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## Composition and distribution of the fish fauna in the Rio Jacuípe, northernmost tributary of the Rio Paraguaçu basin, Bahia, Brazil

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### ABSTRACT

The knowledge of fish fauna in the Caatinga rivers is often limited to the large river basins and their associated aquatic species, with only a few contributions dedicated to adjacent sub-basins. In the present investigation the Rio Jacuípe, the northernmost tributary of the Rio Paraguaçu in Chapada Diamantina, is evaluated regarding the taxonomic diversity, frequency, and constancy of occurrence, of the species distribution in the various segments. Rio Jacuípe flows parallel to Rio Paraguaçu with headwaters in Morro do Chapéu, at the Chapada Diamantina domain, and an artificial mouth in the Pedra do Cavalo dam. With mouth downstream from the metropolitan area of Feira de Santana municipality, the sub-basin has peculiar characteristics distinctive from the main river. The fish fauna of the Jacuípe is for the first time investigated in detail regarding the spatial distribution of aquatic communities. The patterns of fish distribution in the Rio Jacuípe indicate regional endemism although gaps in knowledge of species diversity are identified, especially in middle and lower stretches. The use and occupation of the soil and the alternatives for revitalizing the aquatic environments in the Jacuípe valley are presented and discussed. Our results contribute to the evaluation of public policies on conservation.

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Conservation; endemism;  
Caatinga; freshwater fishes;  
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## Introduction

The Rio Paraguaçu is included in the freshwater ecoregion of the Northeastern Mata Atlântica (sensu Abell et al. 2008). It corresponds to the largest river system exclusive to the state of Bahia, and it flows about 600 km from headwaters to mouth in Todos os Santos Bay. The Rio Paraguaçu northern tributary is the Rio Jacuípe, with headwaters located at the Chapada Diamantina plateau. The vegetation, the particular landscape, and its unique watershed place the Chapada Diamantina plateau as an area of huge biodiversity in northeastern Brazil, with wide swamps in plains, forests on the slopes, valleys embedded with humid forests, riparian forests, dry Cerrado lands, plateau forests and even streams leading to sinks in karst areas (MMA 2007; Sarmiento-Soares et al. 2018, 2021).

The state of Bahia totalizes 281 native freshwater fish species distributed in two distinct aquatic ecoregions – the Northeastern Atlantic ecoregion and the Rio São Francisco ecoregion (Silva et al., 2020). Among the plenty aquatic ecosystems in northeastern Brazil,

the Rio Paraguaçu stands out as the largest river drainage exclusively flowing in Bahia. It is of great importance to the State in water supply and its associated aquatic life (Zucchi 2011; Rosa et al. 2003).

The Rio Jacuípe sub-basin corresponds to the northernmost watershed draining to the Rio Paraguaçu, with an extension of approximately 470 km. Back in the 1880s, Teodoro Sampaio on his journey between the São Francisco River and the Chapada Diamantina characterized the Jacuípe River as a brute diamond but pointed out that the scarce water sources along its headwaters hampered large-scale mining activity (Sampaio 1905). In the same report, Teodoro Sampaio states that in its course between Chapada and eastern Bahia the river crossed vast areas of the Caatinga domain with particular dry weather in some areas (Sampaio 1905). The headwaters of Rio Jacuípe are situated in Morro do Chapéu, at the Chapada Diamantina, and their artificial mouth is located in the Pedra do Cavalo dam, downstream from Feira de Santana municipality.

Although the fish fauna of the Rio Paraguaçu basin has been investigated in recent decades (Santos 2003; Santos & Caramaschi 2007, 2011; Moura 2008; Reis-Filho & Santos 2014), some contributing sub-basins have only punctual records of its freshwater biodiversity, lacking detailed studies. Within the Rio Paraguaçu, the most evaluated sub-basins are the Rio Santo Antônio and the Rio São José (Santos 2003; Santos & Caramaschi 2007, 2011; Sena 2014), both investigated regarding their fish populations and species biodiversity. The Rio Jacuípe, though inhabited by freshwater endemic species in its upper section (Zanata & Camelier 2008), has not been effectively investigated regarding its fish fauna, and species. There is a gap in the knowledge about the diversity of species and the environment of the region.

The present study aims to investigate the fish communities along the Rio Jacuípe sub-basin, evaluating possible differences in species composition along the landscape. We hope to contribute to a better knowledge of the fish species composition in the area, which may be of some help on the definition of conservation strategies and possible alternatives to the revitalization of aquatic environments in a poorly understood Caatinga river drainage: the Jacuípe sub-basin.

## Material and methods

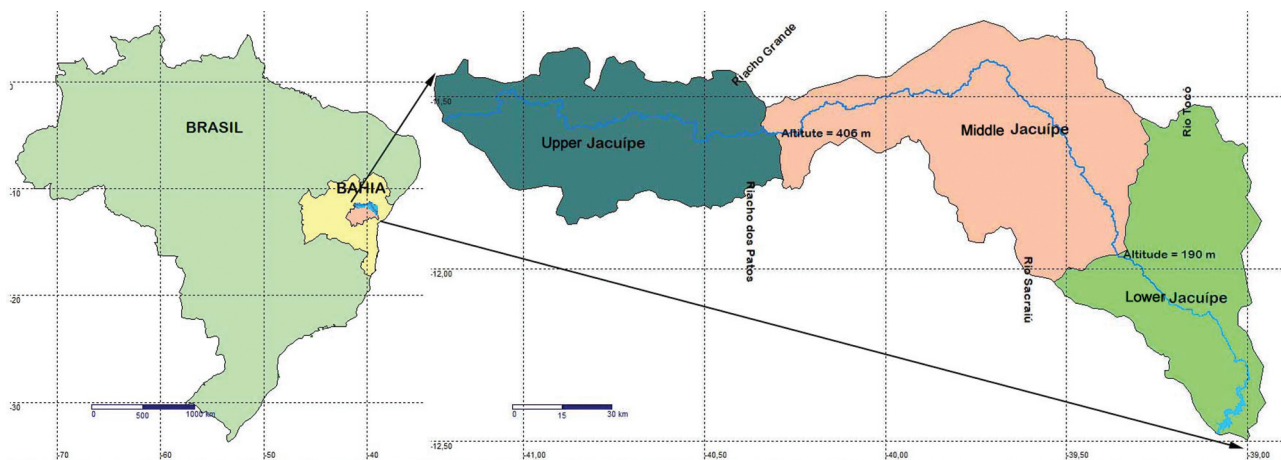
### Study area

The Rio Jacuípe is the northernmost contributor of the Rio Paraguaçu, with main headwaters in the Chapada Diamantina in the Morro do Chapéu municipality respectively, at up to 1,000 meters high, with the highest tributaries being Rio da Barra and Rio Ferro Doido. The Rio Jacuípe flows along 469 km in the semiarid

region of Bahia until it ends at the Pedra do Cavalo dam, in the municipality of Feira de Santana. With an area of approximately 12,251 km<sup>2</sup>, it represents 22.6% of the Rio Paraguaçu basin, runs in parallel to the main valley of the Paraguaçu since Morro do Chapéu municipality (11.5 ° S 41.2 ° W) up to its mouth at São Gonçalo dos Campos municipality (12.5 ° S 39.0 ° W) (Figure 1). The Rio Jacuípe drains totally or partially 35 municipalities.

### Land use and occupation

Locally the landscape is dominated by dry vegetation formations as the Caatinga savannah, rupestrian fields, and ecotones of these types of vegetation (Ferreira 2006). In addition to the variety of plant formations in the area, the highlands in Morro do Chapéu hold 24 geosites with important records of the depositional systems of the middle and upper proterozoic (Rocha & Pedreira 2018). The Rio Jacuípe upper valley at the northern portion of Chapada Diamantina has been heavily explored by mining in the past. Between 1850 and 1932, the municipality of Morro do Chapéu was an important producer of carbonate, a variety of diamonds used for industrial purposes (Dias 2012). The main producing area were the villages of Ventura and Martim Afonso, both prosperous gold mining center in the past, and today they are remarkable geosites for the history of mining in the Bahia territory. In addition to its archeological and geological importance, the upper Rio Jacuípe valley also houses three protected areas: the Morro do Chapéu State Park, with an area of 46,000 ha; Protection Area- APA Vereda do Romão Gramacho/Gruta dos Brejões (11,900 ha)



**Figure 1.** Division of the Jacuípe River basin into upper, middle and lower stretches and their relative geographical position on the map of Brazil. In red, the Rio Paraguaçu.

and the Natural Monument of Cachoeira do Ferro Doido with 400 ha (MMA 2007).

For area evaluation purposes we herein divide the Rio Jacuípe basin into three stretches: upper course, main course, and low course (Figure 1). This division is an adaptation, considering the main sub-basins and also the climatic transition zones identified in Silva and Chaves (2009).

The upper Rio Jacuípe division includes the main headwaters between 406 to 1200 m high, following the Grande stream in the northern direction toward the Patos Creek on southern direction, remaining these two streams within the upper stretch. The middle stretch division was stated within the section of the Rio Jacuípe at 190 m high, following the watershed until the Tocó stream on the northern direction and the watershed divide with the Sacraíú stream in the southern direction, these two rivers remain in the medium stretch. The lower stretch corresponds to the downstream until the artificial mouth at Pedra do Cavalo Dam (Figures 1 and 2).

### Upper stretch

The main headwater of Jacuípe is situated at 1,096 m high, and the river valley drain between the Serra do Cláudio and Serra do Pé do Morro, within the northern portion of the Chapada Diamantina plateau. A tributary of the Jacuípe, the Barra stream headwaters, is even higher with 1,138 meters. The upper stretch of the Jacuípe basin (Figure 2) corresponds to the waters running along the first 170 km of the Rio Jacuípe and its contributors. In this path and the main river

receives ten tributaries nominated in topographical maps (Sudene, 1977a; 1977b, 1977c, 1977d, 1977e, 1977f). Table 1 illustrates the Jacuípe tributaries per stretch. The upper Jacuípe drains seven municipalities in the state of Bahia: Morro do Chapéu, Tapiramutá, Piritiba, Miguel Calmon, Mundo Novo, Várzea do Poço, and Mairi. Within the Piritiba and the Miguel Calmon municipalities the river is interrupted by the river Dam of França, with a storage capacity of 24.2 million m<sup>3</sup> of water for hydroelectric power generation (Dias 2012).

