicos: Rotíferos, Copépodos e Cladóceros. Além disso, a organização espacial das comunidades também foi afetada, dependendo da faceta de diversidade beta e da resolução numérica dos dados – principalmente turnover usando dados de abundância, exceto para Copépodos. Finalmente, houve aumento de aninhamento da comunidade durante o enchimento do reservatório para todos os grupos zooplanctônicos. **Conclusões:** Em resumo, nosso estudo mostrou os impactos que a formação do lago de reservatórios causa na comunidade zooplanctônica. O estudo é inovador por fazer uma descrição completa, que claramente indica a complexidade em evidenciar impactos nas comunidades ecológicas aquáticas. Também se sugere que o monitoramento de longo prazo deve continuar em reservatórios para fins científicos. As mudanças na biota deixam claro que a construção de barragens deve ser acompanhada pela preservação de outros ecossistemas fluviais pristinos.

Palavras-chave: metacomunidade; diversidade-beta; homogeneização biótica; microcrustáceos; reservatórios; Antropoceno.

1. Introduction

Human society is highly dependent in electric power, which generation represents a major source of environmental impacts. Compared to nations that generate power mainly by fossil fuels, which has strong environmental impacts associated to atmospheric pollution and greenhouse gases, Brazil has a relatively sustainable matrix of electric power generation – based mainly in hydropower dams (Von Sperling, 2012). Even so, such generation do represent impact for natural ecosystems, given the strong environmental changes that dam construction represents both considering socio-economic features to communities living nearby water bodies (Von Sperling, 2012), as well as to aquatic ecosystem functioning, habitat fragmentation and freshwater biodiversity (Baxter, 1985; Agostinho et al., 2008).

Any human intervention in natural ecosystems cause ecological impacts, but the extent of impacts, the sustainability of interventions and the information to society still need to be improved for better governmental decisions (Azevedo-Santos et al., 2017). Therefore, ecological studies monitoring biodiversity changes are central. Not surprisingly, understanding causes and patterns of spatial and temporal variation in ecological communities is a major goal of Community Ecology that informs ecosystem conservation (Socolar et al., 2016). When describing impacts of dam constructions, before and after sampling design is a common approach (Agostinho et al., 2008; Vieira et al., 2019). Indeed, although causal inference and impact evaluation in ecology is difficult, before and after sampling design is the most suitable to infer anthropogenic impacts, such as reservoir damming. The most complete approach, however, would be to compare before and after trajectories in impacted ecosystems with trajectories in comparable non-impacted ecosystems (see Ribas et al., 2019)

Immediate effects of dams in several ecological communities have been described (e.g. Agostinho et al., 2008; Pelicice et al., 2015; Silva et al., 2017; Vincentin et al., 2018; Noleto et al., 2019). Although zooplankton is a key biological group that responds quickly to environmental alterations and very important to ecosystem functioning, this groups is relatively less studied compared to fish, together with macroinvertebrates (Figure 1). In a metacommunity perspective, one can expect that environmental alterations may affect distinct groups of zooplankton differently (Soares et al., 2015). For instance, due to small size, quick response to environmental conditions and due to being more sessile (see also Soares et al., 2015), Rotifers can probably be more affected than micro-crustaceans (Cladocerans and Copepods) considering composition changes before and after dam constructions. Moreover, impact may not only be reflected by compositional changes, but also in changes in compositional variation another facet of beta diversity (i.e. mission statements 2 vs. mission statement 4 in Anderson et al., 2011). As described in Anderson et al. (2011), a common goal is to explore relationships between community structure and environmental factors: evaluating compositional changes before and after a dam construction would represent this goal. Another goal in a higher level of abstraction would be comparing variation in community structure among groups: for instance, compositional variation over space among the periods before and after.

The environmental homogenization caused by the formation of the reservoir lake may also reflect in a higher spatial similarity of mainly micro-crustaceans communities. If this is the case, the natural spatial variation that occur along a river system, in response to environmental heterogeneity and migration can be disrupted, and the formation of the reservoir lake could be compared to the flood-homogenization that occurs in floodplain systems (see an example for zooplankton in Bozelli et al., 2015). Indeed, micro-crustaceans (particularly Copepods) seem to be relatively more related to environmental features (Zhao et al., 2017). If so, one can expect changes in spatial organization (not community composition) and possible biotic homogenization phenomenon after the anthropogenic impact (e.g. Olden & Rooney, 2006).

We evaluated the temporal changes in zooplankton communities in a reservoir installed at a river from a major tributary of Amazon Basin. Given the amount of hydropower dams proposed in Amazon (Winemiller et al., 2016), our study is timely to describe effects of river damming in a central regions for biodiversity conservation in Brazil. We analyzed different facets of zooplankton biodiversity that may better inform conservation and ecological monitoring (Socolar et al., 2016).

2. Methods

2.1. Study site

Data used in this study was sampled in the 'Programa de Monitoramento da Qualidade da Água de reservatórios da COPEL' carried out by the Research and Technology Institute called 'Lactec - Instituto de Tecnologia Para o Desenvolvimento'. Sampling occurred before, during and after the construction of the hydropower known as 'UHE Colíder', under responsibility of the company from the 'Companhia Paranaense de Energia – COPEL'. The hydropower dam is located in 'Mato Grosso State' at the transition zone between the hotspot Cerrado and Amazon (Mid-West Brazil), at 'Nova Canaã do Norte' and 'Itaúba' municipalities, but also affecting areas from other two municipalities (COPEL, 2018). The impacted 'Telles Pires' River is one of the rivers that generate the 'Tapajós' River, which in turn is a major tributary of the Amazon River (see Figure 2 for a detailed location). The electric generation power of UHE Colíder is 300 Mega-Watts (enough for a city with 850 thousand people, Wosiack et al., 2018); and the reservoir encompasses an area of 171.7 km^2. The length of the reservoirs is 94 km from the dam to the beginning of the lake. Although the reservoir is not among the largest in Amazon basin, it is one of a series of four medium-sized reservoirs that together may represent a large impact in a major tributary of Amazon Basin. Indeed, although large sized reservoirs represent major 'per capita' impact, the numerous and widespread small and medium reservoirs may represent a great impact in most basins (Couto & Olden, 2018).

