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Itapecuru River Basin (Maranhão, Brazil): limnological, geological and geomorphological preliminary characterization

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Introduction

The Itapecuru River, located in the Maranhão State, Brazil (02° 51′–06° 52′ S and 43° 02′–46° 00′ W Gr), plays an important role in regional development, besides its ecological significance. It flows through different climatic regions: hot, semi-humid and semi-arid. At present, continuing human interference has caused deforestation, erosion, and a reduction in the endemic fauna, not yet scientifically evaluated.

In this work, attention is drawn to the limnological characteristics of the river as well as to its geological and geomorphological features as a contribution to the management of this riverine ecosystem over the long term.

Material and methods

Study site

From its head (on the Croeira Hill, south region of Maranhão) to its mouth at São José Bay (southeast of São Luis Island), the river's extension is 1,090 km (IBGE 1984).

The drainage basin, with an area of 52,700 km^2, is coincident with the oriental border of Legal Amazonia. The rainfall pattern of this region shows a marked seasonality with a wet and a dry period. Along its course, the Itapecuru River cuts through Mesozoic and Cenozoic rocks, on diverse geomorphological contexts.

Surface water samples were collected at bimonthly intervals during the period September 1994–March 1995, along the river for the determination of: water depth, current, and transparency (Secchi disk). Temperature, electrical conductivity, and pH were measured with a field sensor (HORIBA – UV 10) previously calibrated with standard solutions. Suspended matter were estimated by total weight of suspended micromatter using 1.2 µm filters pre-weighted (GFC, Whatman). Samples for dissolved inorganic chemical species of nitrogen and phosphorus were frozen at –20 °C and analysed spectrophotometrically according to GOLTERMAN et al. (1978) and MACKERETH et al. (1978). Topographic maps (scale 1:100,000, from Brazilian Army Ministry) and photogeologic and photogeomorphologic analysis interpretation from aerial photographs (CPRM, Brazilian Ministry of Mines and Energy) were used.

Results and discussion

The environmental variables are expressed on Table 1. The river along its course showed irregular depths (0.78 to 7.10 m). The minimum depths were observed during the dry period, representing a critical factor due to the progressive input of allochthonous material of mineral origin.

Low transparency values reflected human activities. Highest results (1.39 m) were recorded at Alpercatas River, its main tributary, not yet affected by human impact on its gallery forest. The water temperature showed a gradient of 4.8 °C, mainly as a function of the sampling hour. The electrical conductivity had a three peaked gradient along the river course: near 10 µS/cm in the river head, reaching 30–60 µS/cm and 70–100 µS/cm, respectively, in the middle and lower courses. The geological substrate and input of domestic effluents possibly influenced these results. The sea water on the lower course, together with water turbulence in this transition zone, contributed to the high concentrations of suspended solids in this region (266.00 mg/L at Rosário).

The upper reaches of the river is on a substrate composed of basaltic rocks and sandstones of Jurassic age. The geomorphology of the area is composed of plateau and "cuestas", where drainage density is high. At this region, the river flows through a narrow valley, shallow and without rapids. Near Mirador City, there is a small lateral migration of the main channel. In the region of Colinas City, the river develops oxbow lakes.

* in memorian

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Table 1. Depth, transparency, water velocity and temperature at the surface along the River Itapecuru, measured at ten sites from September 1994 to March 1995.