In Morro do Chapéu, where the Jacuípe River runs along its first 95 km, the altitude varies between 1,293 m to 480 m, with the dominance of the tropical altitude climate, low average temperatures, and high daily thermal amplitude. Locally the main types of vegetation are variable as the Caatinga, Cerrado, rupestrian fields, and ecotones of these types of vegetation (Ferreira 2006). The Rio Jacuípe upper valley detains the highest humidity levels within the Chapada Diamantina region. The upper river valley is occupied by small farms with subsistence agriculture, and a culture of ornamental flowers, the Lavanda do Campo that substituted the natural Sempre Viva flowers that became endangered due to overexploitation. The economic activities in the Jacuípe valley correspond to the agriculture in large areas with intense irrigation, the mining of barite, the pottery, the limestone mining for correction of soil, and the marble trade (Dias 2012; Araújo 2016). The legacy of mining activity leads some rivers as silted in the Rio Jacuípe upper course. The shallow waters affect river flow and the presence of chemicals

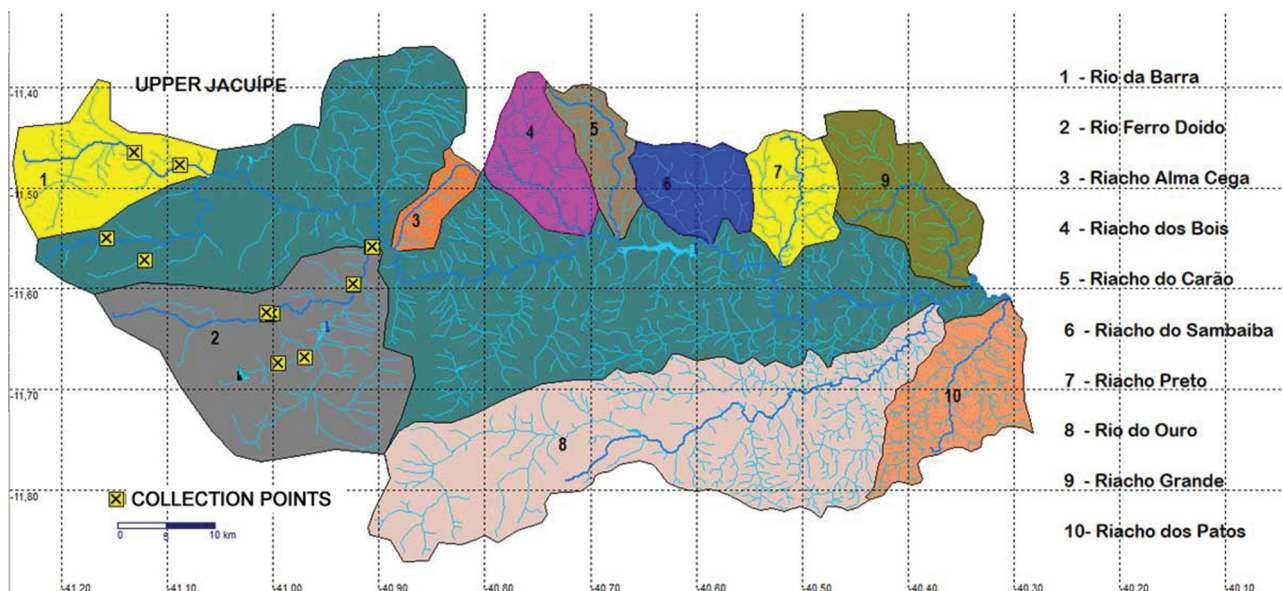


Figure 2. Upper Rio Jacuípe. Sub-basin names follow Sudene maps (Sudene, 1977n).

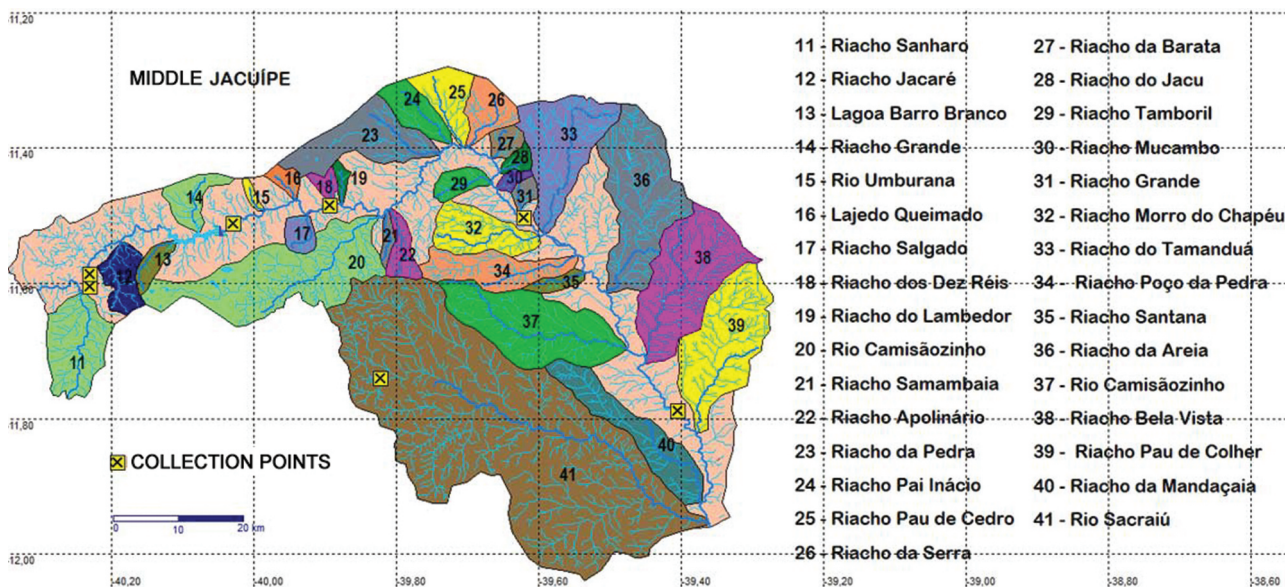
**Table 1.** List of species from the Rio Jacuípe with records for each stretch. Numbers in brackets mean the amount of fish orders-families or species in the area. Endemic species marked with \*. Non-native with \*\*.

Order (5)	Family (12)	Species (35)	Low	Middle	Upper	Total	
Characiformes	Parodontidae	<i>Apareiodon itapicuruensis</i> Eigenmann & Henn, 1916	49	2	132	183	
		<i>Steindachnerina elegans</i> (Steindachner, 1875)	5	0	0	5	
	Prochilodontidae	<i>Prochilodus brevis</i> Steindachner, 1875	0	1	0	1	
	Anostomidae	<i>Leporinus bahiensis</i> Steindachner, 1875	36	3	12	51	
	Crenuchidae	<i>Characidium bahiense</i> Almeida, 1971	9	7	0	16	
		<i>Characidium clistenesi</i> de Melo; Espíndola, 2016	0	0	290	290	
	Characidae	<i>Astyanax epiagos</i> Zanata & Camelier 2008*	0	0	1491	1491	
		<i>Astyanax hamatilis</i> Camelier & Zanata, 2014	540	8	0	548	
		<i>Astyanax</i> aff. <i>A. lacustris</i>	494	41	1563	2098	
		<i>Hyphessobrycon negodagua</i> Lima & Gerhard, 2001	0	0	29	29	
		<i>Hyphessobrycon parvulus</i> Ellis, 1911	17	50	0	67	
		<i>Moenkhausia diamantina</i> Eigenmann, 1903	0	0	10	10	
		<i>Serrapinnus heterodon</i> (Eigenmann, 1915)	193	42	1	236	
		<i>Serrapinnus piaba</i> (Lütken, 1875)	7	0	0	7	
		<i>Serrasalmus brandtii</i> Lütken, 1875	0	53	0	53	
		<i>Tetragonopterus chalceus</i> Spix & Agassiz, 1829	6	7	0	13	
		<i>Triportheus guentheri</i> (Garman, 1890)	6	0	0	6	
		Erythrinidae	<i>Hoplerthrinus unitaeniatus</i> (Spix & Agassiz, 1829)	0	0	4	4
			<i>Hoplias lacerdae</i> Ribeiro, 1908	15	3	1	19
	<i>Hoplias malabaricus</i> (Bloch, 1794)		14	9	37	60	
	Siluriformes	Loricariidae	<i>Hypostomus jaguar</i> Zanata, Sardeiro & Zawadzki, 2013	4	4	4	12
			<i>Pareiorhaphis lophia</i> Pereira & Zanata, 2014	0	0	2	2
			<i>Parotocinclus bahiensis</i> (Miranda-Ribeiro, 1918)	61	18	66	145
<i>Pterygoplichthys chrysoptiktos</i> (Birindelli, Zanata & Lima, 2007)			0	0	2	2	
Heptapteridae		<i>Pimelodella itapicuruensis</i> Eigenmann, 1917	0	2	0	2	
		<i>Rhamdia quelen</i> (Quoy and Gaimard, 1824)	2	0	2	4	
		<i>Gymnotus interruptus</i> Rangel-Pereira, 2012	0	0	1	1	
Gymnotiformes	Gymnotidae	<i>Poecilia reticulata</i> Peters, 1859	5	9	775	789	
Cyprinodontiformes	Poeciliidae	<i>Poecilia vivipara</i> Bloch & Schneider, 1801	262	43	0	305	
		<i>Astronotus ocellatus</i> (Agassiz, 1831) **	1	0	0	1	
Cichliformes	Cichlidae	<i>Cichla pinima</i> (Kullander & Ferreira, 2006)**	1	0	0	1	
		<i>Cichlasoma sanctifranciscense</i> Kullander, 1983	12	6	5	23	
		<i>Geophagus diamantinensis</i> Mattos, Costa & Santos, 2015	0	0	396	396	
		<i>Geophagus obscurus</i> (Castelnau, 1855)	38	17	0	55	
		<i>Oreochromis niloticus</i> (Linnaeus, 1758)**	0	0	1	1	

affect water quality (Garcia 2012). Abandoned mining sites gave way to agriculture and livestock. Adventure tourism is growing in the Morro do Chapéu area.

