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Ethnoichthyology of the Piapoco, Piaroa, Puinave and Sikuani ethnic groups inhabitants of the Matavén Forest (Vichada, Colombia)

Juan David BOGOTÁ GREGORY[1*], Nilvânia Mirelly AMORIM de BARROS[2], Francisco Antonio VILLA NAVARRO[3]

[1] Instituto Amazónico de Investigaciones Científicas Sinchi, Grupo de Ecosistemas Acuáticos, Av. Vásquez Cobo entre Calles 15 y 16, Leticia, Amazonas, Colombia

[2] Universidade Federal do Amazonas, INC/UFAM, Rua Primeiro de Maio, 5 Colônia, Benjamin Constant, Amazonas, Brazil

[3] Universidad del Tolima, Facultad de Ciencias, Grupo de Investigación en Zoología, Barrio Santa Helena, Ibagué, Tolima, Colombia

* Corresponding author: juandbogota@gmail.com; https://orcid.org/0000-0001-9732-4703

ABSTRACT

Since prehistoric times, indigenous communities have relied on fish as a staple source of protein for their subsistence. In most cases, fish is the sole source of income and of animal protein for the communities. Nevertheless, the documentation of fish from an ethnological perspective is rare, and biological research alone might not provide sufficient information required to manage fisheries resources. We discuss the traditional ichthyological knowledge of the Piapoco, Piaroa, Puinave, and Sikuani ethnic groups inhabiting the Matavén Forest (Vichada, Colombia). Each group has its perception regarding knowledge, at times detailed, of fish groups, their distribution, and uses. To obtain information regarding traditional ichthyological knowledge, fish were collected over one month at 31 sampling sites in different habitats along the lower Matavén River basin. The fish were identified by formal taxonomy and the informal classification by experienced fishermen of the four ethnic groups. There was consistency among the names given by the ethnic groups and formal taxonomy. The indigenous collaborators used binomial classification systems in which the organisms are grouped at family and genus levels and, to some extent, categorization depends on distribution within the aquatic habitats (i.e., rivers, streams and lagoons). The indigenous collaborators did not provide sociocultural or mythological information related to the fishes. Our findings contribute to the development of conservation and rural development projects in the Colombian Amazon.

KEYWORDS: Neotropics, freshwater fishes, traditional knowledge, folk taxonomy, artisan fishermen

Etnoictiología de los grupos étnicos Piapoco, Piaroa, Puinave y Sikuani que habitan La Selva de Matavén (Vichada, Colombia)

RESUMEN

Desde la prehistoria, las comunidades indígenas han dependido del pescado como fuente primaria de proteína para su subsistencia. En la mayoría de los casos, el pescado es la única fuente de ingresos y proteína animal para la comunidad. Sin embargo, el estudio de los peces desde una perspectiva etnológica no es común y la investigación científica por sí sola puede no proporcionar información suficiente para gestionar los recursos pesqueros. Se discute aquí el conocimiento ictiológico tradicional de las etnias Piapoco, Piaroa, Puinave y Sikuani que habitan la Selva de Matavén (Vichada, Colombia). Cada etnia tiene una percepción propia, a veces detallada, de los grupos de peces, su distribución y usos. Para obtener información sobre el conocimiento ictiológico tradicional, se colectaron peces durante un mes en 31 sitios de muestreo en diferentes hábitats en la cuenca baja del Río Matavén. Los peces fueron identificados usando taxonomía formal y clasificación informal por pescadores expertos de las cuatro etnias. Hubo coherencia entre los nombres dados por los grupos étnicos y el sistema de taxonomía formal. Los colaboradores indígenas usaron sistemas de clasificación binomial en los que los organismos se agrupan a nivel de familia y género y la categorización depende, hasta cierto punto, de la distribución dentro de los hábitats acuáticos (ríos, arroyos y lagunas). Los colaboradores indígenas no proporcionaron información sociocultural o mitológica relacionada con los peces. Nuestros hallazgos contribuyen al desarrollo de proyectos de conservación y desarrollo rural en la Amazonía colombiana.

PALABRAS CLAVE: Neotrópico, peces de agua dulce, conocimiento tradicional, taxonomía informal, pesca artesanal

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INTRODUCTION

The prefix *Ethno-* is defined as "the way in which others look at the world" (Martin 2001). As prefix of an academic discipline the term refers to the study of the perception of an ethnic group in that discipline. Therefore, the term ethnoichthyology refers to the study of the perception related to fishes. Anderson (1967) and Morril (1967) were the first to use ethnoichthyology in published studies regarding traditional fishermen of the Caribbean and China, respectively. Ethnoichthyology studies the interaction between man and fish regarding cognitive and behavioral characteristics (Marques 1995), or the interaction between fish and a given culture (Posey 1987).

The perception of indigenous communities regarding fish basic information (e.g., recognized species and distribution in the aquatic habitats) and use (ornamental/consumption) is essential to guide and implement conservation and management strategies of these resources in a given region (Berman Arévalo and Ros-Tonen 2009). Fisheries management requires a comprehensive approach to the resources used, the society that uses them, the economic dynamics, and the natural conditions that sustain them (Dudgeon et al. 2005). Participatory and inclusive research with non-specialized personnel is one way to incorporate local ecological knowledge to generate answers on fundamental issues and unknown perceptions (McGrath et al. 2008). In this context, researching traditional knowledge gives access to the information and activities transmitted throughout generations by a specific cultural group. Understanding how communities organize and classify the world components is a subject of interest to anthropologists (Durkheim and Mauss 2013; Lévi-Strauss 1989), regarding aspects of different perceptions, identification, and classification of natural objects and biological groups (e.g., Paz and Begossi 1996; Carrisoza 2004; Castillo et al. 2023). Culture selects the criteria that guide the classification, that is, the emic classifications of nature are not watertight and independent compartments of the cultural sphere (Ribeiro 1986).

In Colombia, published studies with a clear ethnoichthyological focus are limited. Bedoya and Wild (1999) described the natural history, ecology, and edible fishes of an indigenous community in the lower Caquetá River (Amazon basin). In the last decades, TROPENBOS Colombia (http://tropenboscol.org/) has emphasized the importance of traditional knowledge to achieve conservation and sustainable development while taking advantage of the services provided by the fish to the indigenous communities (e.g., Rodríguez 1992; Hernández 2013; Polanco and Rodríguez 2013). The word ethnoichthyology *per se* was used for the first time in Colombia by Prieto-Piraquive (2012), who described aspects of traditional ichthyological knowledge in an indigenous reserve in the Colombian Amazon. Other ethnoichthyological studies in Colombia described general aspects of the traditional knowledge associated with the Yahuarcaca floodplain systems in the Colombian Amazon (2004; Damaso 2006; Damaso et al. 2006; Duque et al. 2008).

