Supplementary materials

Table S1. Abiotic variables at the catchment scale.

Stream	Urban (%)	Sugarcane (%)	Forest (%)	Agriculture (%)	Pasture (%)	Area (km²)	Length (km)
s01	0.00	39.29	23.87	0.00	36.85	3.17	2.07
s02	0.00	66.69	1.11	0.00	32.20	1.07	0.53
s03	2.58	26.15	7.73	0.00	63.55	7.76	4.39
s04	0.00	59.57	13.12	0.00	27.31	7.63	3.17
s05	0.00	23.65	24.02	0.00	52.33	3.43	1.75
s07	13.61	26.18	11.19	0.00	49.01	4.57	2.65
s08	0.02	59.29	36.92	2.72	1.05	3.98	1.96
s09	4.42	68.67	24.14	0.22	2.54	5.48	1.96
s10	0.00	62.4	17.17	0.07	20.36	4.01	1.28
s11	0.00	77.09	4.90	0.35	17.66	6.68	2.17
s12	0.00	62.19	25.43	8.97	3.42	1.55	0.99
s13	0.00	76.78	10.27	0.00	12.95	1.68	0.87
s14	0.00	17.10	34.21	0.27	48.41	6.11	2.17
s15	0.00	4.50	51.95	0.14	43.40	4.14	0.81
s17	18.30	19.55	5.48	0.00	56.68	2.75	1.49
s18	86.50	8.74	2.56	0.00	2.21	2.74	0.80
s20	0.00	15.30	43.34	19,25	22.12	10.13	3.12
s21	0.00	5.58	48.12	16.56	29.74	17.94	3.43
s22	0.00	87.42	0.99	2.65	8.95	5.41	2.78
s23	0.00	72.07	5.84	0.65	21.44	8.13	4.75
s24	0.00	10.49	41.73	0.40	47.37	4.31	3.19
s25	0.00	20.87	21.73	12.48	44.92	5.20	3.15
s27	0.00	11.48	2.23	0.26	86.03	5.23	2.82

Table S2. Local abiotic variables.

Stream	Width (m)	Depth (m)	Slope (°)	Dissolved oxygen (mg/L)	Temperature (ºC)	Velocity (m/s)	pH	Conductivity (µS/m)	Turbity (NTU)
s01	2.00	0.07	3.55	7.28	24.0	0.09	6.33	36.5	4.97

s02	2.59	0.25	2.70	7.79	21.9	0.30	6.49	36.1	11.73
s03	1.62	0.32	4.12	7.56	21.3	0.93	6.45	66.4	8.36
s04	2.12	0.31	2.85	7.65	23.0	0.15	6.22	22.4	8.43
s05	3.82	0.11	2.73	6.26	24.6	0.16	5.69	16.6	35.53
s07	2.65	0.13	2.76	7.30	23.3	0.48	6.48	74.5	25.3
s08	3.00	0.26	3.93	7.28	23.3	0.23	6.88	81.5	13.7
s09	4.63	0.19	2.56	7.43	22.7	0.23	6.57	41.8	10.74
s10	1.38	0.27	3.10	7.26	23.8	0.29	5.83	28.3	4.96
s11	2.24	0.17	2.99	7.30	23.8	0.58	5.44	51.5	10.93
s12	0.85	0.06	4.50	7.38	22.6	0.15	6.52	42.0	12.44
s13	1.60	0.10	3.76	7.15	23.7	0.20	5.82	30.8	6.06
s14	1.19	0.16	2.61	7.34	24.0	0.41	6.28	21.6	7.76
s15	1.30	0.20	3.14	5.65	24.1	0.29	5.54	28.9	4.28
s17	1.49	0.11	2.97	7.29	23.8	0.82	6.71	96.5	156.0
s18	0.80	0.08	2.64	5.46	23.9	0.20	6.83	248.0	7.41
s20	3.12	0.22	3.08	7.35	23.5	0.24	5.96	30.4	3.85
s21	1.65	0.29	3.21	7.35	23.1	0.43	5.69	36.2	2.8
s22	2.83	0.18	3.13	7.32	23.2	0.13	5.76	25.6	3.61
s23	2.76	0.18	2.36	6.70	24.0	0.24	5.87	14.9	17.01
s24	4.74	0.51	3.65	7.37	22.9	0.23	5.79	46.1	11.52
s25	2.11	0.20	3.83	7.18	23.9	0.20	6.23	43.5	37.4
s27	1.27	0.18	2.77	7.06	24.1	0.33	5.67	26.2	21.5