City	Station	1 st				2 nd				3 rd				4 th			
		Depth (m)	Secchi (m)	Velocity (m/s)	Temp. (°C)	Depth (m)	Secchi (m)	Velocity (m/s)	Temp. (°C)	Depth (m)	Secchi (m)	Velocity (m/s)	Temp. (°C)	Depth (m)	Secchi (m)	Velocity (m/s)	Temp. (°C)
Mirador	Cajueiro	1.50	0.58	0.45	27.20	1.50	0.54	0.70	27.40	2.00	0.52	1.03	28.70	2.00	0.36	1.10	28.00
	Piscicultura	1.30	0.61	0.54	28.80	1.30	0.37	0.62	17.10	1.44	0.45	1.07	28.60	2.10	0.29	0.88	28.00
Colinas	Conf. Itapecuru	1.55	0.29	0.67	28.20	0.67	0.31	0.91	26.90	2.40	0.32	1.07	28.30	2.20	0.19	1.00	28.00
	Conf. Alpercata	1.90	1.39	1.00	27.70	2.00	1.08	1.34	26.70	1.70	1.22	0.86	28.80	2.68	1.00	2.00	28.00
	Prara Bonita	–	–	–	28.70	1.79	0.50	–	26.80	2.20	0.40	1.03	28.70	2.38	0.33	1.25	27.00
	Caema	2.26	0.75	1.37	27.60	1.77	0.45	1.25	27.50	2.93	0.52	1.20	28.30	3.35	0.37	1.60	28.00
	Barra Riacho	1.36	0.69	1.00	27.40	1.05	0.50	1.00	27.60	1.12	0.44	1.03	28.10	1.42	0.32	1.00	28.00
Caxias	Veneza	1.05	0.39	0.61	28.90	1.10	0.39	0.75	27.60	2.57	0.30	1.00	30.20	4.11	0.27	1.43	28.00
	Matadouro	1.35	0.40	0.48	29.40	1.31	0.42	0.64	27.20	2.00	0.34	1.15	30.30	3.17	0.31	1.11	28.00
Codó	Barra S. José	0.76	0.40	0.82	28.30	1.20	0.36	1.00	30.20	1.91	0.34	0.93	30.90	3.30	0.31	1.43	29.00
	Matadouro	1.24	0.39	1.00	29.20	1.13	0.34	1.30	30.10	2.65	0.31	0.90	30.80	4.50	0.32	1.11	29.00
Timbiras	Caema	1.10	0.40	0.88	31.20	0.84	0.40	0.87	29.60	2.45	0.42	1.15	29.10	4.50	0.34	1.43	29.00
	Prainha	1.15	0.40	0.88	31.00	1.73	0.46	0.87	29.40	4.39	0.40	1.11	29.30	6.00	0.32	1.34	29.00
Coroatá	Moco	0.93	0.41	0.81	29.90	1.22	0.48	0.45	28.60	1.05	0.37	1.30	29.60	4.00	0.33	1.43	29.00
	João Cacau	1.38	0.40	0.46	30.40	1.37	0.40	0.76	29.60	3.00	0.33	1.30	29.40	5.50	0.35	1.43	29.00
Pirapemas	P. da Guida	0.93	0.44	0.85	30.20	1.16	0.37	0.75	30.50	2.21	0.25	1.43	29.10	5.50	0.27	1.11	29.00
Cantanhede	Vila Monteiro	–	–	–	–	0.85	0.50	0.52	31.40	3.73	0.32	1.43	29.10	7.10	0.33	1.43	27.00
	Caema	1.00	0.47	1.24	30.80	0.85	0.43	0.74	31.50	3.62	0.33	1.15	29.10	4.90	0.34	1.43	27.00
Itapecuru	Barra do Coelho	1.26	0.50	0.61	26.70	1.36	0.37	0.77	29.50	3.00	0.22	1.30	28.20	6.60	0.32	1.11	29.90
	Rampa	1.30	0.50	0.51	29.90	1.36	0.41	0.76	29.50	4.30	0.20	1.15	28.10	6.30	0.32	1.15	27.70
Rosário	Curtume	3.38	0.31	0.64	30.20	4.00	0.12	0.68	29.40	1.50	0.39	1.00	28.10	4.30	0.36	1.00	29.00
	Maré Mansa	3.00	0.23	0.87	30.80	1.90	0.34	0.77	29.30	1.20	0.38	0.90	28.10	3.00	0.32	1.11	28.00
	Maximum	3.38	1.39	1.37	31.20	4.00	1.08	1.34	31.50	4.39	1.22	1.43	30.90	7.10	1.00	2.00	29.90
	Minimum	0.76	0.23	0.45	26.70	0.67	0.12	0.45	26.70	1.05	0.20	0.86	28.10	1.42	0.19	0.88	27.00
	Medium	1.49	0.50	0.78	29.17	1.43	0.43	0.83	28.79	2.43	0.40	1.11	29.04	4.04	0.35	1.27	28.30

In the middle course of the Itapecuru River, the channel becomes large and lateral migrations of the fluvial channel are pronounced, varying from 05° to 10°. The susbtract is composed of sandstones and limestones of Juro-Cretaceous age. Downstream, as far as Rosário City, the landscape is characterized by small hills.

Near its mouth, the river shows a typical meandering channel, transporting high amounts of detritic sediments in suspension. Near Itapecuru-Mirim country, the river course is highly carved and the fall in level between the floodplain and the river course is 8 m. Changes in the river course are evident, varying from 10° to 50°, reaching 90° near Rosário City. At this city, a large number of rapids occur as a function of the geological substrate that changes from sedimentary rocks to igneous and methamorphic ones. After Rosário City, the Itapecuru River flows through a low gradient area (Golfão Maranhense region), liable to tidal action.

From geomorphological and geological features, the Itapecuru River channel is formed by distinct lithologies. Failures and fractures, not obvious at the surface, control its course.

As for the gallery forest, large areas of it have been removed or substituted by crops in abandoned meanders, contributing for enlarged superficial erosion area.

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