Although the Colombian territory is recognized as a multicultural state due to an ample diversity of sociocultural groups with their traditions, lifestyles, beliefs, and perception of the natural environment (Posey 1985; Vieco 2001), huge areas containing a variety of ethnic groups remain undocumented and their traditional knowledge is under significant threat due to agricultural and urban expansion (Cassú 2015). The Matavén Forest Guard located in the Orinoco-Amazon transition zone is one of them. This is a relatively pristine area where different ethnic groups inhabit forests and savannas, with their villages heavily concentrated near the rivers (Villarreal-Leal 2009).

The Matavén Forest Guard is part of the drainages of the Guaviare, Vichada, and Orinoco River basins, each with different dynamics. Although they share the same territory, each community has its own cultural and historical characteristics. Approximately 16000 indigenous people from the Cubeo, Curripaco, Piapoco, Piaroa, Puinave, and Sikuani ethnic groups inhabit this sparsely populated region (Berman Arévalo and Rost-Tonen 2009; REDD+Matavén 2023; Villarreal-Leal 2009). However, the most representative are the Piapoco, Piaroa, Puinave, and Sikuani (Sánchez 2007).

From a linguistic perspective, the Piapoco is an agglutinative language with a nominal system (Bailey 2007) of the Arawak linguistic family, while the Piaroa is from the Sáliva-Piaroa linguistic family (Sánchez 2007). The Puinave and the Sikuani are from the Makú-PuiSánznave and Guahíbo linguistic families, respectively (Sánchez 2007). All languages belong to the Arahuacano trunk (Fabre 2005), yet some consider the Puinave as an isolated language (e.g., PROEL 2023). Despite their importance as ethnic groups, the knowledge about the Piapoco, Piaroa, Puinave, and Sikuan is still limited. The few published studies focus on social and cultural aspects, including elements of the history and social changes in these groups (Sánchez 2007). Indigenous communities have experienced significant changes in the recent past. The speed of these transformations has been so substantial that some communities differ from the material, social, and symbolic descriptions made less than 50 years ago (Freire 2004). Although an essential activity for Piapoco, Piaroa, Puinave, and Sikuani, no study has yet assessed fishing in these communities from an ethnological perspective. Fish taxa and fishing techniques were studied from an ethnoichthyological perspective in Venezuela for the Piaroa.

The distinctive ichthyofauna of the Matavén Forest requires constant monitoring for the integrated and coordinated management of fishing bans, to assure that conservation measures and use of fishing resources are

coherent and successful (Villarreal-Leal et al. 2009). The role of indigenous communities is of critical importance, as they accumulate a wealth of knowledge on fish biology and ecology, which is conveyed to subsequent generations. The first step towards consolidating processes such as fisheries management in the Matavén Forest is to comprehend the terminology used in the communities to identify fish and how these resources are used. Development and conservation efforts would be more effective if these cultural characteristics were considered (McGoodwin 2002).

In view of the loss of traditional knowledge in the indigenous communities in the Matavén Forest, we aimed to provide information on fish names (folk taxonomy), behavioral aspects, capture methods and use of fish species, and analyze the congruence between the systematic taxonomy and the folk taxonomy used by the Piapoco, Piaroa, Puinave, and Sikuani that inhabit the Matavén Forest. Because both systems have strong morphological base, we hypothesized congruence between both systems. We envisage that the generated knowledge will be useful for the management and conservation of the ichthyofauna in the region, which is a staple food resource for local communities.

MATERIAL AND METHODS

Our study was performed simultaneously with the biodiversity characterization of the Matavén Forest, conducted by the Alexander von Humboldt Biological Resources Research Institute (IAvH) (Bogotá, Colombia) and the Matavén Forest Indigenous Traditional Authorities and Cabildos Association-Acatisema (Villarreal-Leal 2009). The biodiversity survey was carried out in the lower portion of the Matavén River basin with collaboration of members of the Piapoco, Piaroa, Puinave, and Sikuani ethnicities. Our study based on participatory research. The indigenous collaborators provided the ethnoichthyological data used in here.

Permits for the collection of biological specimens are under the umbrella of scientific collection permits for research institutions affiliated with the Environmental and Development Ministry of Colombia, including the IAvH. Permits for ethnological studies are not required in Colombia. However, prior to fieldwork, data collection on traditional knowledge was authorized by the indigenous community leaders.

Study area and indigenous groups

The Matavén Forest is part of the Vichada Department in the Colombian Orinoco, which borders Venezuela (Figure 1). It is located in the transition area between the savannas of the Orinoco to the north and the humid jungles of the Amazon to the south. The zone is important for biodiversity because of its well-conserved state and biogeographic location (Maldonado-Ocampo et al. 2009; Villarreal-Leal 2009; Osorno-Muñoz et al. 2019). Due to its physiographical and geological characteristics, this area is part of the western border of the Guiana Shield, and due to its floristic affinity, it is considered the northern limit of the Amazonian phytogeographic region (Villarreal-Leal 2009).

The Piapoco and Puinave populations numbered around 800 individuals each at the time the study, located in the south of the Matavén guard, towards the Guaviare River (Sánchez 2007). The Piaroa counted close to 12,000, with a wide

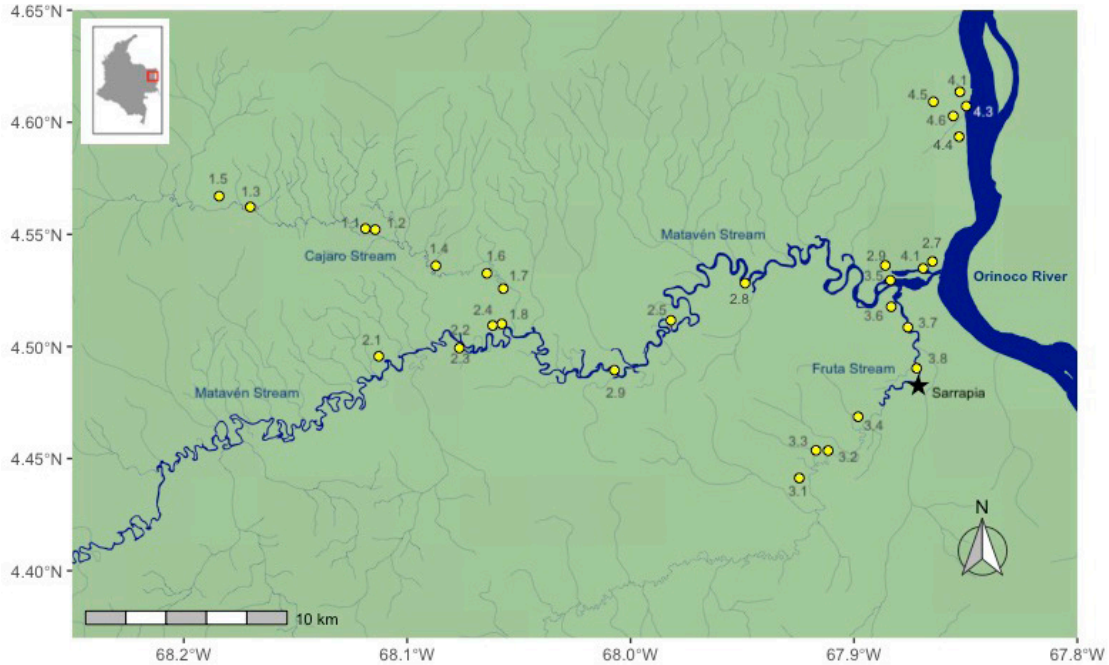

Figure 1. Geographical location of the fish sampling sites in the Matavén Forest, Matavén, Vichada, Colombia.