Table S3. Rapid Assessment Protocol adapted to the study region (Cionek, V. M., Beaumord, A. C., & Benedito E., 2011). All parameters were visually evaluated and scored from zero (worst condition) to 20 (optimum condition). The mean value of all parameters was used as the stream local condition.

Parameter	Background	Evaluation
Underwater available cover	Greater variety and / or mixture of suitable cover available for different biotic communities.	Proportion of underwater aquatic vegetation, organic material, trunks, branches and leaves.
Underwater habitat complexity	Habitat diversity along the stretch promotes higher spatial heterogeneity. The presence of excavated banks, stable mixture of trunks, branches and leaves in contact with water, create backwaters, small lagoons and small waterfalls; all these habitats could be available for the aquatic biota as refuge, food and spawning.	Marginal vegetation inclined over the channel, presence of backwaters, small waterfalls and excavated banks distributed along the evaluated section.

Velocity/depth combinations	A greater variety of water velocity and depth combinations favour the presence and survival of organisms with different ecomorphological and habitat use characteristics.	Presence of the four regimes of water velocity and depth characterize a stretch in optimal condition: (1) fast / shallow, (2) slow / shallow, (3) fast / deep and (4) slow / deep; speed regimes are categorized as rapid when the water flow reaches more than 0.2 m/s and are deep when they reach more than 0.2 m.
Channel sinuosity	Higher sinuosity promotes greater availability of habitats for the aquatic communities, combined with the greater capacity of retention of fluctuations of flow caused by heavy rains. The absorption of energy by the curves protects the water course of excessive erosions and floods, and provides refuge for biota during storm events.	Presence of sharp and evident curves along the channel.
Water level amplitude	Channel-level fluctuations are related to the availability of substrate and other cover elements for aquatic communities.	Proportion of substrates and cover elements submerged by water. It should be evaluated differently according to the time of year (dry and rainy season).
Channel integrity	Human-induced disturbances such as dikes, dredging, landfills, drainage, dams, pavement and flow diversion are contributing factors to disturbance in streams. Their presence promotes selectivity of more resistant species, hindering and even preventing the stabilization and maintenance of an environmental balance.	Presence of channelization, dredging, bridges, dams and embankments.
Bank stability	The bank stability is closely associated with the presence of rooted vegetation, which promotes the cohesion of the sand particles and reduces the effects of erosion. In the study area, dominated by sandy soils, erosive processes can lead to the formation of ravines along the stream path.	Presence and proportion of erosive processes, preserved vegetation and signs of detachment and substrate transport of ravines.
Bank vegetative protection	The riparian forests act as a physical barrier to contain nutrients from terrestrial environments, provide organic matter to the aquatic environment, buffer the temperature variations and contribute to the flow of energy between the environments.	Presence and proportion of riparian vegetation along the stretch, considering a width of up to 15 meters from the stream margin.
Vegetation conservation on the riparian zone	The composition of riparian vegetation depends on geological, geomorphological, hydrological, climatic and anthropogenic factors. Riparian forests with native and diverse composition, and in advanced stage of succession, provide greater protection to the system.	Presence and proportion of native species in good conservation status.

Table S4. Classification of sampled species according to their biological characteristics. Categories as follows: Origin (N = native, A = alien); Habitat guild (Preferred habitat for each fish species on water column position: B = benthopelagic, D = demersal); Reproductive guild (Reproductive habit for each fish species: IF = internal fertilization, PC = parental care behavior, N-PC = no parental care behavior); Tolerance (General tolerance to common anthropogenic, physical, and chemical stressors: I = intolerant, T = tolerant); Trophic guild (Primary source of nutrition for each fish species as an adult: Det = detritivore, Herb = herbivore, Ins = insectivore, Omn = omnivore, Pisc = piscivore).