2.2. Samplings

Samplings before the formation of the lake were carried out in 2016 (BF); during the formation of the lake in 2017 (DU); and after the formation in 2018 (AF). In each of sampling campaigns, 10 sampling units were monitored (see Figure 2, see that location of two sampling units were changed from the campaigns BF to the others; it was not

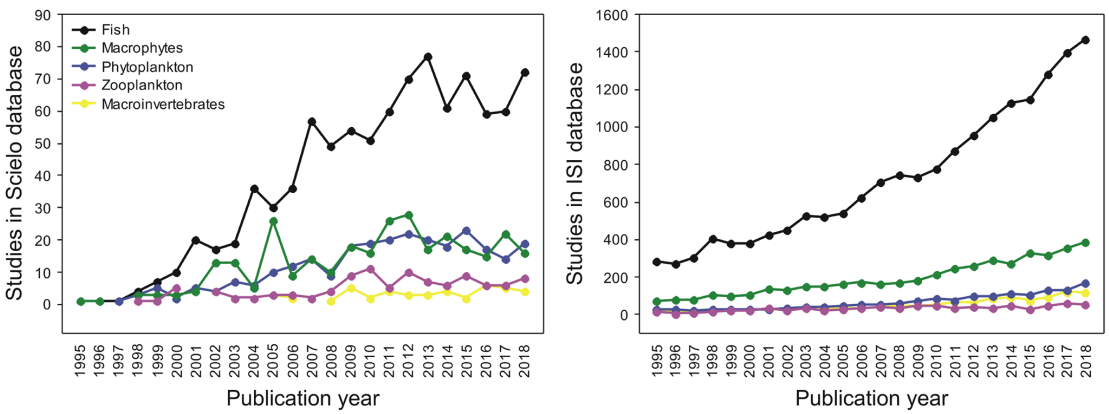

Figure 1. Number of papers returned in a search in Scielo and ISI (Web of Science) databases using the following words in topic: (dam* OR reservoir*) AND (fish* OR (macrophyte* OR 'aquatic plant*') OR (phytoplankt* OR algae) OR zooplankt* OR (macroinvert* OR zoobent* OR 'aquatic insect*')).

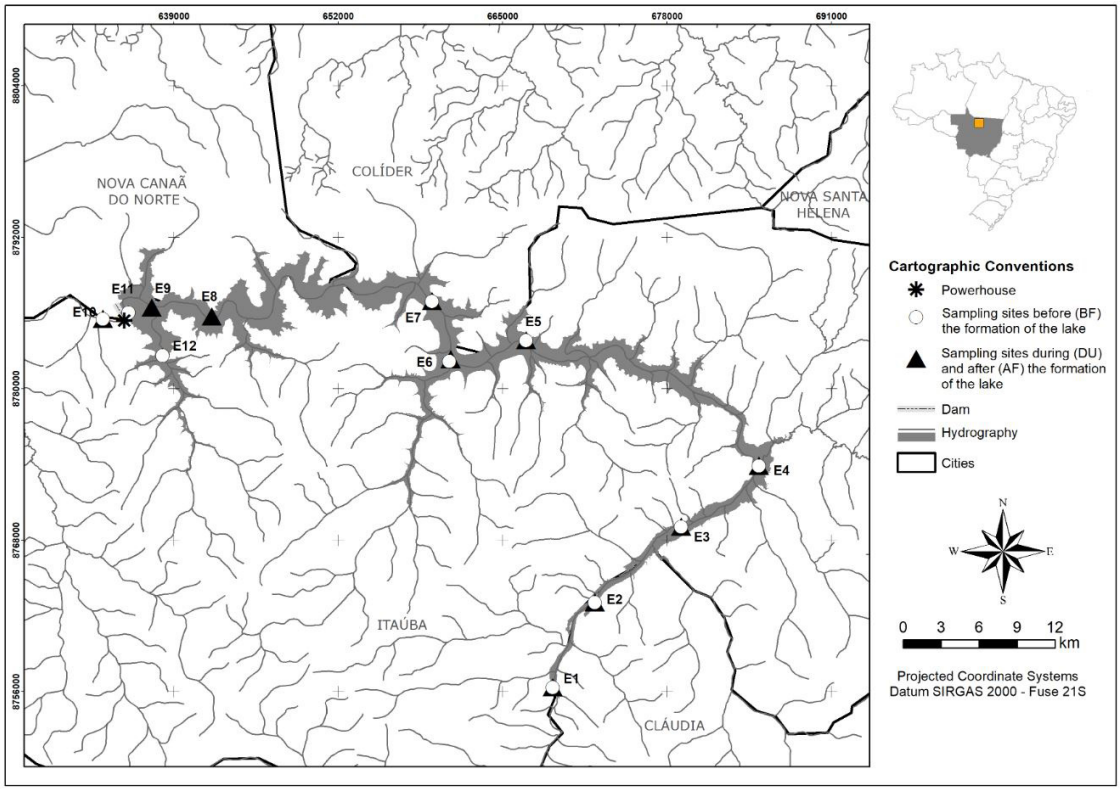

Figure 2. Map showing location of the hydropower dam and the sampling units. Note that two sampling units were modified considering sampling before to sampling during and after. Modified from Wosiack et al. (2018). E1 to E12 indicate location of the 12 sampling sites.

possible to sample at a same location given the landscape change). In each sampling unit, 400 L (BF) and 800 L (DU and AF) were filtered in a mesh of 64 µm. The volume differed to ensure that a similar number of individuals could be recorded in each campaign. Therefore, records were standardized by considering the filtered volume. Sampling material were stored in 500 mL plastic tubes and preserved in 95º Alcohol. At the lab, samplings were filtered again (mesh of 64 µm), and if necessary diluted to facilitate identification. Rose Bengal dye was used as an organism-coloring agent. A 1 mL concentrated sampled was then used for identification in Sedgwick-Rafter counting cell, and identification occurred in optical microscope using up to 100x objective lenses. Identification followed specialized literature (e.g. Ruttner-Kolisko, 1974; Silva et al., 1989; Shiel, 1995; Elmoor-Loureiro, 1997; Witty, 2004; Joko, 2011; Gazulha, 2012).

2.3. Data analysis

All analyses were carried out in R environment (R Core Team, 2017) using the packages 'vegan' (Oksanen et al., 2017), 'labdsv' (Roberts, 2016) and 'betapart' (Baselga et al., 2018). Hypothesis tests were considered significant if type I error were lower than 5%. When multiple tests were done, type I error probability was divided by the number of tests used (popularly known as Bonferroni correction).

Changes in species compositions were analyzed using a PERMANOVA (Anderson, 2001) with 999 permutations. If significant, differences in BF, DU and AF were visualized in a Principal Coordinate Analysis (PCoA; Gower, 1966) and species typical from each period were identified using the Indicator Value Index (IndVal; Dufrêne & Legendre, 1997). IndVal is an index that balances the fidelity (in our case, the occupation of the species in all samplings of a period) and specificity (in our case, the occurrence of the species in only one period) of each species in each classification (in our case, periods). IndVal varies from 0 (no fidelity and specificity) to 1 (maximum specificity and fidelity) (Dufrêne & Legendre, 1997). We then compared IndVal for each species with a null expectation after 999 permutations. The spatial organizations of different periods (described by compositional dissimilarity matrices) were compared among periods using Mantel tests (Mantel, 1967) also with 999 permutations. A significant Mantel

correlation would mean that spatial community organization was not disrupted among periods, contrarily to what we expect. Finally, variation in compositional dissimilarity (mission statement 4 in Anderson et al., 2011) was also evaluated by applying the *betadipser* with *permutest* approach applied in a PCoA (Anderson et al., 2006), also with 999 permutations. This approach estimates a value of variation in compositional dissimilarity calculated by the mean distance of each local community to the centroid of a metacommunity. Thus, we used this approach to estimate the total variation in metacommunity beta diversity for each period (BF, DU and AF).