distribution in the middle Orinoco basin (Sánchez 2007; de la Hoz 2019). The Sikuani is the largest ethnic group, with more than 23,000 individuals estimated at the time of our study (Sánchez 2007; ONIC 2023), located along the lowland areas of the Orinoco River basin. Since the 19th century, European exploration has generated widespread relocations among these ethnicities, therefore their distribution has been dynamic, varying according to the social context (Sánchez 2007). Our collaborators came from different parts of the distribuiton area of each ethnicity to take part in the study, and were not all inhabitants of the lower Matavén River region, where fish sampling took place. The interviewees were selected based on their fishing experience and their interest in participating in the study.

Fieldwork

Fish samples used in our ethnoichthyological study are those from Maldonado-Ocampo et al. (2009). Fish sampling was carried out towards the end of the dry season between March 1 and 29, 2007, at 31 sampling sites established along the lower portion of the Matavén River, up to about 67 km upstream of its confluence with the Orinoco River (Figure 1; Supplementary Material, Table S1). At each sampling site, all available habitat types (i.e., river channels, lakes, and streams) were sampled. Due to habitat heterogeneity and to render a representative fish sample, different conventional fishing techniques were used per site. Samplings occurred at each site for one day, during the morning and the afternoon, using line fishing, various nets (gillnets, trawls, traps), and manual capture. Sampling effort was of more than 10 hours at each site combining all sampling techniques and implemented by a team of six fisherman (four indigenous collaborators and two researchers). Fish caught were preserved in 10% formaldehyde. At the end of each fishing day, three members of each ethnic group were interviewed for qualitative data using a standard questionnaire. The questions included aspects of folk taxonomy, fish behavior (including habitat distribution), capture techniques, uses, and cultural representations for each species.

Fish identification

Fish identification was carried out in two weeks. During the first week, the specimens were taxonomically identified following the classification proposed by Nelson (2006). The sources for species determination and validation are available in Maldonado-Ocampo et al. (2009). During this phase, the participation of the members of the indigenous communities was more passive. They helped in the analysis of diagnostic characters using updated peer-reviewed publications. During the second week, the informal identification was carried out by comparing the classification results from the first week with the information gathered during the interviews conducted at the end of each fishing trip with indigenous collaborators. All identification and classification information reported by the collaborators comes from traditional orally transmitted knowledge, based on their memories and experience of the aquatic ecosystems and fish in the region.

All ichthyological material on which the present study is based was deposited in the freshwater fish collection of the Alexander von Humboldt Biological Resources Research Institute (IAvHP) in Villa de Leyva, Boyacá, Colombia.

Data analysis

A taxonomic list of the species identified and the names used in the four different dialects and languages were subject to network analysis (NtA). With the NtA we attempted to identify patterns of association of the names given by the ethnic groups with our taxonomic system, as both systems have morphological solid grounds. The network analysis was performed using the network package (Butts 2008) for R (R Core Team 2021).

RESULTS

Traditional ichthyological knowledge related to taxonomy

The quantity and organization of names used to identify fish species by the different ethnic groups was abundant (Table 1), especially in the case of the Piapoco, who use more than 80 names, with very few unnamed species. The highest number of names used by the ethnic groups were associated with the most diverse taxonomic order, the Characiformes (Table 1).

Binomial classification systems exist in some groups, similar to the standard Linnaean taxonomy (Table 2). Examples from the Piapoco language are that two of the five species identified in the Anostomidae family are grouped in the ethnogenus *Dali*, three species of the family Loricariidae are grouped into the ethnogenus *Chama,* and five species from the family Auchenipteridae are grouped in the ethnogenus *Chuwali*.

Each of the four languages uses less than 90 names for the 137 species identified in this study (Table 2). In some cases, ethnogenus and ethnospecies used by the four ethnicities designate various species. On the other hand, cases in which more than one name is used for the same species are rare and were observed only in the Piaroa language, which used more than one name for *Hyphessobrycon* sp., *Heros severus,* and *Hypselacara coryphaenoides*.

The quantity of names used by each ethnic group is proportional to the number of characteristics used to establish the classification system. Generally, the classification systems in all ethnicities are based on morphological characteristics such as coloration, size, shape, and presence or absence of spines and scales. According to the names compiled during this study, the classification systems that consider the most

Table 1. Identified fish species, names in the Sikuani, Piapoco, Piaroa and Puinave languages, and uses in the Matavén Forest (Vichada, Colombia). Uses: Auto-consumption (ACp), Consumption (Cp) and Ornamental (Or).