### Middle stretch

Downstream from its upper portion, the Jacuípe runs through a dry climate area until it ends in the Rio Paraguaçu (Fontes 2011). The middle section



**Figure 3.** Middle Rio Jacuípe. Sub-basin names follow Sudene maps (Sudene, 1977n).

**Table 2.** Sub-basins at upper section of Rio Jacuípe, with drainage area, length of the main watercourse, location in relation to the main river, collection points, number of lots, index of points in collection (IPC) and index of lots (Ilt). Code refers to the number of respective basin on map.

Code	Sub-basins at upper stretch	Area (Km <sup>2</sup> )	Length (Km)	Margin	Sampling points	Lots	IPC	Ilt
0	Upper Jacuípe	1.474	169	–	3	56	0.20	3.80
1	Rio da Barra	191	26	Left	2	4	1.05	2.10
2	Rio Ferro Doido	479	37	Right	9	47	1.88	9.81
3	Riacho Alma Cega	46	14	Left	0	0	0.00	0.00
4	Riacho da Serra	125	16	Left	0	0	0.00	0.00
5	Riacho do Carão	80	23	Left	0	0	0.00	0.00
6	Riacho do Sambaiba	106	17	Left	0	0	0.00	0.00
7	Rio do Jacu	106	18	Left	0	0	0.00	0.00
8	Rio do Ouro	767	60	Right	0	0	0.00	0.00
9	Riacho Grande	180	27	Left	0	0	0.00	0.00
10	Riacho dos Patos	187	23	Right	0	0	0.00	0.00
	Total	3.740			14	107	0.37	2.86

corresponds to altitudes between 406 and 190 m and all the contributing sub-basins (Figure 3). In this section the Rio Jacuípe runs along 205 km, and receive 31 tributaries nominated in topographical maps (Sudene, 1977e, 1977f, 1977g, 1977h, 1977i, 1977j). Table 2 illustrates these contributors. This stretch of the Jacuípe River drains totally or partially, 17 municipalities: Várzea do Poço, Mairi, Serrolândia, Quixabeira, Várzea da Roça, São José do Jacuípe, Chapel of Alto Alegre, Pintadas, Gavião, Nova Fátima, Santaluz, São Domingos, Pé de Serra, Riachão do Jacuípe, Conceição do Coité, Retirolândia, and Valente.

In the municipality of São José do Jacuípe, the João Durval Carneiro dam, also known as the São José do Jacuípe dam, was built, with a capacity of 357,000,000 m<sup>3</sup>. Its reservoir is inserted in the context of the semiarid, to mitigate the effects of drought for the communities. Otherwise, the dam causes great water loss by evaporation (Dias 2012). The Rio Jacuípe middle stretch in the Bahia semiarid is marked by the absence of micro-regional integration policies, implying effective obstacles to territorial development. This reality favors the isolation of municipalities in terms of social mobility and outflow of productive activities (Veiga 2016).

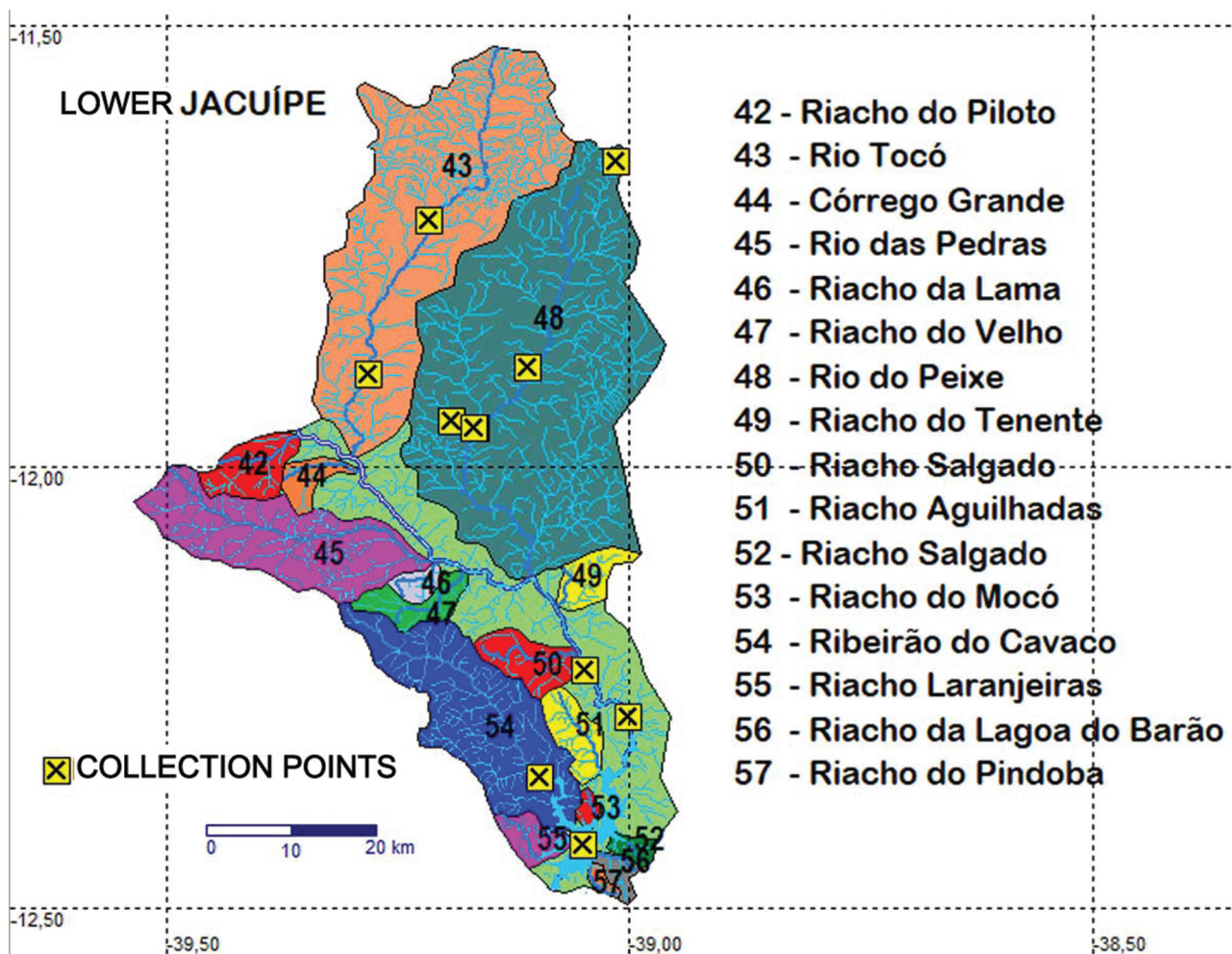
### Lower stretch

It comprises the remaining 4 km of the Rio Jacuípe, until it flows into the Pedra do Cavalo dam (Figure 4). In this section there are 16 contributors named in the topographic maps (Sudene, 1977j, 1977k, 1977l, 1977m, 1977n). Table 3 illustrates these tributaries. The lower section of the Rio Jacuípe drains totally or partially, 15 municipalities: Riachão do Jacuípe, Conceição do Coité, Serra Preta, Candeal, Ichu, Barrocas, Serrinha, Lamarão, Santa Bárbara, Tanquinho, Anguera, Feira de Santana, Antônio Cardoso, São Gonçalo dos Campos,

and Conceição da Feira. The last 33 km of the Rio Jacuípe, corresponds to a flooded area of approximately 30 km<sup>2</sup>, depending on the water level at Pedra do Cavalo dam where the Jacuípe meets the main river, the Paraguaçu, between the cities of Governador Mangabeira and Cachoeira, within the area known as Recôncavo Baiano. Additionally, nowadays the main river is interrupted in its middle stretch by the São José do Jacuípe dam, modifying the water flow and environments from lotic to lentic. The Rio Jacuípe ends artificially at the Pedra do Cavalo dam, a huge reservoir in the Rio Paraguaçu.

The average precipitation in the Jacuípe valley is between 500 mm and 800 mm per year, however, in lower portion of the valley the rainfall exceeds 900 mm/year (Batista et al. 2006; Medeiros 2014). Along its middle stretch, the Jacuípe valley has small tributaries that direct water flows, with the potential for transporting minerals during torrential rainfalls (Araújo 2016).

Historically, the Rio Jacuípe presented serious problems of water scarcity. The main reasons include the aridity of the climate in the middle and lower valley and pluviometric index below 800 mm (Garcia 2012). Added to these limitations are the naturally brackish water, resulting in the dissolution of salts from aquifers in the crystalline basement, the high evaporation of surface water due to high temperatures, and long periods of drought (Santos & Durães 1986). The drought situation limits the development of diverse economic activities mostly agriculture. The subsistence culture is marked by grain plantation of beans and corn, depending on the rainy season, and permanent crops of native origin such as cashew, pine cone, and umbu. Also noteworthy is the palm grown for animal feed and castor bean (feijão de corda) as a backyard activity (Veiga 2016). The sertanejo producer is also engaged in cattle ranching in a still precarious way (Veiga 2016).