Fish Species	Origin	Habitat Guild	Reproductive Guild	Tolerance	Trophic Guild
CHARACIFORMES					
Characidae					
Astyanax aff. *fasciatus*	N[15]	B[18]	N-PC[18]	I[13]	Ins[1,8]
Astyanax aff. *paranae*	N[15]	B[18]	N-PC[18]	I[13]	Ins[1,3]
Astyanax lacustris	N[15]	B[18]	N-PC[18]	I[13]	Omn[1,2]
Astyanax bockmanni	N[15]	B[18]	N-PC[18]	I[13]	Herb[4,7]
Moenkhausia forestii	N[15]	B[18]	N-PC[18]	I[13*]	Ins[3]
Oligosarcus paranensis	N[15]	B[18]	N-PC[18]	I[17,*]	Ins[10]
Oligosarcus pintoi	N[15]	B[18]	N-PC[18]	I[17,*]	Ins[2,11]
Cheirodontinae					
Serrapinnus notomelas	N[15]	B[18]	N-PC[18]	T[13]	Det[2]
Stevardiinae					
Bryconamericus exodon	N[15]	B[18]	N-PC[18]	I[14]	Ins[5]
Knodus moenkhausii	N[15]	B[18]	N-PC[18]	T[13]	Ins[2,3]
Piabarchus stramineus	N[15]	B[18]	N-PC[18]	I[14]	Omn[1]

Piabina argentea	N[15]	B[18]	N-PC[18]	I[13]	Ins[2,4]
Crenuchidae					
Characidium aff. *zebra*	N[15]	B[18]	N-PC[18]	I[17]	Ins[1,2]
Erythrinidae					
Hoplias sp3.	N[15]	B[18]	N-PC[18]	T[17]	Pisc[1,8]
Parodontidae					
Parodon nasus	N[15]	B[18]	N-PC[18]	I[13]	Det[1]
CICHLIFORMES					
Cichlidae					
Crenicichla britskii	N[15]	B[18]	N-PC[18]	I[13]	Ins[2]
CYPRINODONTIFORMES					
Poeciliidae					
Phalloceros harpagos	N[15,16]	B[18]	IF[11], PC[18]	T[17]	Omn[3,6]
Poecilia reticulata	A[15,16]	B[18]	IF[11], PC[18]	T[13]	Det[2,3]
GYMNOTIFORMES					
Gymnotidae					
Gymnotus inaequilabiatus	N[15]	B[18]	N-PC[18]	T[13]	Ins[3,4]
Gymnotus sylvius	N[15]	B[18]	N-PC[18]	T[13*]	Ins[2]
Sternopygidae					
Sternopygus macrurus	N[15]	B[18]	N-PC[18]	I[16]	Ins[9]

SILURIFORMES					
Callichthyidae					
Callichthys callichthys	N[15]	D[18]	N-PC[18]	T[17]	Det[6]
Corydoras aeneus	N[15]	D[18]	N-PC[18]	T[12]	Ins[2,3]
Heptapteridae					
Cetopsorhamdia iheringi	N[15]	D[18]	N-PC[18]	I[14]	Ins[4,7]
Imparfinis schubarti	N[15]	D[18]	N-PC[18]	I[13]	Ins[2,3]
Phenacorhamdia tenebrosa	N[15]	D[18]	N-PC[18]	I[14]	Ins[4,8]
Rhamdia quelen	N[15]	B[18]	N-PC[18]	T[13,17]	Ins[2,3]
Loricariidae					
Hypostominae					
Hypostomus ancistroides	N[15]	D[18]	N-PC[18]	T[13,17]	Det[2,7]
Hisonotus francirochai	N[15]	B[18]	N-PC[18]	I[13]	Det[2]
Rineloricaria pentamaculata	N[15]	D[18]	N-PC[18]	T[17,*]	Ins[7]
Trichomycteridae					
Trichomycterus davisi	N[15]	B[18]	N-PC [18]	I[17,*]	Ins[3,6]
SYNBRANCHIFORMES					
Synbranchidae					
Synbranchus marmoratus	N[15]	D[18]	N-PC[18]	T[17]	Ins[3]