Taxon	Ethnic group				Uses
	Sikuani	Piapoco	Piaroa	Puinave	
Order Myliobatiformes					
Family Potamotrygonidae					
Potamotrygon motoro (Müller & Henle, 1841)	*Pone*	*Yaduli*	*Sibäri*	*Iwín*	Or,Cp
Order Clupeiformes					
Family Engraulidae					
Amazonsprattus scintilla Roberts, 1984	*Bájuto*	*(Zebe)*	*Meretü*	*Pi*	
Anchoviella guianensis (Eigenmann, 1912)	*peniojai báju*	*(Zebe)*	*Meretü*	*Pi*	
Order Characiformes					
Family Crenuchidae					
Characidium sp.		*(Zebe)*	*(Meretü)*	*Detsán*	
Crenuchus spilurus Günther, 1863	*Siwatsa bájuto*	*Tokoli pubanameyei*	*(Meretü)*	*Detsán*	
Microcharacidium gnomus Buckup, 1993	*Payekijai bájuto*	*(Zebe)*	*(Meretü)*	*Pi*	
Poecilocharax weitzmani Géry, 1965	*Bájuto*	*(Zebe)*	*(Meretü)*	*Pi*	Or
Family Erythrinidae					
Hoplerythrinus unitaeniatus (Agassiz, 1829)	*Enobü*	*Pualaý*	*Wärá*	*Ya*	Cp
Hoplias malabaricus (Bloch, 1794)	*Tsumera*	*Inurrý*	*Täćhä*	*Pusum*	Cp
Family Cynodontidae					
Hydrolycus armatus (Jardine & Schomburgk, 1841)	*Malibai*	*Sirribaly*	*Bäyärä*	*Iracbm*	Cp
Hydrolycus tatauaia Toledo-Piza, Menezes & dos Santos, 1999	*Malibai*	*Sirribaly*	*Bäyärä*	*Iracbm*	Cp
Family Serrasalmidae					
Myleus asterias (Müller & Troschel, 1844)	*Fererewato*	*Kana picho yenibe*	*Kjäwạ poña*	*Sucsu*	Cp
Pristobrycon calmoni (Steindachner, 1908)	*Kowarabo*	*Umai ului*	*Cariwí*	*Irac*	Cp
Pygocentrus cariba (Humboldt & Valenciennes, 1821)	*Siribo*		*Caribi*	*Wac*	Cp
Pygocentrus cf. *nattereri* Kner, 1858		*Umai kulichua*	*Caribi*	*Iracpi*	Cp
Pygopristis denticulata (Cuvier, 1819)				*Upiti*	Cp
Serrasalmus manueli (Fernández-Yépez & Ramírez, 1967)				*Upiti*	Cp
Serrasalmus rhombeus (Linnaeus, 1766)				*Pibm*	Cp
Family Hemiodontidae					
Bivibranchia fowleri (Steindachner, 1808)	*Pasojai bájuto*	*Kawiri pubanameyei*	*(Meretü)*	*Walla*	
Hemiodus gracilis-group	*Pasojai bájuto*	*Kawiri*	*(Meretü)*	*Somkt*	Or
Hemiodus immaculatus Kner, 1858	*Bopowato*	*Kawiri*	*Iręsodę poñä*	*Walla*	ACp
Family Anostomidae					
Leporinus friderici (Bloch, 1794)	*Kapinawato*	*Dali kapireni*	*Tuäba kjụmuä*	*Ikmn*	Cp
Leporinus latofasciatus Steindachner, 1910	*Karasi*	*Kaluchi*	*Aräka kjụmuä*	*Tüwan*	Or,Cp
Leporinus cf. *moralesi* Fowler, 1942	*Kapinawa bájuto*	*Dali achumeri*	*Kjụmuä*	*Sim*	Cp
Pseudanos gracilis (Kner, 1858)	*Kekeresufalibo*	*Tokoli kuliri*	*Kjụmuä*	*yeshm*	ACp
Family Curimatidae					
Curimatopsis evelynae Géry, 1964	*Swatsato*	*(Zebe)*	*Meretü*	*Pi*	Or
Curimatopsis macrolepis (Steindachner, 1876)	*Bájuto*	*(Zebe)*	*Meretü*		
Family Prochilodontidae					
Semaprochilodus kneri (Pellegrin, 1909)	*Akerito*	*chanabali*	*Änäbäri*	*Jún*	Cp
Semaprochilodus laticeps (Steindachner, 1879)	*Yana panito*		*Änäbäri*	*Jún*	Cp
Family Lebiasinidae					
Nannostomus eques Steindachner, 1876	*Bájuto*	*Tokolý achumeri*	*Męręćhä*	*Pi*	Or
Nannostomus unifasciatus Steindachner, 1876	*Jetsabáju*	*Tokolý*	*Męręćhä*	*Pi*	Or
Nannostomus sp.	*Bájuto*	*Tokolý achumeri*	*Męręćhä*	*Pi*	Or
Pyrrhulina sp.	*Bájuto*	*Zebe*	*Męręćhä*		
Family Ctenoluciidae					
Boulengerella cuvieri (Agassiz, 1829)	*Tsutsubo*	*Siwapi*	*Susufi*	*Uma*	ACp,Or
Boulengerella lateristriga (Boulenger, 1895)	*Tsutsubo*	*Kupiwa*	*Susufi*	*Uma*	ACp,Or
Boulengerella lucius (Cuvier, 1816)	*Tsutsubo*		*Susufi*	*Uma*	ACp,Or
Family Bryconidae					
Brycon falcatus Müller & Troschel, 1844	*Kuyato*	*Wiriuli*	*Äí bụrä'kạ*	*Ñamsi*	Cp

Table 1. Continued.