All analyses were carried out using Hellinger-transformed (Legendre & Gallagher, 2001) abundance and occurrence (i.e. presence/absence) data (except for IndVal, which uses only abundance to calculate the fidelity, see Dufrêne & Legendre, 1997). As a consequence, Bray-Curtis and Sorensen dissimilarities were used, respectively, to generate dissimilarity matrices. In Mantel tests and *betadisper* approach, we compared spatial organization and community variation (respectively) using turnover and nestedness components (considering both abundance and occurrence) of beta diversity following Baselga (2010). This could show if impact affect a component of beta diversity different from another. All analyses were done separating Rotifers, Copepods and Cladocerans.

3. Results

164 taxa were identified in all samplings. The most common were Rotifers (102 taxa), followed by Cladocerans (41 taxa) and Copepods (21 taxa). A full table of taxa sampled in each period (BF, DU and AF) is available as supporting information (Table 1).

Table 1. Full list of zooplankton taxa (separated by Rotifers, Copepods and Cladocerans) sampled before (BF), during (DU) and after (AF) the formation of the reservoir lake from the hydropower dam UHE Colíder.

Rotifers	BF	DU	AF	Rotifers (...continuing...)	BF	DU	AF
Ascomorpha sp.	X	X	X	*Pleosoma* sp.	X		
Asplanchna brightwellii			X	*Ploesoma truncatum*			X
Asplanchna sieboldii	X			*Polyarthra dolichoptera*	X		
Asplanchna sp.	X	X	X	*Polyarthra remata*	X		
Bdelloidea	X	X	X	*Polyarthra* sp.	X	X	X
Beauchampiella sp.	X		X	*Polyarthra vulgaris*	X		
Brachionus calyciflorus f. Amphicerus	X			*Scaridium* sp.	X		X
Brachionus dolabratus	X	X	X	*Synchaeta* sp.		X	X
Brachionus falcatus		X	X	*Testudinela ohlei*	X	X	X
Brachionus mirus		X	X	*Testudinella ahlstrom*	X		X
Brachionus mirus angustus	X			*Testudinella emarginula*	X		
Brachionus mirus laticaudatus	X			*Testudinella mucronata*	X		X
Brachionus mirus mirus	X			*Testudinella ohlei*	X		
Brachionus quadridentatus quadridentatus			X	*Testudinella patina*	X	X	X
Brachionus tropica		X		*Testudinella* sp.	X		X
Brachionus zahniseri	X	X	X	*Testudinella tridentata*	X		X
Conochilus coenobasis	X			*Trichcocerca* sp.	X	X	X
Conochilus dossuarius	X		X	*Trichocerca mus*			X
Conochilus sp.	X	X	X	*Trichotia tetractis*	X	X	X
Dipleuchlanis propatula	X		X	**Copepods**	**BF**	**DU**	**AF**
Fiinia saltator			X	*Argyrodiaptomus robertsonae*			X
Filina limnetica	X	X	X	*Attheyella* sp.	X		
Filinia longiseta	X	X		Calanoida	X	X	X
Filinia opolienis	X	X	X	Cyclopoida	X	X	X
Filinia saltator	X	X	X	Copepodito	X	X	X
Filinia sp.	X			Copepodito ciclopoida	X	X	X
Filinia terminalis	X	X	X	Harpacticoida	X	X	X
Floscullariidae	X			*Mesocyclops meridianus*	X		
Hexarthra intermedia brasiliensis	X			*Mesocyclops* sp.	X		X
Hexarthra sp.	X	X	X	*Metacyclops* sp.	X	X	X

Table 1. Continued...

Rotifers	BF	DU	AF	Rotifers (...continuing...)	BF	DU	AF
Keratella amerciana	X	X	X	*Microcyclops* sp.	X	X	X
Keratella cochlearis	X	X	X	Nauplio	X	X	X
Keratella lenzi	X	X	X	Nauplio Calanoida	X	X	X
Keratella tropica	X	X	X	Nauplio Cyclopoida	X	X	X
Keratellla lenzi			X	*Notodiapotmus* sp.	X	X	X
Lecane amazonica	X	X	X	*Notodiaptomus henseni*	X		
Lecane bulla	X	X	X	*Odontodiaptomus* sp.		X	
Lecane bulla bulla	X	X	X	*Paracyclops* sp.	X		
Lecane closterocerca			X	*Parastenocaris fontinalis*	X		
Lecane cornuta	X			*Thermocyclops minutus*	X	X	X
Lecane cornuta			X	*Thermocyclops* sp.	X	X	X
Lecane curvicornis	X			**Cladocerans**	**BF**	**DU**	**AF**
Lecane curvicornis curvicornis	X	X	X	*Acroperus harpae*			X
Lecane curvicornis nitida			X	*Acroperus* sp.			X
Lecane elsa			X	*Alona guttata*	X		
Lecane haliclysta	X	X		*Alona* sp.	X		X
Lecane hamata			X	*Alonella dadayi*	X	X	X
Lecane leontina	X		X	*Alonella* sp.	X		
Lecane limnetica			X	*Bosmina longirostris*	X	X	X
Lecane ludwigii	X		X	*Bosmina cf. Longirostris*	X		
Lecane ludwigii f. Ohiensis		X		*Bosmina* sp.	X		
Lecane ludwigii ludwigii		X		*Bosminopsis deiterrsi*	X	X	X
Lecane luna			X	*Camptocercus* sp.			X
Lecane lunaris	X	X	X	*Ceriodaphania cornuta*	X	X	X
Lecane lunaris crenata			X	*Ceriodaphnia quadrangula*	X		
Lecane monostyla	X	X	X	*Ceriodaphnia richardi*	X		
Lecane pyriformis		X		*Ceriodaphnia* sp.	X	X	X
Lecane quadridentata	X		X	*Chydorus eurynotus*			X
Lecane signifera		X	X	*Chydorus parvireticulatus*	X		
Lecane sp.	X	X		*Chydorus* sp.	X		X
Lecane stichaea	X			*Chydorus sphaericus*			X
Lecane subtilis	X	X		*Daphnia gessneri*	X	X	X
Lecane thienemanne	X		X	*Daphnia* sp.	X	X	X
Lecane ungulata		X	X	*Diaphanosoma birgei*	X		
Lepadella benjamini	X	X	X	*Diaphanosoma brachyurum*	X		
Lepadella ovalis		X	X	*Diaphanosoma sp*	X	X	X
Lepadella sp.	X			*Disparalona dadayi*	X		X
Lophocharis sp.			X	*Disparalona hamata*			X
Macrochaetus collinsi			X	*Disparalona* sp. *1*	X		
Macrochaetus sericus			X	*Ephemeroporus hybridus*	X		X
Manfredium eudactylota euchla	X			*Graptoleberis testudinaria*			X
Monommata sp.	X			*Ilyocriptus spinifer*	X		X
Mytilina macrocera	X		X	*Ilyocryptus* sp.			X
Mytilina mucronata			X	*Kurzia latissima*	X		X
Mytilina sp.	X			*Leydigiopsis curvirostris*			X
Mytilina ventralis	X			*Leydigiopsis* sp.	X	X	X
Platias leloupi f. Latiscapularis	X			*Macrothrix* sp.	X		
Plationus patulus macracanthus	X	X	X	*Macrothrix triserialis*	X		X
Plationus patulus patulus	X	X	X	*Moinodaphnia* sp.		X	
Platyas quadricornis	X			*Notoalona sculpta*	X		X
Platyias cf. Leloupi	X	X	X	*Pseudochydorus globosus*	X		
Platyias quadricornis	X	X	X	*Scapholeberis* sp.	X		
Pleosoma lenticulare			X	*Simocephalus* sp.			X

There were compositional changes according to PERMANOVA considering nearly all datasets (except for Cladocerans using abundance data, Table 2). In agreement, there were typical species from DU and AF periods (but not BF), as identified in IndVal analysis (Table 3). Compositional changes are also visible in PCoA diagrams (Figure 3). It is possible to observe a continuum of changes from period BF to AF (except for abundance of Cladocerans, as stated above). However, it is clear that for most comparisons, the period AF is the most different (Figure 3).