Modified from Pereira, 2016. [1]Smith et al., 2013; [2]Zeni; Casatti, 2014; [3]Cionek, 2016; [4]Silva, 2013; [5]Novakowski et al., 2008; [6]Abilhoa et al., 2008; [7]Silva et al., 2012; [8]Ferreira, 2007; [9]Luz-Agostinho et al., 2006; [10]Esteves et al., 2008; [11]Casatti, 2002; [12]Araújo; Garutti, 2003; [13]Casatti et al., 2009; [14]Casatti et al., 2012; [15]Graça; Pavanelli, 2007; [16]Petry et al., 2013; [17]Bozzetti; Schulz, 2004; [18]Froese; Pauly, 2019. *The classification of these species followed its genus pattern.

Table S5. Candidate metrics for the N3S-IBI. Total metrics (227) were calculated using standardized measures of number, biomass and proportion of taxa or individuals.

Metric
Diversity
Shannon index
Simpson's dominance (1 – D)
Total richness
Abundance
Biomass of fish
Number of fish
Composition (Individuals)
A. aff. *fasciatus*
A. aff. *paranae*
A. bockmanni
A. lacustris
B. exodon
C. aeneus
C. britskii
C. callichthys
C. iheringi
C. aff. *zebra*
G. inaequilabiatus
G. sylvius
H. ancistroides
H. francirochai
Hoplias sp3
I. schubarti
K. moenkhausii
M. forestii
O. paranensis
O. pintoi
P. argentea
P. harpagos
P. nasus
P. reticulata
P. stramineus
P. tenebrosa
R. pentamaculata
R. quelen
S. macrurus
S. marmoratus
S. notomelas
T. davisi
Characiformes less tolerant
Characiformes + Siluriformes
Characiformes + Siluriformes less tolerant
Characiformes
Siluriformes less tolerant
Siluriformes
Synbranchiformes
Characidae
Loricariidae

Heptapteridae
Composition (Family/Order)
Characiformes
Cichliformes
Cyprinodontiformes
Gymnotiformes
Siluriformes
Characiformes + siluriformes
Characiformes less tolerant
Characiformes + Siluriformes less tolerant
Siluriformes less tolerant
Characidae
Loricariidae
Heptapteridae
Origin
Alien
Native
Habitat guild
Benthopelagic
Demersal
Benthopelagic less tolerant
Demersal less tolerant
Reproductive Guild
With parental care
Without parental care
External reproduction
Internal reproduction
Without parental care less tolerant
Tolerance
Intolerant
Tolerant
Richness of intolerant
Richness of tolerant
Trophic Guild
detritivore
herbivore
insectivore
omnivore
piscivore
detritivore less tolerant
insectivore less tolerant
omnivore less tolerant

Table S6. RAP metrics. LM – left margin; RM – right margin.