Taxon	Ethnic group				Uses
	Sikuani	Piapoco	Piaroa	Puinave	
Brycon pesu Müller & Troschel, 1845	*Ayai bájuto*	*Chamusi yenibe*	*Kjụmuä*	*Drmy*	ACp
Family Iguanodectidae					
Iguanodectes cf. *adujai* Géry, 1970	*Bájuto*	*(Zebe)*	*Mẹrẹćha*	*Pi*	Or
Iguanodectes geisleri Géry, 1970	*Petobenawayajai bájuto*	*(Zebe)*	*Mẹrẹćha*	*Pishat*	ACp
Iguanodectes spilurus (Günther, 1864)	*Taimaboto*	*(Zebe)*	*Mẹrẹćha*	*Pi*	ACp
Family Acestrorhynchidae					
Acestrorhynchus microlepis (Schomburgk, 1841)	*Kujanabo*	*Watuli*	*Wäturi*	*Wác*	ACp
Acestrorhynchus nasutus Eigenmann, 1912	*Kujanasipa*	*Watuli achumeri*	*Wäturi*		ACp
Family Characidae					
Astyanax sp.		*(Zebe)*	*Mẹrẹćha*	*Pibm*	ACp
Bryconamericus cismontanus Eigenmann, 1914	*Pewayajai báju*	*Chamusi yenibe*	*Mẹrẹćha*	*Pi*	
Bryconops alburnoides Kner, 1858	*Pasojai bájuto*	*Wirriuli yenibe*	*Mẹrẹćha*	*Buluti*	ACp,Or
Bryconops caudomaculatus (Günther, 1864)	*Petobenawayajai báju*	*Wirriuli*	*Mẹrẹćha*	*Pi*	Cp
Bryconops magoi Chernoff & Machado-Allison, 2005	*Bájuto*	*Wirriuli pubanameyeri*	*Mẹrẹćha*	*Pisat*	
Chalceus macrolepidotus Cuvier, 1817	*Dopanito*	*Kira isibana*	*Yupari*	*Ipai*	Or,Cp
Creagrutus maxillaris (Myers, 1927)	*Penasabi báju*	*(Zebe)*	*Mẹrẹćha*	*Pi*	
Hemigrammus analis Durbin, 1909	*Pesojai baju*	*(Zebe)*	*Meretü*	*Pipac*	Or
Hemigrammus gracilis-group	*Bájuto*	*(Zebe)*	*Mẹrẹćha*	*Pi*	
Hemigrammus micropterus Meek, 1907	*Tsikiri bajutoxi*	*(Zebe)*	*Mẹrẹćha*	*Pi*	
Hemigrammus newboldi (Fernández-Yépez, 1949)		*(Zebe)*	*Meretü*	*Pi*	
Hemigrammus rhodostomus Ahl, 1924	*Pemata tsobia báju*	*Ira iwita*	*Mẹrẹćha*	*Juyacqrit*	Or
Hemigrammus unilineatus (Gill, 1858)	*Báju*	*(Zebe)*	*Mẹrẹćha*	*Pi*	Or
Hemigrammus unilineatus-group	*Tsikiri bájuto*	*(Zebe)*	*Mẹrẹćha*	*Pi*	
Hemigrammus sp.	*Penasabi báju*	*Zebe*	*Mẹrẹćha*	*Pi*	Or
Hyphessobrycon sp.	*Bájuto*	*Puya idu*	*Päräwä, Mẹrẹćha*	*Pi*	ACp
Markiana geayi (Pellegrin, 1908)	*Kamalito*	*Iwayu*		*Pi*	
Microschemobrycon casiquiare Böehlke, 1953	*Báju*	*(Zebe)*	*Mẹrẹćha*	*Pi*	
Moenkhausia chrysargyrea (Günther, 1864)		*(Zebe)*		*Tecsat*	ACp
Moenkhausia copei (Steindachner, 1882)	*Báju*	*(Zebe)*	*Mẹrẹćha*	*Pibm*	ACp
Moenkhausia cotinho Eigenmann, 1908	*Werronito*	*Erri ituii*	*Mẹrẹćha*	*Tec*	Or
Moenkhausia grandisquamis (Müller & Troschel, 1845)	*Kamali bájuto*	*Kamali*	*Mẹrẹćha*	*Whë*	ACp
Moenkhausia megalops (Eigenmann, 1907)	*Pewayajai kamali*	*Kamali*	*Mẹrẹćha*	*Pi*	ACp
Parapristella georgiae Géry, 1964		*(Zebe)*	*Mẹrẹćha*	*Pi*	
Triportheus orinocensis Malabarba, 2004	*Arenka*	*Arenka*	*Nawodä poña*	*Manún*	Cp
Aphyocharax alburnus (Günther, 1869)	*Tsikiribáju*	*(Zebe)*	*Mẹrẹćha*	*Pi*	Or
Aphyocharax dentatus Eigenmann & Kennedy, 1903	*Tsikiribáju*	*Dupu yenibe*	*Mẹrẹćha*	*Pi*	
Charax condei (Géry & Knöppel, 1976)		*(Zebe)*	*Mẹrẹćha*	*Iracbm*	Or
Heterocharax macrolepis Eigenmann, 1912	*Peyenepanatsajai bájuto*	*Irrabali*	*Mẹrẹćha*	*Pi*	
Tetragonopterus argenteus Cuvier, 1816	*Kamali*	*Kamali*	*Päräwä pechị*	*Pi*	ACp
Tetragonopterus chalceus Spix & Agassiz, 1829	*Kamali*	*Kamali*	*Päräwä pechị*	*Say*	ACp
Paracheirodon axelrodi (Schultz, 1956)	*Tsikiri báju*	*(Zebe)*	*Säuru*	*Pi*	Or
Order Gymnotiformes					
Family Gymnotidae					
Electrophorus electricus (Linnaeus, 1766)					
Family Hypopomidae					
Brachyhypopomus sp.	*Manabo*	*Manapi achumery*			
Steatogennys cf. *elegans* (Steindachner, 1880)	*Sarama*	*Zalama*	*Ruäju*		ACp,Or
Family Rhamphichthyidea					
Gymnorhamphichthys rondoni (Miranda Ribeiro, 1920)	*Masete*	*Manapi kabalery*	*Ruäju*	*Uma*	Or
Order Siluriformes					
Family Trichomycteridae					
Ochmacanthus alternus Myers, 1927	*Tsalito*	*(Zebe)*	*Päräwä dúdụba*	*Beu*	
Ochmacanthus sp.	*Tsikirí tsaliuto*	*(Zebe)*	*Päräwä dúdụba*	*Dmey*	

Table 1. Continued.