**Figure 4.** Lower Rio Jacuípe. Sub-basin names follow Sudene maps (Sudene, 1977n).

### Species data

Available records in fish collections from the Rio Jacuípe were consulted, all of them belong to Brazilian collections. Each of the sampling points at Jacuípe had coordinates estimated from the locations indicated in the records. Initially, a survey of historical data was carried out in the fish collection of the Museu de Zoologia da Universidade Estadual de Feira de Santana, Bahia (MZFS), fish collection at the Universidade Federal da Bahia (UFBA), and fish collection at the Museu Nacional (MNRJ). In the same way, records available in the database – SpeciesLink – Centro de Referência em Informação Ambiental [Reference Center for Environmental Information – CRIA] were consulted, through which the data available in the collections of the DZSJRP, MBML, MZUSP, NUP were inventoried. These institutional acronyms follow Sabaj (2020). The records in collections were geo-referred and plotted on a map of the Rio Jacuípe sub-basin, from Morro do Chapéu to Feira de Santana

in Bahia (Figure 1). Two complementary samplings were carried out on the Rio Jacuípe in Feira de Santana municipality (Figure 5). Fieldwork was carried out using nets and hand trawls. In the sampling, a combination of fishing resources was used to ensure a sampling of the bed, bottom, and margin of the sampled site which configures different microhabitats. The localities were sampled once in June 2019 and once again in February 2020, covering a stretch of approximately 50 m and upstream when possible. The fieldwork was conducted in order to explore the different habitats and in this sense the river stretch was explored in a patronized time effort of approximately one hour in each locality. Annotations on visual abiotic aspects were taken, as current, water color, substrate, as well as aquatic vegetation, near around vegetation and local land use. The specimens were euthanized with menthol, fixed in 10% formalin, and transported to the Universidade Estadual de Feira de Santana- UEFS ichthyology laboratory, where they were later

**Table 3.** Sub-basins at middle section of the Rio Jacuípe, with drainage area, length of the main watercourse, location in relation to the main river, collection points, number of lots, index of points in collection (IPC) and index of lots (Ilt). Code refers to the number of respective basin on map.

Cod	Sub-basins at midlle stretch	Area (Km2)	Length (Km)	Margin	Sampling points	Lots	Ipc	Ilt
0	Médio Jacuípe	1.222	205	–	7	44	0.57	3.60
11	Riacho Sanharo	124	21	Right	0	0	0.00	0.00
12	Riacho Jacaré	54	13	Right	0	0	0.00	0.00
13	Riacho Lagoa Barro Branco	24	12	Right	0	0	0.00	0.00
14	Riacho Grande	48	11	Left	0	0	0.00	0.00
15	Rio Umburana	8	5	Left	0	0	0.00	0.00
16	Córrego Lajedo Queimado	17	6	Left	0	0	0.00	0.00
17	Riacho Salgado	25	9	Right	0	0	0.00	0.00
18	Riacho dos Dez Réis	14	5	Left	0	0	0.00	0.00
19	Riacho do Lambedor	10	6	Left	0	0	0.00	0.00
20	Rio Camisãozinho	302	30	Right	0	0	0.00	0.00
21	Riacho Samambaia	12	10	Right	0	0	0.00	0.00
22	Riacho Apolinário	35	14	Right	0	0	0.00	0.00
23	Riacho da Pedra	144	15	Left	0	0	0.00	0.00
24	Riacho Pai Inácio	56	12	Left	0	0	0.00	0.00
25	Riacho Pau de Cedro	67	14	Left	0	0	0.00	0.00
26	Riacho da Serra	57	11	Left	0	0	0.00	0.00
27	Riacho da Barata	22	7	Left	0	0	0.00	0.00
28	Riacho do Jacu	15	5	Left	0	0	0.00	0.00
29	Riacho Tamboril	31	11	Right	0	0	0.00	0.00
30	Riacho Mucambo	11	5	Left	0	0	0.00	0.00
31	Riacho Grande	15	6	Left	0	0	0.00	0.00
32	Riacho Grande	96	20	Right	0	0	0.00	0.00
33	Riacho do Tamanduá	185	33	Left	0	0	0.00	0.00
34	Riacho Poço da Pedra	105	17	Right	0	0	0.00	0.00
35	Riacho Santana	19	9	Right	0	0	0.00	0.00
36	Riacho da Areia	257	14	Left	0	0	0.00	0.00
37	Rio Camisãozinho	241	38	Right	0	0	0.00	0.00
38	Riacho Bela Vista	244	30	Left	0	0	0.00	0.00
39	Riacho Pau de Colher	223	22	Left	0	0	0.00	0.00
40	Riacho da Mandaçaia	140	20	Right	0	0	0.00	0.00
41	Rio Sacraíú	1.290	62	Right	1	2	0.08	0.16
	Total	5.115			8	46	0.16	0.90



**Figure 5.** Fieldwork at Rio Jacuípe at Ponte do Rio do Branco, Feira de Santana, Bahia.



transferred for conservation in alcohol at 70 ° GL, identified and cataloged. Some specimens collected were photographed in a field aquarium. The taxonomic classification of fishes follows Fricke et al. (2021). Presence of endangered species was investigated based on available information in redlists (MMA 2018; Silva et al. 2020). Taxonomic problems are commented on under section results. The inventoried specimens were examined and registered in the fish collection in the Museum of Zoology at Universidade Estadual de Feira de Santana (MZFS).

### Data analysis

To characterize fish populations present in the Rio Jacuípe sub-basin, the number of historical samples was considered at different times of the year. We developed a methodology for assessing the representation of the material in analysis and we came up with the following indexes: the index points per collection (IPC) and index of total lots (ITL). The IPC was the estimated number of collection points for each 100 km<sup>2</sup> of the basin area, while the ITL was the estimated area in the collected samples for each 100 km<sup>2</sup> of the river basin area. The comparison of these calculated indexes, with the index found for the whole of the Jacuípe river basin, were considered average when found in the range of + or - 30%, bad when below 30%, and good when above 30%. To assess differences in the fish fauna present in each stretch of the Jacuípe River basin the number of individuals recorded was calculated using Richness; Shannon Diversity, Equitability, and Dominance as explained in Harper (1999). Values were calculated using the PAST 2.17 program – Paleontological Statistics Software Package for Education and Data Analysis (Hammer et al. 2001). To determine the diversity indexes, the Jacuípe river basin considered its division into three sections- Upper, Middle, and Lower (Figure 1). The number of specimens captured of each species per stretch was calculated in Table 1 to serve as a basis for assessing the diversity indexes. The PAST was also used to trace the diversity profiles, using the Rényi series, to compare the basin and the three sections into which it was divided.

### Geographic localization

Georeferenced maps from Rio Jacuípe were prepared using the GPS Trackmaker Professional 4.8 program (Ferreira Júnior 2012), based on letters from the Superintendence for Development of the Northeast (Superintendência de Desenvolvimento do Nordeste-

SUDENE), on a scale of 1: 100,000, and on fieldwork observations. The results of cartographic length and area were calculated based on the verified maps and using the GPS Trackmaker program. Using Google Earth, the types of use and land occupation were checked and the original phyto-physiognomies were identified with base maps from IBGE.

## Results

### Taxonomic composition

The fish species inventory at Jacuípe provided an overview of its components along the sub-basin from headwaters to mouth. There were 248 lots evaluated from the collections, 203 of which were defined at the species level and 19 at the genus level. The lots were obtained from collection samples between the years 1900 to 2020 (Figure 6), totalizing 33 different collection points in the Jacuípe basin.

The representation of lots for fish species composition at the Rio Jacuípe can be achieved by calculating the indexes of collecting localities and samples. Within the sampling localities at upper stretch most fishes captured come from the Rio da Barra (IPC = 1.05/ITL = 1.05) and Rio Ferro Doido (IPC = 1.88/ITL = 2.10) and also from main upper Rio Jacuípe (IPC = 0.20/ITL = 3.8), when compared with the total area of the upper Jacuípe stretch (IPC = 0.37/ITL = 2.86) (Table 2).

The middle Jacuípe stretch was mostly represented by the main river bed (IPC = 0.57/ITL = 3.60). Within the middle stretch, the Rio Sacraíú presented a low sampling representation (IPC = 0.08/ITL = 0.16) when compared with the total area of the medium stretch of the Rio Jacuípe (IPC = 0.16/ITL = 0.90) (Table 3).

The lower Jacuípe stretch exhibited good representation at the Rio Tocó (IPC = 0.27/ITL = 3.08) and the Rio do Peixe (IPC = 0.46/ITL = 3.83) and for the main river bed of Jacuípe (IPC = 0.55/ITL = 4.97). The Cavaco stream (IPC = 0.31/0.92 = ITL) had comparatively several collection localities, but a low representation in species diversity when compared with the total area of the lower Rio Jacuípe (IPC = 0.32/ITL = 2, 80) (Table 4).

When comparing the three stretches of the Jacuípe, the upper (IPC = 0.37/ITL = 2.86) and lower (IPC = 0.32/ITL = 2.80) sections presented a good representation, while the middle stretch (IPC = 0.16/ITL = 0.90) presented few representation when compared to the total area of the Rio Jacuípe (IPC = 0.27/ITL = 2.02) (Table 5).