The spatial organization of Rotifers (measured as a matrix of dissimilarities among sampling units in each period) was similar in two comparisons for turnover (expect occurrence between BF and AF; and between DU and AF), but not for nestedness (Table 4). For Copepods, spatial organization differed for almost all comparisons and data resolutions; only nestedness between DU and AF for occurrence data were correlated (Table 4). Finally, Cladocerans had a similar spatial organization in two comparisons for turnover (except for abundance turnover between BF and AF), but not for nestedness (Table 4).

Total variation of community dissimilarity also differed between periods, but depending on the data resolution and facet of beta diversity (turnover or nestedness, see Table 4). For all groups, compositional variation in nestedness increased during the formation of the reservoir lake, and decreased after the formation of the lake (both for abundance and occurrence, see Table 5 and also the size of multivariate dispersion in Figure 3). Compositional variation in turnover did not differ for any group and data resolution (Table 5).

Table 2. Results from Permutational Multivariate Analysis of Variance (F statistics and P value are shown) applied in zooplankton data (for each zooplankton group separately, see methods) considering both abundance and occurrence data.

Zooplankton group	Data resolution	F	P
Rotifers	Abundance	3.526	0.001
Rotifers	Occurrence	2.896	0.002
Copepods	Abundance	9.772	0.001
Copepods	Occurrence	7.057	0.001
Cladocerans	Abundance	1.627	0.101
Cladocerans	Occurrence	2.736	0.007

4. Discussion

Our results show a clear and immediate effect of damming in zooplankton community composition. We expected that compositional changes would be less affected for micro-crustaceans. Even so, only for abundance of Cladocerans we could not reject the hypothesis that species composition was not changed. Particularly after the formation of the lake, the species composition was the most different; indicating that species composition immediately

Table 3. Typical taxon or taxa stage (when not possible to identify) for each period identified as significantly different from a null expectation in Indicator Value (IndVal) analysis. The Indicator value is shown for the significant species in each period: during (DU) and after (AF) the reservoir lake formation. There was no typical species identified before reservoir formation.

	Taxon or stage	Period	IndVal	*P*
Rotifers	*Trichocerca* sp.	DU	0.763	0.047
	Keratella coclearis	DU	0.580	0.005
	Brachionus falcatus	DU	0.574	0.034
	Asplanchna brightwellii	AF	0.900	0.001
	Keratella americana	AF	0.688	0.002
	Lecane amazonica	AF	0.665	0.002
	Synchaeta sp.	AF	0.597	0.003
	Lecane leontina	AF	0.586	0.009
	Testudinella mucronata	AF	0.549	0.006
	Lecane elsa	AF	0.500	0.003
	Testudinella tridentata	AF	0.496	0.008
	Filinia opoliensis	AF	0.470	0.046
Copepods	*Odontodiaptomus* sp.	DU	0.400	0.027
	Copepodito	DU	0.378	0.039
	Cyclopoida	AF	0.900	0.001
	Mesocyclops sp.	AF	0.589	0.002
	Nauplio Cyclopoida	AF	0.500	0.008
	Nauplio Calanoida	AF	0.400	0.018

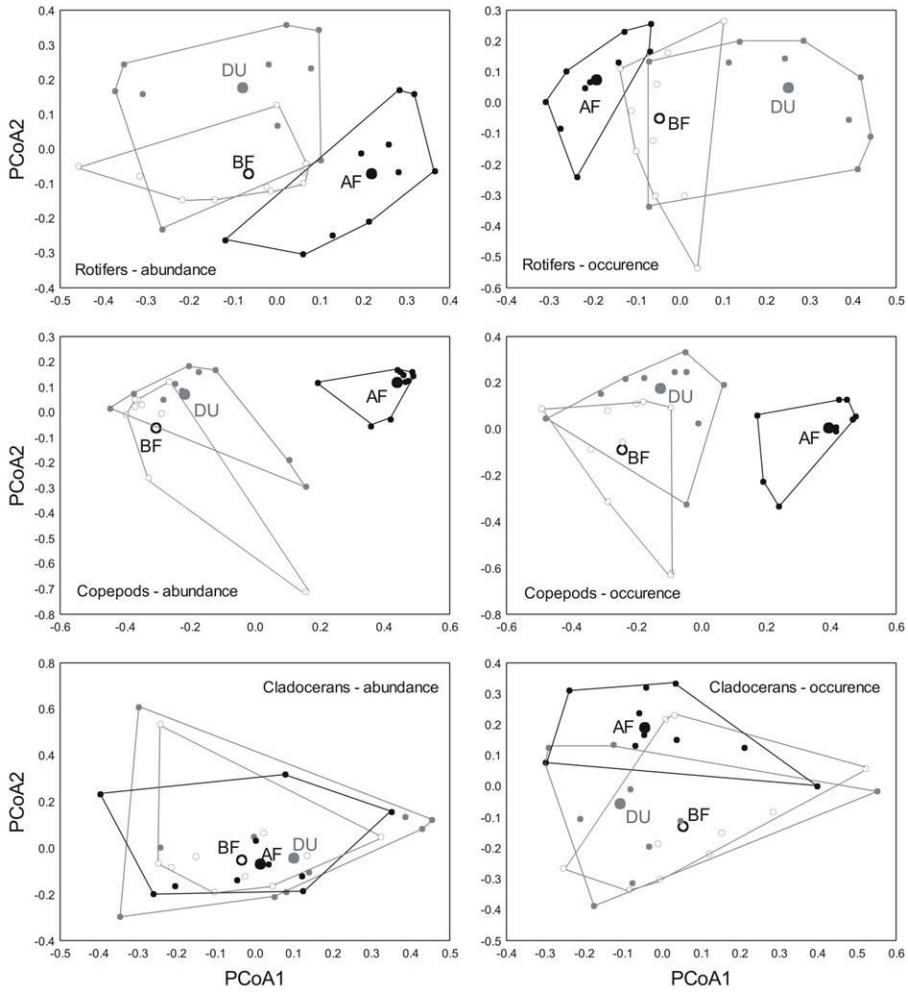

Figure 3. Two first axes of a Principal Coordinate Analysis (PCoA1 and PCoA2) showing the local communities (small balls) and the centroid (large balls) of each period of the dam construction (see methods) for abundance and occurrence of Rotifers, Copepods and Cladocerans. Before dam construction: BF, open light-black balls and light-black lines; During dam construction: DU, grey balls grey lines; After dam construction: AF, filled dark-black balls, dark-black lines.