Stream	Underwater available cover	Underwater habitat complexity	Velocity/depth combinations	Channel sinuosity	Water level amplitude	Channel integrity	Bank stability – LM	Bank stability – RM	Bank vegetative protection – LM	Bank vegetative protection – RM	Vegetation conservation - LM	Vegetation conservation - RM	RAP
s01	18	17	4	6	6	7	7	7	6	6	5	5	**94**
s02	11	14	15	16	19	20	9	9	6	6	5	5	**135**
s03	1	3	6	16	7	16	3	3	3	3	0	0	**61**
s04	15	15	15	20	20	20	8	7	8	7	8	7	**150**
s05	10	10	10	15	15	15	6	5	6	5	6	5	**108**
s07	4	5	8	17	12	18	3	3	3	3	0	0	**76**
s08	5	5	9	8	14	20	9	9	4	4	5	5	**97**
s09	1	3	3	10	6	2	1	1	2	2	3	3	**37**
s10	11	11	12	8	11	18	8	7	8	7	6	8	**115**
s11	9	7	5	4	7	19	5	6	4	5	3	5	**79**
s12	11	6	2	10	4	3	4	4	4	4	3	3	**58**
s13	16	16	15	15	19	20	7	8	8	8	8	8	**148**
s14	17	16	18	17	13	12	4	4	4	4	3	3	**115**
s15	12	5	7	6	11	17	7	8	3	3	3	4	**86**
s17	1	3	5	9	8	12	3	4	3	3	4	4	**59**
s18	3	2	7	5	7	16	2	2	3	3	5	5	**60**
s20	18	16	15	20	19	20	9	9	9	9	8	8	**160**
s21	17	17	16	19	17	20	10	10	9	8	10	9	**162**
s22	16	15	13	13	11	19	5	4	5	5	5	5	**116**
s23	11	11	13	13	13	13	3	4	2	2	3	3	**91**
s24	7	7	7	5	8	18	7	7	5	5	5	5	**86**
s25	7	3	12	13	12	13	4	4	5	5	4	4	**86**
s27	11	15	12	13	12	20	5	5	5	5	7	7	**117**

Table S7. Rapid Assessment Protocol – Field Spreadsheet.

Location: _____

Evaluator: _____ Date: ___ / ___ / ___

General observations (i.e.: rainy day, cloudy day, new fallen trees, new flow disruption, or any observation important for data interpretation): _____

_____

Underwater Available Cover																				
Categories																				
Optimal					Good					Regular					Poor					
Stream reach presents 76% to 100% of potential cover, such as trunks, branches and leaves fallen into the water, underwater aquatic vegetation and decomposing organic material.					Stream reach presents 51% to 75% of potential cover, such as trunks, branches and leaves fallen into the water, underwater aquatic vegetation and decomposing organic material.					Stream reach presents 26% to 50% of potential cover, such as trunks, branches and leaves fallen into the water. Absence or minimum occurrence of decomposing organic material and underwater vegetation.					Clear dominance of sand. Flow velocity carrying away branches and leaves and limiting the establishment of underwater aquatic vegetation or decomposing organic material. Stream reach presents less than 25% of potential cover.					
20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Underwater Habitat Complexity																				
Categories																				
Optimal					Good					Regular					Poor					
Reaches with aquatic vegetation, marginal vegetation, small waterfalls, excavated banks, backwaters, and branches and leaves fallen into the water covering from 76% up to 100% of the stream reach, as potential habitat for fauna.					Reaches with aquatic vegetation, marginal vegetation, small waterfalls, excavated banks, backwaters, and branches and leaves fallen into the water covering from 51% up to 75% of the stream reach, as potential habitat for fauna.					Reaches with aquatic vegetation, marginal vegetation, small waterfalls, excavated banks, backwaters, and branches and leaves fallen into the water covering from 26% up to 50% of the stream reach, as potential habitat for fauna.					Reaches with aquatic vegetation, marginal vegetation, small waterfalls, excavated banks, backwaters, and branches and leaves fallen into the water covering less than 25% of the stream reach, as potential habitat for fauna.					
20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Velocity/depth Combinations