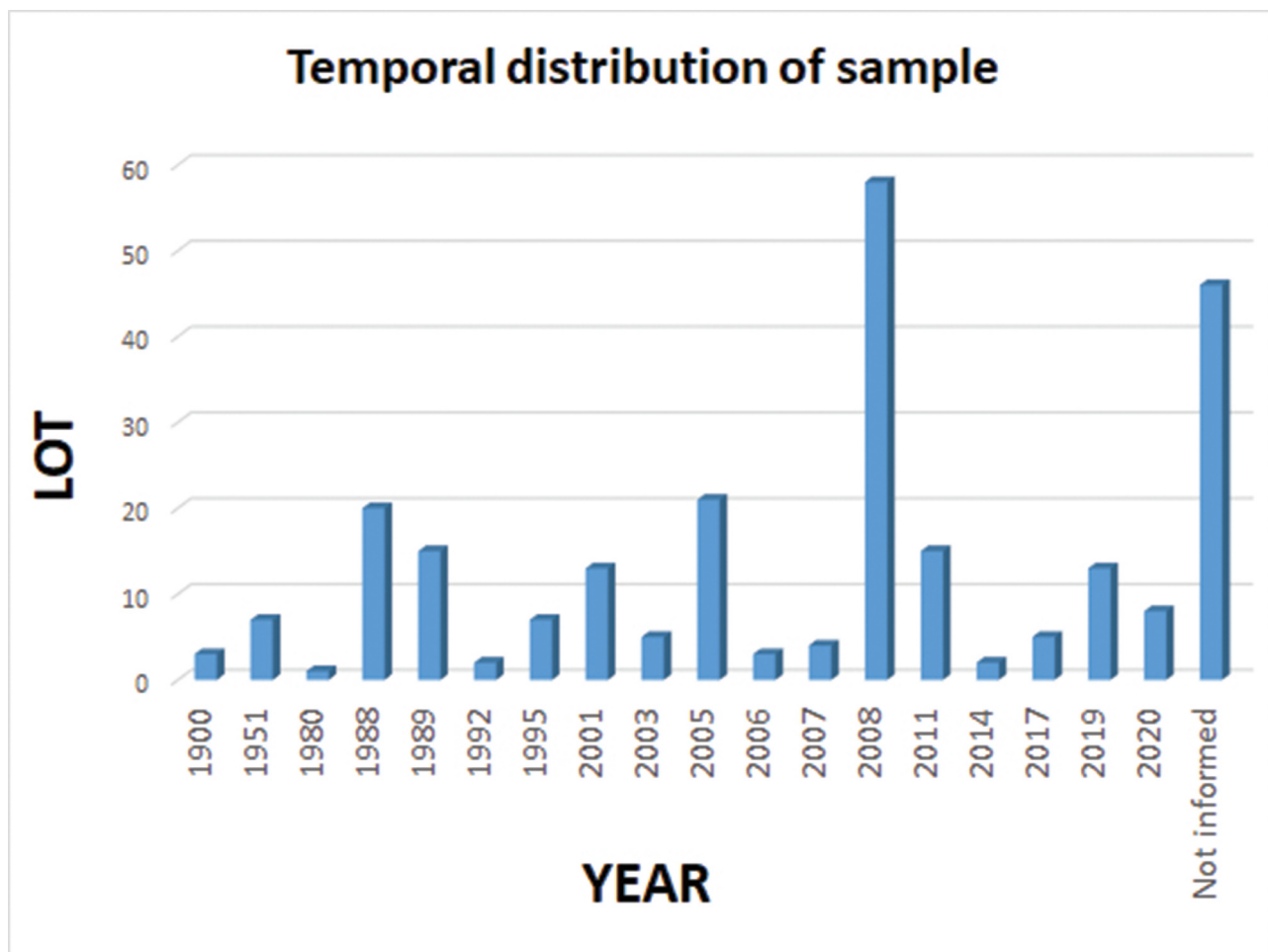


Figure 6. Temporal distribution of samples in the Jacuípe river valley. (lots x year of collections).

Table 4. Sub-basins of the lower stretch of the Jacuípe, with drainage area, length of the main watercourse, location in relation to the main river, collection points, number of lots, index of points in collection (IPC) and index of lots (Ilt). Code refers to the number of respective basin on map.

Cod	Sub-basins (from headwaters to mouth)	Area (Km <sup>2</sup> )	Length (Km)	Margin	Collecting points	Collection records (Tombs)	IPC	Ilt
0	Baixo Jacuípe	543	94	-	2	6	0.37	1.11
42	Riacho do Piloto	65	12	Right	0	0	0.00	0.00
43	Rio Tocó	747	69	Left	2	23	0.27	3.08
44	Córrego Grande	32	10	Right	0	0	0.00	0.00
45	Rio da Pedras	281	39	Left	0	0	0.00	0.00
46	Riacho da Lama	20	9	Left	0	0	0.00	0.00
47	Riacho do Velho	46	13	Left	0	0	0.00	0.00
48	Rio do Peixe	1.096	70	Right	5	42	0.46	3.83
49	Riacho do Tenente	42	6	Right	0	0	0.00	0.00
50	Riacho Salgado	61	15	Left	0	0	0.00	0.00
51	Riacho Aguilhadas	51	13	Left	0	0	0.00	0.00
52	Riacho Salgado	16	5	Right	0	0	0.00	0.00
53	Riacho do Mocê	10	6	Left	0	0	0.00	0.00
54	Ribeirão do Cavaco	326	47	Right	1	3	0.31	0.92
55	Riacho Laranjeiras	35	13	Right	0	0	0.00	0.00
56	Rio da Pedras	19	7	Left	0	0	0.00	0.00
57	Riacho do Pindoba	9	6	Left	0	0	0.00	0.00
	Total	3.398			10	74	0.29	2.18

Regarding the fish fauna composition, a total of 30 species were collected in the sub-basin of the Rio Jacuípe belonging to 11 families into 5 orders (Table 1). The Superorder Ostariophysi is the most representative group in freshwaters at Jacuípe, with 27 species (77.14% of the total 312 recorded for the basin). The order Characiformes were the majority with 20 species (70.07%), followed by Siluriformes with six species (22.22%), followed by the Cichliformes (six species, 17.14%), and the Cyprinodontiformes (two species, 5.71%). The Gymnotiformes are represented by a single species (3.70%) (Figure 7). No endangered fish species was found to occur in the Rio Jacuípe. The results were obtained through PAST and illustrated in Table 6.

The species composition, in terms of abundance per family, indicates an expressive predominance of Characidae, with 4,558 specimens captured from 11 species, with emphasis on the abundance of individuals of *Astyanax* sp. aff. *A. lacustris* (Figure 7A) with 2,098 specimens; followed by Loricariidae, with 161 individuals of 4 species, among which *Parotocinclus bahiensis* (Figure 7H) is the most representative one with 145 specimens.

The diversity index reveals low species diversity within the upper stretch of the basin, and comparatively similar values of diversity along the middle and lower stretches (Figure 8). Specimens attaining middle or large sizes, with more than 300 mm standard length, such as the *Leporinus bahiensis* (Figure 7D) and *Prochilodus brevis*, were found only in the middle and lower Rio Jacuípe. Rheophilic species as *Apareiodon itapicuruensis* and catfishes as *Hypostomus jaguar* and *Pterygoplichthys chrysostiktos* appeared mainly in the upper stretch where torrential environments are abundant. In all areas, most of the species recorded correspond to small-sized fishes, such as the Ostariophysi typical of riverine environments, in special the characins attaining adult size with less than 100 mm in standard length.

**Table 5.** Drainage area per stretch of the Rio Jacuípe, with length of the main watercourse, location in relation to the main river, collection points, number of lots, index of points in collection (IPC) and index of lots (Ilt).

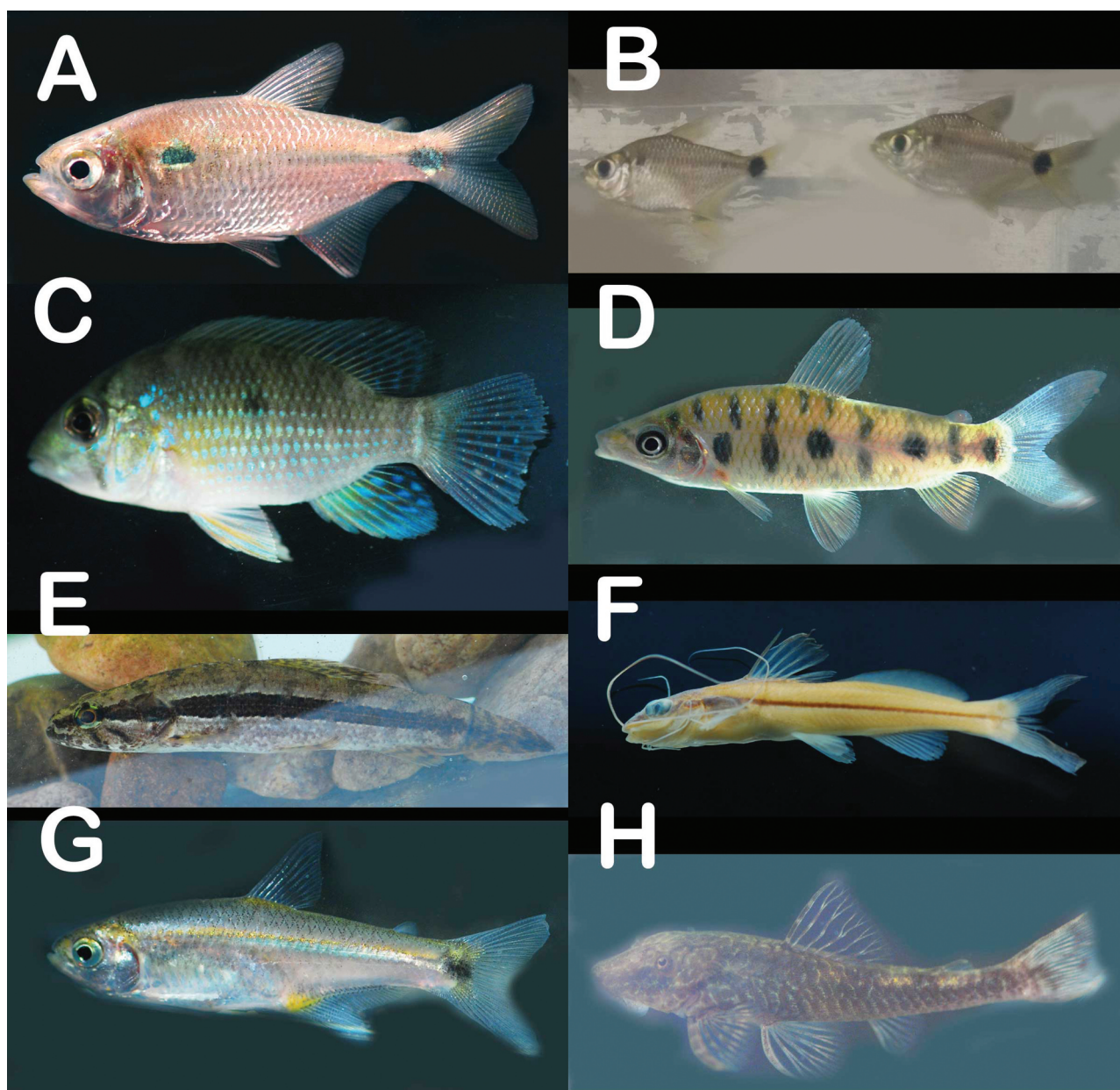
Stretch	Area (Km <sup>2</sup> )	Length (Km)	Collection Points	Tombs	IPC	Ilt
Upper Jacuípe	3,738	170	14	107	0.37	2.86
Middle Jacuípe	5,115	205	8	46	0.16	0.90
Lower Jacuípe	3,398	94	10	74	0.29	2.18
Total	12,251	469	32	227	0.26	1.85

The upper stretch of the Jacuípe concentrates most of the sampling recorded for the sub-basin. The Pediplanos at Morro do Chapéu concentrate 22 of the 30 known species of the basin. Among the sampled species *Astyanax epiagos* is the only endemic species inhabiting the upper Jacuípe waters. Besides the *Astyanax epiagos*, other species found only in the headwaters include the characins *Moenkhausia diamantina*, *Hyphessobrycon negodagua*, and also the armored catfishes *Pterygoplichthys chrysosticktos* and *Pareiorhaphis lophia*. The so-called Piaba fish *Astyanax* sp. aff. *A. lacustris* was identified in association with the species name in the drainage of the São Francisco River, due to the small morphological difference observed. These fishes lack a formal name and may represent a new species. Four exotic species recorded in the Jacuípe sub-basin were *Oreochromis niloticus*, *Astronotus ocellatus*, *Cichla pinima*, and *Poecilia reticulata*.