Taxon	Ethnic group				Uses
	Sikuani	Piapoco	Piaroa	Puinave	
Family Loricariidae					
Acestridium colombiensis Retzer, 2005	*Tsama*	*Chama*	*Äjuwä*	*Beuti*	Or
Acestridium dichromum Retzer, Nico & Provenzano R., 1999	*Tsama*	*Chama*	*Äjuwä*	*Beuti*	Or
Acestridium martini Retzer, Nico & Provenzano R., 1999	*Tsama*	*Chama*	*Äjuwä*	*Beuti*	Or
Paratocinclus eppleyi Scheafer & Provenzano, 1993	*Tsama*	*Chama achumeri*	*Äjuwä*		Or
Limatulichthys griseus (Eigenmann, 1909)	*Bosikito*	*Alcalde*	*Äjuwä*	*Beupat*	Or
Loricariichthys sp.	*Bosikito*	*Alcalde achumeri*	*Äjuwä*	*Rtjuput*	Or
Rineloricaria formosa Isbrücker & Nijssen, 1979	*Bosikito*	*Chama*	*Äjuwä*	*Rtjuput*	Or
Hypostomus ammophilus (Armbruster & Page, 1996)	*Tsama*	*Chama kainaminalu*	*Äjuwä*	*Rtjuput*	Or
Dekeyseria brachyura (Kner, 1854)	*Tsama*	*Chama kuliyei iwaliaba*	*Äjuwä*	*Beu*	Or
Dekeyseria scaphirhyncha (Kner, 1854)	*Tsama*	*Chama*	*Äjuwä*	*Beu*	Or
Family Cetopsidae					
Helogenes marmoratus Günther, 1863	*Leku leku*	*Chuwali irri*		*Bulút*	
Family Auchenipteridae					
Ageneiosus inermis (Linnaeus, 1766)					Cp
Auchenipterichthys punctatus (Valenciennes, 1840)	*Müpabü*	*Chuwali kataneyei*	*Dụdụbạ*	*Bulút*	ACp,Or
Liosomadoras oncinus (Jardine & Schomburgk, 1841)	*Müpabü*	*Chuwali malenery*	*Dụdụbạ*	*Bulút*	ACp,Or
Tatia aulopygia (Kner, 1858)	*Müpabü*	*Chuwali achumery*	*Suäri*	*Bulút*	ACp,Or
Tetranematichthys wallacei Vari & Ferraris, 2006	*Upipa*	*Awatu*		*Bulút*	ACp
Trachelyopterichthys anduzei Ferraris & Fernández, 1987	*Wena*	*Chuwali pubanameyei*	*Dụdụbạ*	*Bulút*	ACp,Or
Trachelyopterichthys taeniatus (Kner, 1858)	*Müpabü*	*Chuwali kalapiyei*	*Dụdụbạ*	*Suali*	ACp,Or
Trachycorystes trachycorystes (Valenciennes, 1840)	*Müpabü*	*Chuwaly*	*Suäri*	*Bulút*	Cp
Family Doradidae					
Acanthodoras spinosissimus Eigenmann & Eigenmann, 1888	*Yayakato*	*Raki raki*	*Corí*	*Ayca*	ACp,Or
Amblydoras bolivariensis (Fernández-Yépez, 1968)	*Yayakato*	*Ufa*	*Corí*	*Beu*	ACp,Or
Platydoras hancocki	*Yayakato*	*Raki raki manuiri*	*Corí*	*Raqui raqui*	ACp
Family Heptapteridae					
Heptapterus sp.	*Tsaliuto*	*(Zebe)*	*Mụịka*	*Jaipai*	ACp
Imparfinis pristos Mees & Cala, 1989	*Tsaliuto*	*Chalio pubanameyeri*		*Pi*	ACp
Pimelodella cristata (Müller & Troschel, 1848)	*Tsalitsaliu*	*Kaliwa achumery*	*Mụi'ka*	*Diüy*	ACp
Pimelodella cf. *gracilis* (Valenciennes, 1836)	*Tsaliuto*	*Chalio*	*Nịụwä*	*Sú*	ACp
Rhamdia laukidi Bleeker, 1858	*Tsawijana*	*Yawiana*		*Dmey*	Cp
Family Pimelodidae					
Pimelodus blochii Valenciennes, 1840	*Tsaliuto*	*Dulupuni*	*Mạrạkä*	*Su*	Or,Cp
Pseudoplatystoma trigrinum (Valenciennes, 1840)					
Family Pseudopimelodidae					
Batrochoglanis raninus (Valenciennes, 1840)	*Wena*	*Chuwali kataneri*	*Suäri*	*Jaiwetti*	ACp
Batrochoglanis villosus (Eigenmann, 1912)	*Wena*	*Kaliwa maleneyei*	*Suäri*	*Dry*	ACp
Microglanis iheringi Gomes, 1946	*Tsaliuto*	*Chuwali achumery*	*Suäri*	*Dmey*	ACp
Order Gobiiformes					
Family Gobiidae					
Microphilypnus amazonicus Myers, 1927	*Tsaliu*	*(Zebe)*	*Mẹrẹćhä*		
Order Synbranchiformes					
Family Synbranchidae					
Synbranchus marmoratus Bloch, 1795	*Manabo*	*Kuluri mapi*	*Ñumäri*	*Sicyu*	
Order Cichliformes					
Family Cichlidae					
Aequidens chimantanus Inger, 1956	*Upeto*	*Damuleý*	*Tjäka pärewa*	*Tüm*	ACp
Aequidens sp1.	*Atujani jaibi*	*Damuleý achumechua*	*Wạ'käñu pärewa*	*Tüm*	ACp,Or
Aequidens sp2.	*Upeto*	*Damuleý ziwa*	*Tjäka pärewa*	*Tüm*	ACp,Or
Apistogramma ortmanni (Eigenmann, 1912)	*Upe báju*	*Damuleý calizaminalu*	*Pärewa*	*Tüm*	Or
Biotodoma wavrini (Gosse, 1963)	*Kolay*	*Zoba kainaminanai*	*Ñäwä*	*Jalama*	Or
Cichla orinocensis Humboldt, 1821	*Wanapabü*	*Eewaba*	*Afó*	*Jaipac*	Cp

Table 1. Continued.

Taxon	Ethnic group				Uses
	Sikuani	Piapoco	Piaroa	Puinave	
Cichla temensis Humboldt, 1821					
Cichla sp.	*Upe báju*	*Eewa achumery*	*Mẹrẹćhä*		Cp
Crenicichla johanna Heckel, 1840	*Bajiwi*	*Chuwi*	*Yuwí-Juão*	*Jaipat*	ACp,Or
Crenicichla lugubris Heckel, 1840	*Bajiwi*	*Chubaza*	*Yuwí-Marapurí*	*Wi*	ACp,Or
Crenicichla wallacii Regan, 1905	*Bopi*	*Chuwi kirrerriitura*	*Yuwí-Juão*	*Wi*	ACp,Or
Crenicichla sp.			*Ruwäju*	*Sityu*	Or
Dicrossus filamentosus (Ladiges, 1958)	*Upe bájuto*	*Damuley achumery*	*Pärewa*		Or
Heros severus Heckel, 1840	*Mamarto*	*Mamarra idu*	*Sạẹjä, Pärewa*	*Yaunón*	ACp,Or
Hoplarchus psittacus (Heckel, 1840)		*Damuley culichúa*	*Copei*	*Shm*	ACp
Hypselecara coryphaenoides (Heckel, 1840)	*Upeto*	*Damuley*	*Pärubí, Päiewa*	*Eva*	ACp
Mesonauta egregius Kullander & Silfvergrip, 1991	*Toseto*	*Kachichu*	*Pechị*	*Dawakú*	ACp,Or
Mesonauta insignis (Heckel, 1840)	*Toseto*	*Kachichu*	*Pechị*	*Dawakú*	ACp,Or
Mesonauta aff. *mirificus* Kullander & Silfvergrip, 1991	*Toseto*	*Kachichu*	*Pechị*	*Dawakú*	ACp,Or
Satanoperca daemon (Heckel, 1840)	*Atujani jaibi*	*Zoba*	*Ñäwä*	*San pam*	ACp,Or
Order Beloniformes					
Family Belonidae					
Belonion dibranchodon Collette, 1966	*Tsutsubo*	*Yuyo*	*Susufi*	*Lapicero*	Or

Table 2. Number of fish species names in Sikuani, Piapoco, Piaroa and Puinave languages in the Matavén Forest (Vichada, Colombia).

Name type	Ethnicity			
	Sikuani	Piapoco	Piaroa	Puinave
Polysemes	48	34	31	59
Binomial	25	46	11	2
Total	73	80	42	61

significant number of specific characteristics are those of the Piapoco and Sikuani. The Puinave consider more general characteristics, while the Piaroa are less specific. The Sikuani and Piapoco also use ecological criteria to classify fish. This system is based simply on how fish are distributed within aquatic habitats according to three categories: the main river channel, lagoons, or near beaches (Table 3).