Table 4. Mantel tests (r and P) correlating the spatial organization of communities between periods. Spatial organization was measured as a dissimilarity matrix between sampling units, which was estimated using turnover and nestedness components of beta diversity, both for abundance and for occurrence data, following Baselga (2010).

	Data Resolution	Facet of beta diversity	Comparison	Mantel's r	P
Rotifers	Abundance	Turnover	BF-DU	**0.588**	**0.001**
	Abundance	Turnover	BF-AF	0.406	0.036
	Abundance	Turnover	DU-AF	**0.626**	**0.001**
	Abundance	Nestedness	BF-DU	-0.172	0.888
	Abundance	Nestedness	BF-AF	-0.353	0.994
	Abundance	Nestedness	DU-AF	-0.058	0.636
	Occurrence	Turnover	BF-DU	0.388	0.039
	Occurrence	Turnover	BF-AF	0.286	0.077
	Occurrence	Turnover	DU-AF	0.369	0.077
	Occurrence	Nestedness	BF-DU	-0.239	0.940
	Occurrence	Nestedness	BF-AF	-0.345	0.999
	Occurrence	Nestedness	DU-AF	-0.017	0.551

Comparisons were always made between pair of periods: BF = before; DU = during; and AF = after formation of the reservoir lake (see methods). Given that two comparisons were always done with a same dataset, we considered significant only when P values were lower than 2.5% (see methods). Significant values are highlighted in bold.

Table 4. Continued...

	Data Resolution	Facet of beta diversity	Comparison	Mantel's r	P
Copepods	Abundance	Turnover	BF-DU	-0.139	0.696
	Abundance	Turnover	BF-AF	0.139	0.184
	Abundance	Turnover	DU-AF	-0.160	0.743
	Abundance	Nestedness	BF-DU	-0.068	0.612
	Abundance	Nestedness	BF-AF	0.025	0.442
	Abundance	Nestedness	DU-AF	0.217	0.140
	Occurrence	Turnover	BF-DU	0.013	0.447
	Occurrence	Turnover	BF-AF	0.062	0.352
	Occurrence	Turnover	DU-AF	-0.190	0.772
	Occurrence	Nestedness	BF-DU	0.066	0.322
	Occurrence	Nestedness	BF-AF	0.243	0.053
	Occurrence	Nestedness	DU-AF	**0.476**	**0.016**
Cladocerans	Abundance	Turnover	BF-DU	0.610	0.049
	Abundance	Turnover	BF-AF	0.412	0.124
	Abundance	Turnover	DU-AF	**0.581**	**0.007**
	Abundance	Nestedness	BF-DU	0.016	0.467
	Abundance	Nestedness	BF-AF	-0.199	0.818
	Abundance	Nestedness	DU-AF	0.072	0.337
	Occurrence	Turnover	BF-DU	0.421	0.045
	Occurrence	Turnover	BF-AF	**0.702**	**0.002**
	Occurrence	Turnover	DU-AF	**0.370**	**0.018**
	Occurrence	Nestedness	BF-DU	-0.063	0.588
	Occurrence	Nestedness	BF-AF	0.119	0.246
	Occurrence	Nestedness	DU-AF	-0.021	0.517

Comparisons were always made between pair of periods: BF = before; DU = during; and AF = after formation of the reservoir lake (see methods). Given that two comparisons were always done with a same dataset, we considered significant only when P values were lower than 2.5% (see methods). Significant values are highlighted in bold.

Table 5. Variation in compositional dissimilarity (calculated following *betadisper* approach, see Anderson et al., 2006) for turnover and nestedness (following Baselga, 2010) using both abundance and occurrence data for each zooplankton group estimated before (BF), during (DU) and after (AF) the formation of the reservoir (see methods). The F statistics and P value for the permutation test is also shown. Significant values are highlighted in bold.

	Data Resolution	Period	Facet of beta diversity	Variation in compositional dissimilarity	Permutation test
Rotifers	Abundance	BF	Turnover	0.402	F = 0.904
	Abundance	DU	Turnover	0.332	P = 0.425
	Abundance	AF	Turnover	0.349	
	Abundance	BF	Nestedness	0.034	**F = 5.057**
	Abundance	DU	Nestedness	0.064	**P = 0.014**
	Abundance	AF	Nestedness	0.030	
	Occurrence	BF	Turnover	0.393	F = 3.147
	Occurrence	DU	Turnover	0.243	P = 0.057
	Occurrence	AF	Turnover	0.345	
	Occurrence	BF	Nestedness	0.110	**F = 13.643**
	Occurrence	DU	Nestedness	0.246	**P = 0.002**
	Occurrence	AF	Nestedness	0.097	
Copepods	Abundance	BF	Turnover	0.390	F = 0.028
	Abundance	DU	Turnover	0.386	P = 0.968
	Abundance	AF	Turnover	0.409	
	Abundance	BF	Nestedness	0.022	**F = 7.593**
	Abundance	DU	Nestedness	0.070	**P = 0.001**
	Abundance	AF	Nestedness	0.016	
	Occurrence	BF	Turnover	0.390	F = 1.301
	Occurrence	DU	Turnover	0.386	P = 0.291
	Occurrence	AF	Turnover	0.409	
	Occurrence	BF	Nestedness	0.022	**F = 3.119**
	Occurrence	DU	Nestedness	0.070	**P = 0.029**
	Occurrence	AF	Nestedness	0.016	

Table 5. Continued...

	Data Resolution	Period	Facet of beta diversity	Variation in compositional dissimilarity	Permutation test
Cladocerans	Abundance	BF	Turnover	0.377	F = 0.149
	Abundance	DU	Turnover	0.326	P = 0.887
	Abundance	AF	Turnover	0.359	
	Abundance	BF	Nestedness	0.023	**F = 4.108**
	Abundance	DU	Nestedness	0.055	**P =0.024**
	Abundance	AF	Nestedness	0.033	
	Occurrence	BF	Turnover	0.377	F = 1.729
	Occurrence	DU	Turnover	0.326	P = 0.193
	Occurrence	AF	Turnover	0.359	
	Occurrence	BF	Nestedness	0.023	**F = 6.017**
	Occurrence	DU	Nestedness	0.055	**P =0.006**
	Occurrence	AF	Nestedness	0.033	

changes with landscape changes. More than showing the well-described pattern of compositional changes due to reservoir damming (e.g. Simões et al., 2015) we also indicate that changes are directional, promoting certain species during and after the formation of the lake. Just after the formation of the lake, water is usually turbid and nutrient-rich due to the decomposition of remnant vegetation, promoting cyanobacteria (Kennedy & Thornton, 2001). Among the typical zooplankton species found in this period are *Asplanchna brightwellii* and a Cyclopoid species. Also, our results are in line with previous studies indicating that species from Lecanidae, Brachionidae and Trichocercidae are typical after floods, where habitat connection is higher and community similarity is greater (Bonecker et al., 2013).