Along the middle stretch there is some decrease in the local species diversity, there are 20 species. *Pimelodella itapicuruensis*, *Prochilodus brevis* and *Serrasalmus brandti* are unique to this section. Fishermen have reported that *Serrasalmus brandti* also occurs in the lower section, however, we have not confirmed these records in the evaluated material.

In the lower third of the Jacuípe, 22 species were recorded, with emphasis on the records of rheophilic species such as *Triportheus guentheri* and *Steindachnerina elegans*, which are inhabitants of this section.

The diversity indexes of the basin indicate the upper and lower stretches as having higher values. The middle stretch (Figure 8- blue) section does not allow an assessment of diversity, as it crosses with the other curves, indicating that it is more diverse when considering some of the indexes and less diverse when considering other indexes. Regarding temporal species representation, the Jacuípe was investigated regarding fishes over the last 120 years, though sampling information is sometimes incomplete – 46 lots (19%) had no information on the date of collection. In the last twelve years, 101 lots (41%) were collected. This way, only about 50% of the samples precisely reflect the most recent conditions of the basin. As for the spatial representation of species inventoried, we can clearly observe the low amount of records on the middle stretch of the basin. The sampling of the upper Jacuípe stretch, although relatively well represented, reveals the absence of records at some of the local rivers, for example, the Rio do Ouro, which occupies a surface of 21% of the upper stretch but has not been sampled. Likewise in the lower section, the Rio das Pedras sub-basin, occupying 8% of the surface of the Jacuípe lower course, a portion that has not been sampled yet.



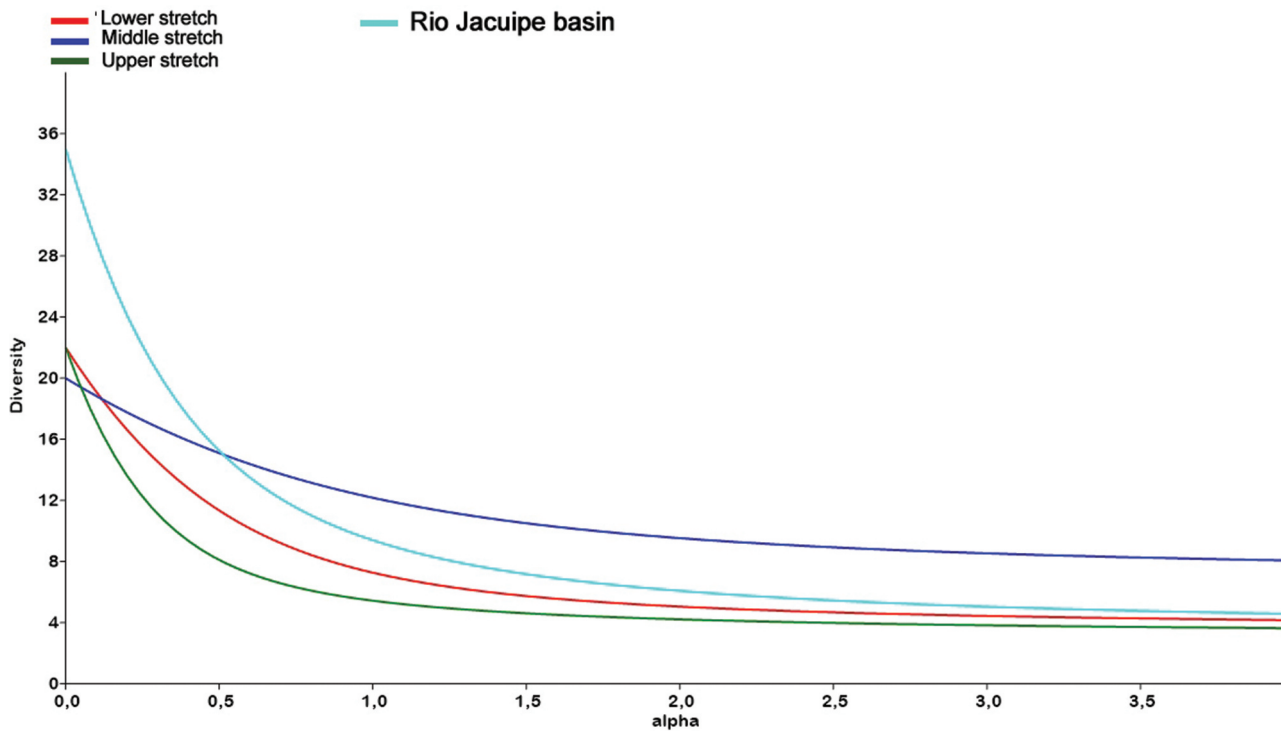
**Figure 7.** Fish species at the Jacuípe River, mostly photographed alive in a field aquarium. A. *Astyanax lacustris* MZFS unnumbered 02; B. *Triportheus guentheri* MZFS unnumbered 09; C. *Geophagus obscurus* MZFS unnumbered 03; D. *Leporinus bahiensis* MZFS unnumbered 05; E. *Hoplias malabaricus* MZFS unnumbered 13; F. *Pimelodella itapicuruensis* UFBA 7982 (photographed in collection); G. *Serrapinnus heterodon* MZFS unnumbered 04 and H. *Parotocinclus bahiensis* MZFS unnumbered 07.

**Table 6.** Diversity indexes obtained using PAST.

Index/Section	Low	Medium	Upper	Total
Richness (no. Species)	22	20	22	35
Specimens	1817	334	4832	6983
Dominance	0.198	0.105	0.237	0.164
Shanon's Diversity	1,985	2,500	1,694	2,240
Equitability	0.331	0.609	0.247	0.269

## Discussion

Throughout the hydrographic basin, its contributors increase in width and other parameters, adding a greater number of aquatic environments (Vannote et al. 1980). This aggregation of environments was



**Figure 8.** Diversity curve at the Rio Jacuípe. In red lower section. In blue middle section. In green upper section.

perceived in the continuous river theory, where the addition of environments contributes to a greater variety and biomass of inhabitants as the fluvial order increases (Vannote et al. 1980). In the present study, specifically, we observed an increase in richness toward the mouth, except for the middle river section, probably due to the low number of collection records of that area.

The Rio Jacuípe, the northernmost river sub-basin, is inhabited by fewer fish species than the main river – the Paraguaçu. The species richness in Jacuípe is much lower than that of the upper Paraguaçu (35 against 69), which corresponds to only 50.7% of the species on the main river. Also, the relationship of the fish Characiformes and Siluriformes, among the Ostariophysi, is very different when compared with the upper Paraguaçu. In the Jacuípe, the Siluriformes represent 22.20% of the Ostariophysi fish in the sub-basin, while in the upper Paraguaçu the same group represents 45.90%. Such values may represent a deficiency in the sampling of catfishes in the Jacuípe. As already evidenced, different works were done aiming to know in more detail the Paraguaçu basin and its upper course tributaries. The studies already carried out in the Rio Jacuípe were specific, often limited to the upper reaches, due to its location at the Chapada Diamantina an attractive area with ecological and social interest in Bahia. Unlike this the

downstream portions of the Jacuípe have been historically neglected, being recorded only on its lower stretch, due to the proximity to the university campus in the Feira de Santana municipality.

The Jacuípe valley is occupied by the sertanejo people, fishing communities, and quilombolas. Potential tourism is concentrated in Morro do Chapéu in the headwaters at Chapada Diamantina, where protected areas are located, the climate is milder due to higher altitudes, and the scene is particularly beautiful. In the middle river valley, the Pé de Serra municipality is the only one that welcomes visitors who stay in the Serra do Leão, a place of religious influence. In the middle and lower Jacuípe valley, historical, economic and socio-cultural inequalities prevail, and cannot be seen as an exclusive attribution of climatic phenomena. Drought is a phenomenon prior to Portuguese colonization, but its effects have become more chronic and devastating since the 20th century, especially due to predatory interference: forest reserves have been reduced or even suppressed; water sources have become insufficient; scarcity of animals due to habitat loss (Veiga 2016). Nowadays the environment is threatened by the serious problem of burning that has led to a permanent process of devastation, eliminating forest species that could become valuable socio-biodiversity products for the local population, such as the Umbuzeiro trees (*Spondias tuberosa*). The historical

social reality of the ‘drought industry’ in this region should also be taken into account. Both this region and the semi-arid region of Bahia are regularly neglected by sectoral public policies. The municipalities of these regions, namely the Jacuípe River valley, present a low HDI (Human Development Index) which leads to rural exodus. Alternatives for sustainable development of local people in Jacuípe Valley are being evaluated to improve quality of life. The production of agroecological honey and mamona oil has been developed to stimulate the exchange of knowledge about the organization and management of cooperative ventures, as well as the formulation of proposals for social intervention, funding, and resource management.

We argue the middle Jacuípe stretch is a priority area to be inventoried, particularly sampling the Rio do Ouro and Rio das Pedras which proportionally occupy a large area of the river basin but have not yet been sampled concerning fish fauna. Ecological studies regarding freshwaters in this area should be encouraged.