Overall, the network analysis showed a consistency between the names given by the ethnic groups and the formal taxonomic classification system (Figures 2 and 3). At the order level, there was a clear grouping in the names used by the ethnicities regarding modern taxonomy (Figure 2). In a few instances, a name is used to name fishes belonging to more than one order. For example, the Piapoco use the name *Zebe* for fishes that belong to the Characiformes, Siluriformes, and Perciformes. The Piaroa use *Marecha* to name fishes from the Characiformes and Perciformes. The Puinave use *Pi* to name fishes from the Characiformes and Siluriformes. The Sikuani use *Bajuto* for Characiformes and Clupeiformes, and *Manabo* to name fishes from Gymnotiformes and Synbranchiformes. Therefore, in some cases, several names might correspond to generic terms that refer to the fish in general. The patterns are less clear at the family level due to the number of names and taxa (Figure 3). However, some patterns can be

Table 3. Fish classification by aquatic ecosystem according to the Sikuani and Piapoco ethnicities in the Matavén Forest (Vichada, Colombia).

Ethnic group	Habitat	Species	Vernacular names (Spanish)
Sikuani	Main channel	*Dekeyseria scaphirhyncha*	cucha
		Tetranematichthys wallacei	bagre ciego
		Cichla orinocensis	pabón real
		Cichla temensis	pabón pintado
	Lake	*Curimatopsis* spp.	bocachico
		Leporinus spp.	mazorca, porraemanteco
		Paracheirodon axelrodi	cardenal
		Hoplias malabaricus	dormilón, dulce sueño
		Dekeyseria scaphirhyncha	cucha
		Boulengerella spp.	agujón
		Rhamdia laukidi	dentón
		Pimelodus blochii	bagre
		Cichla orinocensis	pabón real
		Cichla temensis	pabón pintado
	Beach	*Brycon falcatus*	sardina
Piapoco	Main channel	*Potamotrygon motoro*	raya
		Dekeyseria scaphirhyncha	cucha
		Tetranematichthys wallacei	bagre sapo
	Lake	*Curimatopsis* spp.	bocachico
		Leporinus spp.	cabezaemanteco
		Pygocentrus cariba	caribe
		Acestrorhynchus spp.	dienteperro
		Hoplias malabaricus	dormilón
		Boulengerella spp.	agujón
		Dekeyseria scaphirhyncha	cucha
		Cichla spp.	pabón
	Beach	*Brycon falcatus*	sardina

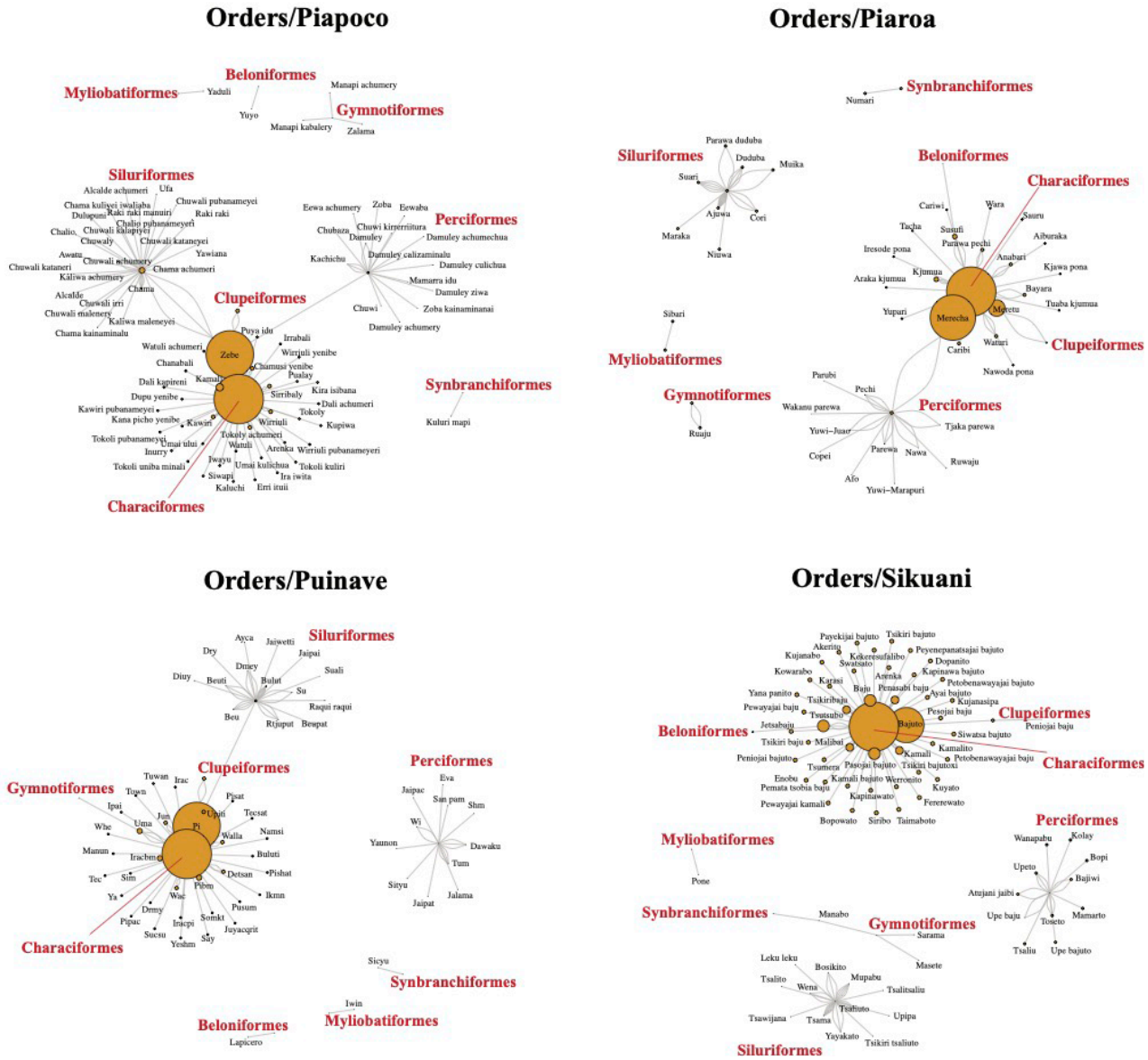

Figure 2. Results of the network analysis with fish names used by the Sikuani, Piapoco, Piaroa and Puinave ethnicities and taxonomic orders.

recognized. A considerable number of families have unique names used to designate their "species". For the Puinave, only one single relatively complex network represents names for the Heptapteridae, Pimelodidae, Pseudopimelodidae, Trichomycteridae, Loricariidae, and Doradidae. However, all these families belong to a common order, the Siluriformes.

Capture methods

Fishing in the area is a traditional and historically masculine activity. The fishing methods differ depending on the community's location in the watershed (upper, medium, and lower stretches) and the aquatic habitats available in that area. Concerning capture techniques, fishing is conducted differently depending on whether the species are for food or ornamental use. In general, the four ethnic groups use hooks, basic harpoons, and nets to catch species for consumption. For ornamental fish commerce, the preferred capture method is the seine net, also known locally as *chinchorro*, which is one of the most effective methods in the lower Orinoco during the low water season (Ramírez and Ajiaco 2001). For species of the order Siluriformes (specifically of the families Loricariidae, Doradidae, and Auchenipteridae, which are used both for feeding and ornamental purposes) a pound net with the help of a facemask is used. In the most isolated communities, where acquiring fishing supplies is difficult, these species are captured using a knife and plastic bags.