Our study goes further in describing the impact of dam construction by showing that effects in composition occurs for both abundance and occurrence data. Even so, we do highlight that such analyses should be done with both data resolutions, given that impact was identified for Cladocerans only using occurrence data. Probably, the fact that most abundance species occurred in all periods, compositional changes using abundance data is more difficult to identify. We thus refute the suggestion that a significant correlation between abundance and occurrence data could simplify monitoring (e.g. Ribas & Padial, 2015; Souza et al., 2019). At least for impact assessment, we highlight that analyzing different data resolutions should be preferred.

We also suggest that impact of dams also disrupt spatial community organization, which suggest that species filtering mechanisms (Leibold et al., 2004) are also altered by reservoir damming. Indeed, responses of zooplankton to environmental gradients have been altered by reservoir damming (Portinho et al., 2016). Again, we reinforce that a complete investigation should be done, given that such patter was described for most but not all comparisons (see Table 3). The fact that Rotifers are more affected by both compositional changes as well as for changes in spatial organization of metacommunity was expected, as this group is more susceptible to environmental alterations and is more sessile (Soares et al., 2015). However, our results also suggest that Cladocerans can also have a disruption of its spatial organization, but the fact that effect was detected using occurrence may suggest that the disruption occurred mainly in less abundance taxa, which could be more susceptible to environmental alterations promoted by reservoir damming. Relatedly, Missias et al. (2017) also suggest that Rotifers, Copepods and Cladocerans do respond differently to spatial ecological gradients in reservoirs; which reinforce that all groups should be evaluated separately in studies evaluating anthropogenic impacts in aquatic ecosystems.

Contrarily to what we expected, reservoirs did not necessarily decreased compositional variation over space; which would indicate a biotic homogenization phenomenon (Olden & Rooney, 2006); already evidenced in other reservoirs (Daga et al., 2015). Maybe the homogenization phenomenon could still occur, given that such phenomenon does need a long time-spam to be identified (see Olden et al., 2018). However, by scrutinizing data and evaluating turnover and nestedness separately, our results do show an interesting pattern: an increase in nestedness during the formation of the lake. We did not find any report on this in literature. Instead, Lopes et al. (2017)

suggested that temporal variation of zooplankton beta diversity components are difficult to predict and do not have a monotonic pattern of increase and decrease in a tropical reservoir. However, such study took place only after the formation of the reservoir. The increase in nestedness during the formation of the lake do indicate that is this period, the metacommunity experience a relatively more impacted gradient. Indeed, increasing nestedness is associated to an ecological gradient of impact (e.g. Declerck et al., 2007). In our study, the increase in nestedness occurred for all biological groups and data resolutions. Even so, we do recognize that impacts were not overwhelming compared to others that may combine high turnover with increasing nestedness.

In this study, we did show the trajectory of zooplankton community following to the formation of a reservoir lake. We highlight that impacts are detectable using different facets of metacommunity beta-diversity, including compositional changes, spatial organization changes and compositional variation changes (see Anderson et al., 2011 for a description of different ways to evaluate beta-diversity). We reinforce the urge in literature for a complete assessment of biodiversity (Socolar et al., 2016) and also for digging deeper in evaluating phenomena such as Biotic Homogenization as a consequence of anthropogenic impacts (Olden et al., 2018). We also suggest that data resolution and differential responses of biological groups are features that should be considered in zooplankton assessments (Missias et al., 2017). Our study is unique by following the trajectory of the formation of a reservoir lake in a still under-study aquatic biological group. We showed that zooplankton cope with landscape changes caused by reservoir lake formation, which may also reflect in ecosystem functioning features such as productivity, matter and nutrient cycling (Simões et al., 2015). It is well-known that environmental alterations caused by changes associated to reservoirs extend to biota (Agostinho et al., 2008). Here, we scrutinized the complexity of effects in zooplankton, considering data resolution, biological groups and the facet of biodiversity evaluated. Given the relatively short time-spam (i.e. three years) studied; we do suggest that monitoring in this reservoir continues to evaluate the long-term effects that river-damming cause to zooplankton community. For instance, the compositional changes observed here can be only transitory, or other changes can be only identified after a long time-spam. It is also worth-mentioning that is not prudent to infer causality based on observational studies. An approach to do so is the so called 'counterfactual thinking' (Ribas et al., 2019). Therefore, we also highlight the need to monitor and preserve pristine riverine ecosystems to meet conservation of biodiversity and also to a better inference of causality in anthropogenic impacts (e.g. Ribas et al., 2019). We believe that monitoring such as the realized in this case is a model to be followed in other dam constructions, if simultaneously accompanied by monitoring in similar areas without impacts.

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ERRATUM: Zooplankton trajectory before, during and after a hydropower dam construction

ERRATUM: Trajetória do zooplâncton antes, durante e depois da construção de uma barragem de hidroelétrica

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Authors are really sorry for some spelling mistakes in species names in Tables 1 and 3. See below the correct tables. Also, authors used capital letters to refer for biological groups along the text, such as 'Rotifers', 'Cladocerans' and 'Copepods'. Authors should use lowercase letters in these cases and keep capital letters only for the formal names of taxonomic categories.

Were it reads:

Table 1. Full list of zooplankton taxa (separated by Rotifers, Copepods and Cladocerans) sampled before (BF), during (DU) and after (AF) the formation of the reservoir lake from the hydropower dam UHE Colíder.

Rotifers	BF	DU	AF	Rotifers (...continuing...)	BF	DU	AF
Ascomorpha sp.	X	X	X	*Pleosoma* sp.	X		
Asplanchna brightwellii			X	*Ploesoma truncatum*			X
Asplanchna sieboldii	X			*Polyarthra dolichoptera*	X		
Asplanchna sp.	X	X	X	*Polyarthra remata*	X		
Bdelloidea	X	X	X	*Polyarthra* sp.	X	X	X
Beauchampiella sp.	X		X	*Polyarthra vulgaris*	X		
Brachionus calyciflorus f. Amphicerus	X			*Scaridium* sp.	X		X
Brachionus dolabratus	X	X	X	*Synchaeta* sp.		X	X
Brachionus falcatus		X	X	*Testudinela ohlei*	X	X	X
Brachionus mirus		X	X	*Testudinella ahlstrom*	X		X
Brachionus mirus angustus	X			*Testudinella emarginula*	X		
Brachionus mirus laticaudatus	X			*Testudinella mucronata*	X		X
Brachionus mirus mirus	X			*Testudinella ohlei*	X		
Brachionus quadridentatus quadridentatus			X	*Testudinella patina*	X	X	X
Brachionus tropica		X		*Testudinella* sp.	X		X

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Table 1. Continued...