### Final comments

This study illustrates the diversity of fish species in the Rio Jacuípe and indicates the gaps of knowledge throughout the northernmost contributor of the Rio Paraguaçu. Spatial distribution studies are essential to understand what species of fishes and where they occur in a given area. Our results contribute to the evaluation of public policies on conservation. The scarce material available in collections for the Rio Jacuípe sub-basin is indicative that the river is incipiently sampled so far, mainly in its middle section. But it also reveals that the possibility that the sampling methods and/or schedules may have been deficient for the collecting of species. As an example, several catfish families common to the Rio Paraguaçu basin were not even recorded for the Jacuípe, as is the case of Trichomycteridae. It is important in the near future to provide a systematic inventory of the basin for the real knowledge of its aquatic biodiversity. We can speculate that more fish species inhabit the Rio Jacuípe than those presented herein. We hope the present contribution can guide future taxonomic and ecological studies in the area. We preserve what we love, what is precious to us, and it is necessary to involve local people to value local biodiversity. Clarifications to the local community on issues related to biodiversity, conservation of water systems, and eco-tourism, are fundamental, and this study can contribute to these and other subjects facing the preservation of species and the ecosystems of local waters.

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- Astyanax epiagos*. Morro do Chapéu: ANSP 189081 (20) Rio Ferro Doido above Ferro Doido waterfalls. elevation 899 m; DZSJRP 12401 (3) Rio Jacuípe; DZSJRP 13707 (3) Rio Jacuípe; MZFS 10607 (5) Rio do Ventura tributary of Rio Ferro Doido (PPBIO); MZFS 10609 (2) Rio do Ventura tributary of Rio Ferro Doido (PPBIO); MZFS 10631 (94) Rio Jacuípe on Domingos Lopes waterfalls (PPBIO); MZFS 10636 (3) Rio do Ventura tributary of Rio Ferro Doido (PPBIO); MZFS 12012 (48) Rio do Ventura tributary of Rio Ferro Doido; MZFS 12048 (8) Rio do Ventura tributary of Rio Ferro Doido; MZFS 12083 (58) Rio do Ventura tributary of Rio Ferro Doido; MZFS 12099 (49) Rio Ferro Doido na poça acima da Cachoeira do Ferro Doido; MZFS 12101 (26) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 14525 (10) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 14532 (5) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 14534 (25) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 8700 (233) Rio Ferro Doido; MZUSP 89568 (1) Rio Ferro Doido acima da Cachoeira do Ferro Doido; MZUSP 89569 (20) Rio Ferro Doido upstream from Ferro Doido waterfalls; UFBA 2792 (344) Rio Ferro Doido above Ferro Doido waterfalls at 18 km from Morro do Chapéu under bridge at BA 052; UFBA 2794 (6) Tributary of rio Jacuípe on BA 052 at 4 km from Morro do Chapéu; UFBA 3211 (173) Rio Ferro Doido below Ferro Doido waterfalls near bridge of road to Fedegoso; UFBA 3220 (311) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 3235 (16) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 8466 (28) Rio Ferro Doido below Ferro Doido waterfalls near bridge at road to Fedegoso.
- Astyanax hamatilis*. Riachão do Jacuípe: MZFS 161 (1) Córrego Castelo. Serrinha: MNRJ 21238 (72) Açude da Bomba na cidade de Serrinha; MNRJ 21244 (467) Açude da Bomba na cidade de Serrinha; Várzea da Roça: UFBA 7955 (8) Rio Jacuípe.
- Astyanax sp. aff. A. lacustris*. Capela do Alto Alegre: MZFS 5369 (4) Rio Jacuípe. Passagem de Itatiaia. Feira de Santana: MZFS unnumbered 02 (257) Rio Jacuípe on bridge of Rio Branco; MZFS unnumbered 10 (150) Rio Jacuípe on bridge of Rio Branco. Ichu: MZFS 13981 (18) Rio Tocó afluente do rio Jacuípe. Morro do Chapéu: MZFS 10666 (102) Rio da Barra or Rio Ligeiro; MZFS 11674 (705) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 11680 (37) Rio Ferro Doido no Povoado de Estácio; MZFS 11681 (11) Riacho do Bonifácio em Ventura; MZFS 11740 (90) Rio Ferro Doido; MZFS 11946 (141) Rio da Barra ou Rio Ligeiro. Estrada pra Jacobina; MZFS 11951 (433) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 3215 (8) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 3226 (36) Rio Ferro Doido below Ferro Doido waterfalls near bridge on road to Fedegoso. Riachão do Jacuípe: MZFS 13895 (14) Rio Tocó afluente do rio Jacuípe. São Domingos: UFBA 3582

## Appendix A.

Examined material. The presentation of the species follows alphabetical order, followed by respective municipality (underlined), lot and collection number, number of specimens (in brackets) and locality.

*Apareiodon itapicuruensis*. Capela do Alto Alegre: NUP 3095 (3) Rio Jacuípe. Feira de Santana: MZFS unnumbered 01 (20) Rio Jacuípe on bridge of Rio Branco; MZFS unnumbered 11 (26) Rio Jacuípe on bridge of Rio Branco. Morro do Chapéu: DZSJRP 13709 (1) Rio Jacuípe; MBML 5504 (10) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 10612 (68)



(25) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324. São José do Jacuípe: UFBA 7985 (12) Rio Jacuípe. Tanquinho: MZFS 153 (13) Rio do Peixe; MZFS 833 (1) Rio do Peixe. Faz. de Baú; UFBA 3589 (41) Rio do Peixe na BR 324 na divisa com Candéal.

**Characidium bahiense.** São Domingos: UFBA 3580 (7) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324. Serrinha: MNRJ 21240 (1) Açude da Bomba na cidade de Serrinha; MNRJ 21241 (2) Açude da Bomba na cidade de Serrinha. Tanquinho: UFBA 3594 (6) Rio do Peixe na BR 324 na divisa com Candéal.

**Characidium clisteresi.** Morro do Chapéu: MZFS 11737 (99) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 11742 (10) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 11943 (1) Riacho do Bonifácio em Ventura; MZFS 12043 (39) Rio do Ventura tributary of Rio Ferro Doido; MZFS 12045 (1) Rio do Ventura tributary of Rio Ferro Doido; MZFS 12093 (57) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 12094 (11) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 12097 (2) Rio do Ventura tributary of Rio Ferro Doido; MZFS 14528 (24) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 3213 (6) Rio Ferro Doido below Ferro Doido waterfalls near bridge on road to Fedegoso; UFBA 3231 (34) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 8467 (6) Rio Ferro Doido below Ferro Doido waterfalls near bridge on road to Fedegoso.

**Cichla pinima.** São Gonçalo dos Campos: MZFS 6664 (1) Rio Jacuípe na Ilha de São Gonçalo.

**Cichlasoma sanctifranciscense.** Feira de Santana: MZFS unnumbered 12 (3) Rio Jacuípe on bridge of Rio Branco. Morro do Chapéu: UFBA 3216 (5) Rio Jacuípe on Domingos Lopes waterfalls; Riachão do Jacuípe: MZFS 10 (1) Rio Tocó. Fazenda Lagedinho; MZFS 12 (2) Rio Tocó. Fazenda Lagedinho; MZFS 160 (1) Córrego Castelo; MZFS 17 (1) Rio Jacuípe on Riachão do Jacuípe Dam; MZFS 18 (1) Rio Jacuípe on Riachão do Jacuípe Dam; UFBA 7883 (1) Rio Jacuípe. Tanquinho: MZFS 150 (2) Rio do Peixe; MZFS 156 (1) Rio do Peixe; MZFS 497 (1) Rio do Peixe; MZFS 498 (1) Rio do Peixe. **Várzea da Roça:** UFBA 7958 (3) Rio Jacuípe.

**Geophagus diamantinensis.** Morro do Chapéu: MZFS 10602 (87) Rio Jacuípe on Domingos Lopes waterfalls (PPBIO); MZFS 10616 (70) Rio do Ventura tributary of Rio Ferro Doido (PPBIO); MZFS 10628 (3) Rio do Ventura tributary of Rio Ferro Doido (PPBIO); MZFS 10629 (6) Rio Jacuípe on Domingos Lopes waterfalls (PPBIO); MZFS 10635 (2) Rio Jacuípe on Domingos Lopes waterfalls (PPBIO); MZFS 10637 (10) Rio do Ventura tributary of Rio Ferro Doido (PPBIO); MZFS 11675 (1) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 11682 (1) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 11956 (25) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 12040 (121) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 12052 (1) Rio do Ventura tributary of Rio Ferro Doido; MZFS 14524 (30) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 3228 (24) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 8593 (15) Rio Jacuípe Cachoeira (Rodrigo de Freitas?) Domingos Lopes.

**Geophagus obscurus.** Feira de Santana: MZFS unnumbered 03 (1) Rio Jacuípe on bridge of Rio Branco; MZFS unnumbered 21 (2) Rio Jacuípe on bridge of Rio Branco; UFBA 7005 (2) Ribeirão do Cavaco afluente do rio Jacuípe na BR 116 no Km 442 + 500. Ichu: MZFS 10434 (21) Rio

Tocó afluente do rio Jacuípe. Riachão do Jacuípe: MZFS 11 (1) Rio Tocó. Fazenda Lagedinho; MZFS 163 (1) Córrego Castelo; MZFS 19 (5) Rio Jacuípe on Riachão do Jacuípe Dam; MZFS 8 (2) Rio Tocó. Fazenda Lagedinho. São Domingos: UFBA 3901 (3) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324. São José do Jacuípe: UFBA 7886 (7) Rio Jacuípe. Tanquinho: MZFS 149 (1) Rio do Peixe; MZFS 152 (1) Rio do Peixe; MZFS 21 (4) Rio do Peixe; UFBA 8479 (2) Rio do Peixe na BR 324 na divisa com Candéal. Várzea da Roça: UFBA 7957 (2) Rio Jacuípe.