Categories																				
Optimal					Good					Regular					Poor					
Sites with the presence of 4 combinations: fast/shallow; fast/ deep; slow/shallow; slow/deep.					Sites with the presence of 3 combinations; the fast/shallow must be present.					Sites with the presence of 2 combinations; if fast/shallow is absent, scores must be lower.					Prevalence of 1 type; if slow regime predominates, scores must be lower.					
20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Channel Sinuosity																				
Categories																				
Optimal					Good					Regular					Poor					
Occurrence of sharp and evident curves along the stream reach.					Stream reach sinuosity is not evident, with distant curves.					Stream reach with a few, smooth and distant curves .					Stream reach is straight. If stream is channelized, scores must be lower.					
20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Water Level Amplitude – Rainy Season																				
Categories																				
Optimal					Good					Regular					Poor					
Water level covers all available habitats for the aquatic fauna.					Water level covers up to 75% of the stream channel, and less than 25% of substrates and cover elements available for fauna colonization are exposed.					Water level covers between 26% up to 75% of the stream channel, and less than 25% of substrates and cover elements available for fauna colonization are exposed.					Water level is critical, with reduced water flux; most of the flow rate is standing water in wells.					
20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Water Level Amplitude – Dry Season																				
Categories																				
Optimal										Regular										Poor
Water level covers all available habitats for the aquatic fauna.					Water level covers up to 75% of the stream channel, and less than 25% of substrates and cover elements available for fauna colonization are exposed.					Water level covers between 26% up to 75% of the stream channel, and less than 25% of substrates and cover elements available for fauna colonization are exposed.										Stream reach completely dry.
20					19	18	17	16	15	14	13	12	11	10						0

Channel Integrity																					
Categories																					
Optimal					Good					Regular					Poor						
Absence or minimum alterations such as channelization, dredging, bridges, dikes, embankments and dams. The water course follows a natural flow pattern.					Presence of past alterations such as bridges or dredging up to 20% of the stream reach, with absence of recent alterations.					Presence of recent embankments, dikes, channelization, or others, altering from 21% up to 50% of the stream natural course.					Channelized streams or margins supported by gabions. Reaches with strong flow disruption.					
20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	

Bank Stability											
Categories											
Optimal			Good			Regular			Poor		
Sites with minimum occurrence of erosion, preserved riparian vegetation sustaining the soil.			Banks present 11% to 30% of erosion, with soil exposure in sparse locations due to lack of vegetation; colonization by grasses and herbaceous vegetation; roots exposure, soil movements forming small beaches that may be colonized again by terrestrial vegetation.			Banks present 31% to 65% of erosion, with root exposure; increased domain of grasses and minimum presence of arborous vegetation in some sparse locations; clear soil movement and silting along the stretch limiting vegetation successional events.			Over 66% of the banks are eroded, with clear signs of burial and flow interruption due to erosion and silting; minimum arborous vegetation; margins dominated by grasses or herbaceous vegetation.		
LM	**10**	9	8	7	6	5	4	3	2	1	0
RM	10	9	8	7	6	5	4	3	2	1	0

*LM = left margin. RM = right margin. The sum of both margins provides this parameter scores.

Bank Vegetative Protection											
Categories											
Optimal			Good			Regular			Poor		
Stream reach with over 90% covered with natural vegetation, without evidence of plantations, pasture or urbanization in the proximity. Most riparian plants can grow naturally.			Stream reach with 70% up to 89% of the stream margins covered with natural vegetation, with evidence of minimum plantations, pasture or urbanization. Absence of large discontinuities in vegetation.			Stream reach with 50% up to 69% of the stream margins covered with natural vegetation, with various spots of anthropic occupation for agriculture, pasture or urban land uses. In case of urbanization, scores must be lower.			Less than 50% of the stream margins covered with vegetation, with large discontinuities or absence of vegetation.		
LM	10	9	8	7	6	5	4	3	2	1	0
RM	10	9	8	7	6	5	4	3	2	1	0

*LM = left margin. RM = right margin. The sum of both margins provides this parameter scores.

Vegetation Conservation on the Riparian Zone											
Categories											
Optimal			Good			Regular			Poor		
Surrounding vegetation composed by native species, in a good conservation status.			Vegetation composed by native (dominant) and non-native species. It presents a good conservation status, with minimum anthropogenic impacts.			Dominance of non-native species; minimal presence of native species is associated to anthropogenic impacts.			Absence of native vegetation giving rise to invasive species; pressure factors include the removal of native species, opening of trails and burnings.		
LM	10	9	8	7	6	5	4	3	2	1	0
RM	10	9	8	7	6	5	4	3	2	1	0

*LM = left margin. RM = right margin. The sum of both margins provides this parameter scores.