Rotifers	BF	DU	AF	Rotifers (...continuing...)	BF	DU	AF
Brachionus zahniseri	X	X	X	*Testudinella tridentata*	X		X
Conochilus coenobasis	X			*Trichcocerca* sp.	X	X	X
Conochilus dossuarius	X		X	*Trichocerca mus*			X
Conochilus sp.	X	X	X	*Trichotia tetractis*	X	X	X
Dipleuchlanis propatula	X		X	**Copepods**	BF	DU	AF
Fiinia saltator			X	*Argyrodiaptomus robertsonae*			X
Filina limnetica	X	X	X	*Attheyella* sp.	X		
Filinia longiseta	X	X		Calanoida	X	X	X
Filinia opolienis	X	X	X	Cyclopoida	X	X	X
Filinia saltator	X	X	X	Copepodito	X	X	X
Filinia sp.	X			Copepodito ciclopoida	X	X	X
Filinia terminalis	X	X	X	Harpacticoida	X	X	X
Flosculariidae	X			*Mesocyclops meridianus*	X		
Hexarthra intermedia brasiliensis	X			*Mesocyclops* sp.	X		X
Hexarthra sp.	X	X	X	*Metacyclops* sp.	X	X	X
Keratella amerciana	X	X	X	*Microcyclops* sp.	X	X	X
Keratella cochlearis	X	X	X	Nauplio	X	X	X
Keratella lenzi	X	X	X	Nauplio Calanoida	X	X	X
Keratella tropica	X	X	X	Nauplio Cyclopoida	X	X	X
Keratellla lenzi			X	*Notodiapotmus* sp.	X	X	X
Lecane amazonica	X	X	X	*Notodiaptomus henseni*	X		
Lecane bulla	X	X	X	*Odontodiaptomus* sp.		X	
Lecane bulla bulla	X	X	X	*Paracyclops* sp.	X		
Lecane closterocerca			X	*Parastenocaris fontinalis*	X		
Lecane cornuta	X			*Thermocyclops minutus*	X	X	X
Lecane cornuta			X	*Thermocyclops* sp.	X	X	X
Lecane curvicornis	X			**Cladocerans**	BF	DU	AF
Lecane curvicornis curvicornis	X	X	X	*Acroperus harpae*			X
Lecane curvicornis nitida			X	*Acroperus* sp.			X
Lecane elsa			X	*Alona guttata*	X		
Lecane haliclysta	X	X		*Alona* sp.	X		X
Lecane hamata			X	*Alonella dadayi*	X	X	X
Lecane leontina	X		X	*Alonella* sp.	X		
Lecane limnetica			X	*Bosmina longirostris*	X	X	X
Lecane ludwigii	X		X	*Bosmina cf. Longirostris*	X		
Lecane ludwigii f. Ohiensis		X		*Bosmina* sp.	X		
Lecane ludwigii ludwigii		X		*Bosminopsis deiterrsi*	X	X	X
Lecane luna			X	*Camptocercus* sp.			X
Lecane lunaris	X	X	X	*Ceriodaphania cornuta*	X	X	X
Lecane lunaris crenata			X	*Ceriodaphnia quadrangula*	X		
Lecane monostyla	X	X	X	*Ceriodaphnia richardi*	X		
Lecane pyriformis		X		*Ceriodaphnia* sp.	X	X	X
Lecane quadridentata	X		X	*Chydorus eurynotus*			X
Lecane signifera		X	X	*Chydorus parvireticulatus*	X		
Lecane sp.	X	X		*Chydorus* sp.	X		X
Lecane stichaea	X			*Chydorus sphaericus*			X
Lecane subtilis	X	X		*Daphnia gessneri*	X	X	X
Lecane thienemanne	X		X	*Daphnia* sp.	X	X	X
Lecane ungulata		X	X	*Diaphanosoma birgei*	X		
Lepadella benjamini	X	X	X	*Diaphanosoma brachyurum*	X		
Lepadella ovalis		X	X	*Diaphanosoma sp*	X	X	X
Lepadella sp.	X			*Disparalona dadayi*	X		X
Lophocharis sp.			X	*Disparalona hamata*			X
Macrochaetus collinsi			X	*Disparalona* sp.	X		
Macrochaetus sericus			X	*Ephemeroporus hybridus*	X		X

Table 1. Continued...

Rotifers	BF	DU	AF	Rotifers (...continuing...)	BF	DU	AF
Manfredium eudactylota euchla	X			*Graptoleberis testudinaria*			X
Monommata sp.	X			*Ilyocriptus spinifer*	X		X
Mytilina macrocera	X		X	*Ilyocryptus* sp.			X
Mytilina mucronata			X	*Kurzia latissima*	X		X
Mytilina sp.	X			*Leydigiopsis curvirostris*			X
Mytilina ventralis	X			*Leydigiopsis* sp.	X	X	X
Platias leloupi f. Latiscapularis	X			*Macrothrix* sp.	X		
Plationus patulus macracanthus	X	X	X	*Macrothrix triserialis*	X		X
Plationus patulus patulus	X	X	X	*Moinodaphnia* sp.		X	
Platyas quadricornis	X			*Notoalona sculpta*	X		X
Platyias cf. Leloupi	X	X	X	*Pseudochydorus globosus*	X		
Platyias quadricornis	X	X	X	*Scapholeberis* sp.	X		
Pleosoma lenticulare			X	*Simocephalus* sp.			X

It should be read:

Table 1. Full list of zooplankton taxa (separated by rotifers, copepods and cladocerans) sampled before, during and after the formation of the reservoir lake from the hydropower dam UHE Colíder.

Rotifers	BF	DU	AF	Rotifers (...continuing...)	BF	DU	AF
Ascomorpha sp.	X	X	X	*Polyarthra dolichoptera*	X		
Asplanchna brightwellii			X	*Polyarthra remata*	X		
Asplanchna sieboldii	X			*Polyarthra* sp.	X	X	X
Asplanchna sp.	X	X	X	*Polyarthra vulgaris*	X		
Bdelloidea	X	X	X	*Scaridium* sp.	X		X
Beauchampiella sp.	X		X	*Synchaeta* sp.		X	X
Brachionus calyciflorus f. amphicerus	X			*Testudinela ohlei*	X	X	X
Brachionus dolabratus	X	X	X	*Testudinella ahlstrom*	X		X
Brachionus falcatus		X	X	*Testudinella emarginula*	X		
Brachionus mirus		X	X	*Testudinella mucronata*	X		X
Brachionus mirus angustus	X			*Testudinella ohlei*	X		
Brachionus mirus laticaudatus	X			*Testudinella patina*	X	X	X
Brachionus mirus mirus	X			*Testudinella* sp.	X		X
Brachionus quadridentatus quadridentatus			X	*Testudinella tridentata*	X		X
Brachionus tropica		X		*Trichocerca* sp.	X	X	X
Brachionus zahniseri	X	X	X	*Trichocerca mus*			X
Conochilus coenobasis	X			*Trichotia tetractis*	X	X	X
Conochilus dossuarius	X		X	**Copepods**	BF	DU	AF
Conochilus sp.	X	X	X	*Argyrodiaptomus robertsonae*			X
Dipleuchlanis propatula	X		X	*Attheyella* sp.	X		
Filinia saltator			X	Calanoida	X	X	X
Filinia limnetica	X	X	X	Cyclopoida	X	X	X
Filinia longiseta	X	X		Copepodid	X	X	X
Filinia opolienis	X	X	X	Copepodid ciclopoida	X	X	X
Filinia saltator	X	X	X	*Harpacticoida*	X	X	X
Filinia sp.	X			*Mesocyclops meridianus*	X		
Filinia terminalis	X	X	X	*Mesocyclops* sp.	X		X
Flosculariidae	X			*Metacyclops* sp.	X	X	X
Hexarthra intermedia brasiliensis	X			*Microcyclops* sp.	X	X	X
Hexarthra sp.	X	X	X	Nauplii	X	X	X
Keratella amerciana	X	X	X	Nauplii Calanoida	X	X	X
Keratella cochlearis	X	X	X	Nauplii Cyclopoida	X	X	X

Table 1. Continued...