**Gymnotus interruptus.** Morro do Chapéu: MZFS 14623 (1) Rio Jacuípe on Domingos Lopes waterfalls.

**Hoplerethrinus unitaeniatus.** Morro do Chapéu: MZFS 8680 (1) Rio Ferro Doido; MZUSP 42200 (1) Rio Ferro Doido on Ferro Doido waterfalls; UFBA 3210 (2) Rio Ferro Doido acima da cachoeira do Ferro Doido a 18 km de Morro do Chapéu sob ponte na BA 052.

**Hoplias lacerdae.** Ichu: MZFS 10438 (3) Rio Tocó afluente do rio Jacuípe. Morro do Chapéu: MZFS 10610 (1) Rio Jacuípe on Domingos Lopes waterfalls (PPBIO). São José do Jacuípe: UFBA 7946 (3) Rio Jacuípe. Serrinha: MNRJ 21243 (12) Açude da Bomba na cidade de Serrinha.

**Hoplias malabaricus.** Feira de Santana: MZFS unnumbered 13 (4) Rio Jacuípe on bridge of Rio Branco. Morro do Chapéu: MZFS 10614 (2) Rio do Ventura tributary of Rio Ferro Doido (PPBIO); MZFS 10621 (12) Rio da Barra ou Rio Ligeiro; MZFS 12005 (5) Rio da Barra or Rio Ligeiro. Estrada pra Jacobina; MZFS 12044 (7) Rio do Ventura tributary of Rio Ferro Doido; MZFS 14527 (1) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 3214 (6) Rio Ferro Doido abaixo da cachoeira do Ferro Doido próximo à ponte na estrada Para Fedegoso; UFBA 3218 (4) Rio Jacuípe on Domingos Lopes waterfalls. Riachão do Jacuípe: MZFS 13 (1) Rio Tocó. Fazenda Lagedinho; MZFS 164 (1) Córrego Castelo; MZFS 20 (2) Rio Jacuípe on Riachão do Jacuípe Dam. São Domingos: UFBA 3579 (7) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324. São Gonçalo dos Campos: MZFS 6662 (1) Rio Jacuípe na Iha de São Gonçalo. Tanquinho: MZFS 154 (2) Rio do Peixe; MZFS 162 (1) Rio do Peixe; UFBA 3588 (4) Rio do Peixe na BR 324 na divisa com Candéal.

**Hyphessobrycon negodagua.** Morro do Chapéu: MZFS 12087 (1) Rio do Ventura tributary of Rio Ferro Doido; MZFS 12096 (28) Rio Ferro Doido na poça acima da Cachoeira do Ferro Doido.

**Hyphessobrycon parvellus.** Ichu: MZFS 10430 (6) Rio Tocó afluente do rio Jacuípe. São Domingos: UFBA 4311 (37) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324. São José do Jacuípe: UFBA 7983 (8) Rio Jacuípe. Tanquinho: UFBA 3590 (11) Rio do Peixe na BR 324 na divisa com Candéal. Várzea da Roça: UFBA 8104 (5) Rio Jacuípe.

**Hypostomus jaguar.** Morro do Chapéu: MZFS 13496 (4) Rio do Ventura tributary of Rio Ferro Doido (PPBIO). Riachão do Jacuípe: MZFS 15 (4) Rio Jacuípe on Riachão do Jacuípe Dam. Tanquinho: MZFS 155 (4) Rio do Peixe.

**Leporinus bahiensis.** Feira de Santana: MZFS unnumbered 05 (13) Rio Jacuípe on bridge of Rio Branco; MZFS unnumbered 18 (15) Rio Jacuípe on bridge of Rio Branco; Capela do Alto Alegre: MZFS 5374 (1) Rio Jacuípe; UFBA 6937 (1) Rio Jacuípe. Morro do Chapéu: MZFS 12014 (5) Rio

do Ventura tributary of Rio Ferro Doido; MZFS 12039 (5) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 12084 (2) Rio Jacuípe on Domingos Lopes waterfalls. Riachão do Jacuípe: MZFS 16 (2) Rio Jacuípe on Riachão do Jacuípe Dam; MZFS 5 (1) Rio Tocó. Fazenda Lagedinho. Tanquinho: MZFS 13875 (2) Rio do Peixe; UFBA 3593 (4) Rio do Peixe na BR 324 na divisa com Candeal.

***Moenkhausia diamantina***. Morro do Chapéu: UFBA 3212 (9) Rio Ferro Doido below Ferro Doido waterfalls near bridge on road to Fedegoso; UFBA 8464 (1) Rio Ferro Doido below Ferro Doido waterfalls near bridge on road to Fedegoso.

***Oreochromis niloticus***. Capela do Alto Alegre: MZFS 5378 (9) Riacho Salgado. Fazenda Tabuleiro. Feira de Santana: MZFS unnumbered 08 (4) Rio Jacuípe on bridge of Rio Branco; MZFS unnumbered 17 (12) Rio Jacuípe on bridge of Rio Branco. Ichu: MZFS 13932 (24) Rio Tocó afluente do rio Jacuípe. Morro do Chapéu: MZFS 14526 (1) Rio Jacuípe on Domingos Lopes waterfalls. São Gonçalo dos Campos: MZFS 6663 (1) Rio Jacuípe na Iha de São Gonçalo.

***Pareiorhaphis lophia***. Morro do Chapéu: DZSJRP 13706 (2) Rio Jacuípe

***Parotocinclus bahiensis***. Feira de Santana: MZFS unnumbered 07 (25) Rio Jacuípe on bridge of Rio Branco; MZFS unnumbered 14 (30) Rio Jacuípe on bridge of Rio Branco; UFBA 7008 (2) Ribeirão do Cavaco afluente do rio Jacuípe na BR 116 no Km 442 + 500. Morro do Chapéu: MZFS 10611 (1) Rio do Ventura tributary of Rio Ferro Doido (PPBIO); MZFS 11743 (13) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 12056 (10) Rio do Ventura tributary of Rio Ferro Doido; MZFS 12098 (9) Rio Jacuípe on Domingos Lopes waterfalls; MZFS 14530 (29) Rio Jacuípe on Domingos Lopes waterfalls; UFBA 3219 (4) Rio Jacuípe on Domingos Lopes waterfalls. São Domingos: UFBA 3583 (18) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324. Tanquinho: UFBA 3592 (4) Rio do Peixe na BR 324 na divisa com Candeal.

***Pimelodella itapicuruensis***. São José do Jacuípe: UFBA 7982 (2) Rio Jacuípe na cidade de São José do Jacuípe.

***Poecilia reticulata***. Morro do Chapéu: MZFS 10617 (27) Rio do Ventura tributary of Rio Ferro Doido (PPBIO); MZFS 11738 (562) Riacho do Bonifácio em Ventura; MZFS 12047 (185) Rio do Ventura tributary of Rio Ferro Doido; UFBA 8465 (1) Rio Ferro Doido below Ferro Doido waterfalls near bridge on road to Fedegoso. São José do Jacuípe: UFBA 7885 (9) Rio Jacuípe. Tanquinho: UFBA 3591 (5) Rio do Peixe na BR 324 na divisa com Candeal.

***Poecilia vivipara***. Feira de Santana: MZFS unnumbered 06 (7) Rio Jacuípe on bridge of Rio Branco; MZFS

unnumbered 16 (20) Rio Jacuípe on bridge of Rio Branco. Ichu: MZFS 12543 (165) Rio Tocó afluente do rio Jacuípe; MZFS 12544 (58) Rio Tocó afluente do rio Jacuípe. São Domingos: UFBA 3585 (43) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324. Serrinha: MNRJ 21239 (12) Açude da Bomba na cidade de Serrinha.

***Prochilodus brevis***. Várzea da Roça: UFBA 7882 (1) Rio Jacuípe no povoado de Morrinhos.

***Pterygoplichthys chrysoptiktos***. Morro do Chapéu: UFBA 2788 (2) Rio Jacuípe on Domingos Lopes waterfalls.

***Rhamdia quelen***. Morro do Chapéu: MZFS 10605 (1) Rio Jacuípe on Domingos Lopes waterfalls (PPBIO); UFBA 6476 (1) Rio Ferro Doido abaixo da cachoeira do Ferro Doido próximo à ponte na estrada Para Fedegoso. Riachão do Jacuípe: MZFS 6 (1) Rio Tocó. Fazenda Lagedinho; MZFS 7 (1) Rio Tocó. Fazenda Lagedinho.

***Serrapinnus heterodon***. Feira de Santana: MZFS unnumbered 04 (2) Rio Jacuípe on bridge of Rio Branco; MZFS unnumbered 20 (8) Rio Jacuípe on bridge of Rio Branco. Ichu: MZFS 13931 (27) Rio Tocó afluente do rio Jacuípe. Morro do Chapéu: UFBA 3217 (1) Rio Jacuípe on Domingos Lopes waterfalls. São Domingos: UFBA 3581 (31) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324. São José do Jacuípe: UFBA 7917 (11) Rio Jacuípe na cidade de São José do Jacuípe. Serrinha: MNRJ 21242 (140) Açude da Bomba na cidade de Serrinha. Tanquinho: UFBA 3595 (16) Rio do Peixe na BR 324 na divisa com Candeal.

***Serrapinnus piaba***. Feira de Santana: UFBA 7006 (3) Ribeirão do Cavaco afluente do rio Jacuípe na BR 116 no Km 442 + 500. São Domingos: UFBA 3587 (7) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324. São José do Jacuípe: UFBA 7984 (45) Rio Jacuípe. Tanquinho: UFBA 3654 (4) Rio do Peixe na BR 324 na divisa com Candeal.

***Serrasalmus brandtii***. Capela do Alto Alegre: MZFS 5372 (1) Rio Jacuípe.

***Steindachnerina elegans***. Feira de Santana: MZFS unnumbered 19 (5) Rio Jacuípe on bridge of Rio Branco.

***Tetragonopterus chalceus***. Feira de Santana: MZFS unnumbered 15 (4) Rio Jacuípe on bridge of Rio Branco; UFBA 6938 (2) Rio Jacuípe. São Domingos: UFBA 3584 (7) Rio Jacuípe (próximo a Santo Antônio) sob ponte entre Santa Luz e BR 324.

***Triportheus guentheri***. Feira de Santana: MZFS unnumbered 09 (6) Rio Jacuípe on bridge of Rio Branco .