Rotifers	BF	DU	AF	Rotifers (...continuing...)	BF	DU	AF
Keratella lenzi	X	X	X	*Notodiaptomus* sp.	X	X	X
Keratella tropica	X	X	X	*Notodiaptomus henseni*	X		
Lecane amazonica	X	X	X	*Odontodiaptomus* sp.		X	
Lecane bulla	X	X	X	*Paracyclops* sp.	X		
Lecane closterocerca			X	*Parastenocaris fontinalis*	X		
Lecane cornuta	X		X	*Thermocyclops minutus*	X	X	X
Lecane curvicornis	X			*Thermocyclops* sp.	X	X	X
Lecane curvicornis curvicornis	X	X	X	*Cladocerans*	BF	DU	AF
Lecane curvicornis nitida			X	*Acroperus* sp.			X
Lecane elsa			X	*Acroperus tupinamba*			X
Lecane haliclysta	X	X		*Alona cf. guttata*	X		
Lecane hamata			X	*Alona* sp.	X		X
Lecane leontina	X		X	*Alonella dadayi*	X	X	X
Lecane limnetica			X	*Alonella* sp.	X		
Lecane ludwigii	X		X	*Bosmina longirostris*	X	X	X
Lecane ludwigii f. ohiensis		X		*Bosmina cf. longirostris*	X		
Lecane ludwigii ludwigii		X		*Bosmina* sp.	X		
Lecane luna			X	*Bosminopsis deiterrsi*	X	X	X
Lecane lunaris	X	X	X	*Camptocercus* sp.			X
Lecane lunaris crenata			X	*Ceriodaphania cornuta*	X	X	X
Lecane monostyla	X	X	X	*Ceriodaphnia quadrangula*	X		
Lecane pyriformis		X		*Ceriodaphnia richardi*	X		
Lecane quadridentata	X		X	*Ceriodaphnia* sp.	X	X	X
Lecane signifera		X	X	*Chydorus eurynotus*			X
Lecane sp.	X	X		*Chydorus parvireticulatus*	X		
Lecane stichaea	X			*Chydorus* sp.	X		X
Lecane subtilis	X	X		*Chydorus sphaericus*			X
Lecane thienemanne	X		X	*Daphnia gessneri*	X	X	X
Lecane ungulata		X	X	*Daphnia* sp.	X	X	X
Lepadella benjamini	X	X	X	*Diaphanosoma birgei*	X		
Lepadella ovalis		X	X	*Diaphanosoma brachyurum*	X		
Lepadella sp.	X			*Diaphanosoma* sp.	X	X	X
Lophocharis sp.			X	*Disparalona dadayi*	X		X
Macrochaetus collinsi			X	*Disparalona hamata*			X
Macrochaetus sericus			X	*Disparalona* sp.	X		
Manfredium eudactylota euchla	X			*Ephemeroporus hybridus*	X		X
Monommata sp.	X			*Graptoleberis testudinaria*			X
Mytilina macrocera	X		X	*Ilyocryptus spinifer*	X		X
Mytilina mucronata			X	*Ilyocryptus* sp.			X
Mytilina sp.	X			*Kurzia latissima*	X		X
Mytilina ventralis	X			*Leydigiopsis curvirostris*			X
Platias leloupi f. latiscapularis	X			*Leydigiopsis* sp.	X	X	X
Plationus patulus macracanthus	X	X	X	*Macrothrix* sp.	X		
Plationus patulus patulus	X	X	X	*Macrothrix triserialis*	X		X
Platyas quadricornis	X			*Moinodaphnia* sp.		X	
Platyias cf. leloupi	X	X	X	*Notoalona sculpta*	X		X
Platyias quadricornis	X	X	X	*Pseudochydorus globosus*	X		
Ploesoma lenticulare			X	*Scapholeberis* sp.	X		
Ploesoma sp.	X			*Simocephalus* sp.			X
Ploesoma truncatum			X				

Were it reads:

Table 3. Typical taxon or taxa stage (when not possible to identify) for each period identified as significantly different from a null expectation in Indicator Value (IndVal) analysis. The Indicator value is shown for the significant species in each period: during (DU) and after (AF) the reservoir lake formation. There was no typical species identified before reservoir formation.

	Taxon or stage	Period	IndVal	P
Rotifers	*Trichocerca* sp.	DU	0.763	0.047
	Keratella coclearis	DU	0.580	0.005
	Brachionus falcatus	DU	0.574	0.034
	Asplanchna brightwellii	AF	0.900	0.001
	Keratella americana	AF	0.688	0.002
	Lecane amazonica	AF	0.665	0.002
	Synchaeta sp.	AF	0.597	0.003
	Lecane leontina	AF	0.586	0.009
	Testudinella mucronata	AF	0.549	0.006
	Lecane elsa	AF	0.500	0.003
	Testudinella tridentata	AF	0.496	0.008
	Filinia opoliensis	AF	0.470	0.046
Copepods	*Odontodiaptomus* sp.	DU	0.400	0.027
	Copepodito	DU	0.378	0.039
	Cyclopoida	AF	0.900	0.001
	Mesocyclops sp.	AF	0.589	0.002
	Nauplio Cyclopoida	AF	0.500	0.008
	Nauplio Calanoida	AF	0.400	0.018

It should be read:

Table 3. Typical taxon or taxa stage (when not possible to identify) for each period identified as significantly different from a null expectation in Indicator Value (IndVal) analysis. The Indicator Value is shown for the significant species in each period: before (BF), during (DU) and after (AF) the reservoir lake formation.

	Taxon or stage	Period	IndVal	P
Rotifers	*Trichocerca* sp.	DU	0.763	0.047
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	Keratella americana	AF	0.688	0.002
	Lecane amazonica	AF	0.665	0.002
	Synchaeta sp.	AF	0.597	0.003
	Lecane leontina	AF	0.586	0.009
	Testudinella mucronata	AF	0.549	0.006
	Lecane elsa	AF	0.500	0.003
	Testudinella tridentata	AF	0.496	0.008
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	Copepodid	DU	0.378	0.039
	Cyclopoida	AF	0.900	0.001
	Mesocyclops sp.	AF	0.589	0.002
	Nauplii Cyclopoida	AF	0.500	0.008
	Nauplii Calanoida	AF	0.400	0.018