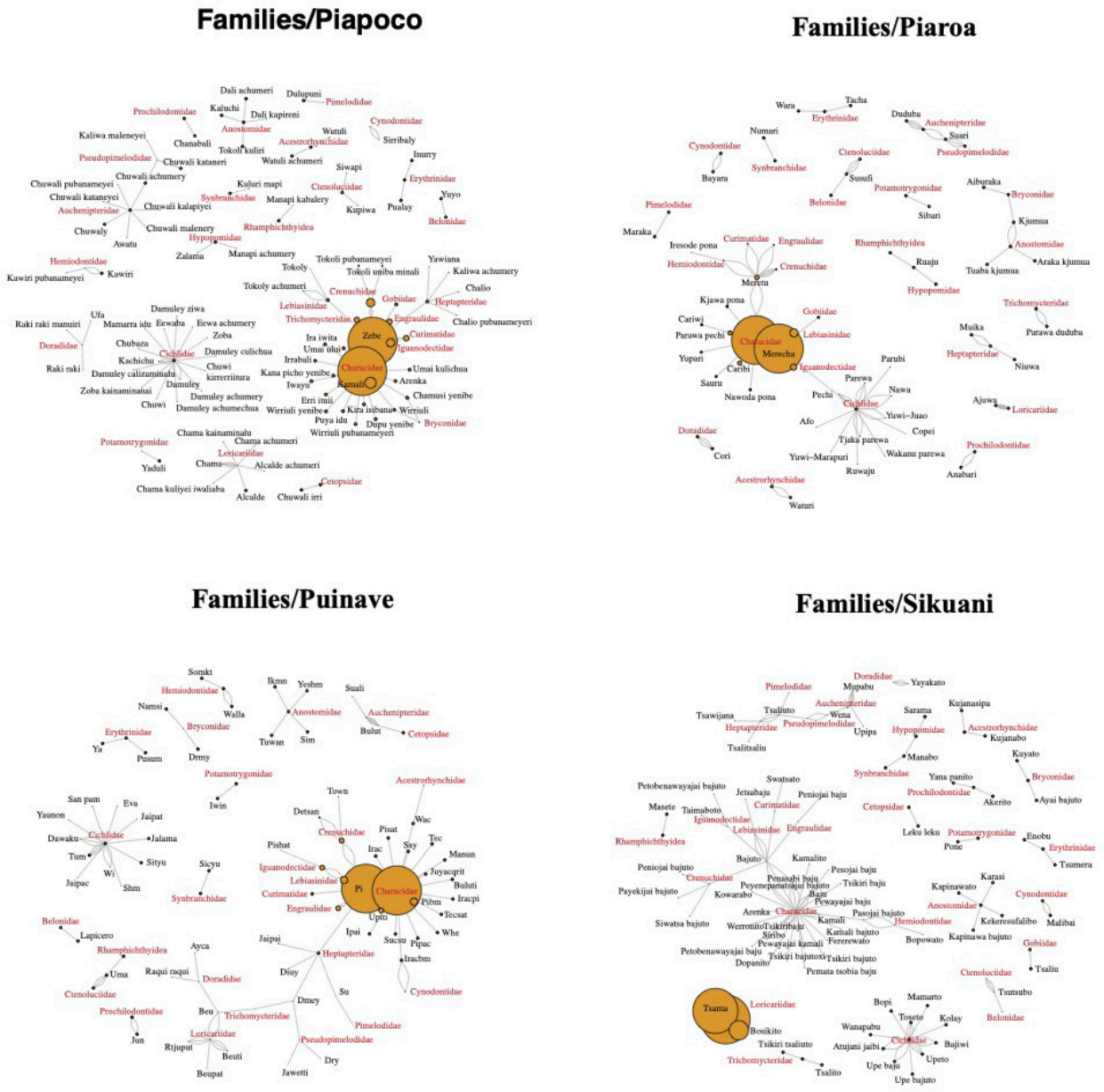

Figure 3. Results of the network analysis with fish names used by the Sikuani, Piapoco, Piaroa and Puinave ethnicities and taxonomic families.

Use of fishing resources

The destiny of the extracted species varies among communities but is directly related to their proximity to collection and transportation centers. For example, in the Piaroa communities, the extraction of ornamental species is higher now that they are located relatively close to Puerto Inírida (Guainía), the main collection center in the region. In general, the variety of species used for ornamental purposes is wide, nearly half of the total identified species, with preference given to *Paracheirodon axelrodi, Hemigrammus rhodostomus* and various species of the family Loricariidae, such as *Dekeyseria scaphirhyncha,* and *Paratocinclus eppleyi*. Contrary to ornamental species, commercial fishing of food species does not exist in this area. No species are captured for commercial food sale, nor do conditions exist to store the product, such as refrigeration units or freezers. This type of fishing is generally for subsistence and there is no species preference, however, the number of species caught for consumption is as high as the number of species caught for ornamental use. This further corroborates the critical nutritional role that fish play in these communities. At certain times of the year, capturing certain species is impossible, thus large portions of the fish caught are not for immediate use but instead are salted or smoked to be stored for consumption when supply is low.

DISCUSSION

Our study delivers the first integrative approach to explore the ethnoichthyological knowledge of the Piapoco, Piaroa, Puinave, and Sikuani communities that inhabit the Matavén Forest. Traditional ichthyological knowledge about fish names is abundant in the study area, specifically among the Piapoco, who use more than 80 names, with very few unnamed species. In most cases the ethnospecies in each of the four ethnic groups are polysemic, meaning that they designate only one word for the levels of genus and species, as already reported for the Piaroa and other ethnic groups of Venezuela (Royero 1993, 1996). We compiled 42 names used by the Piaroa, which constitutes a relatively small number considering that Royero (1989) recorded 77 names used by the Piaroa in the Cataniapo River basin and nearby Puerto Ayacucho, Venezuela. Additionally, the Piaroa in Venezuela have a second system of classification based on a supernatural/religious realm (Royero 1993). During our study, Piaroa interviewees did not reference this mythological classification system.

Although we obtained relevant information, our results could be influenced by the loss of traditional knowledge caused by contact with recently established cultures in the region, as Cassú (2015) reports for other areas of the Amazon. This contact with other cultures generated recent changes due to human displacement, the strong influence of the establishment of churches, and new job and economic relationships (Rosado-Cárdenas 2014). It is possible that the interest in the more detailed identification system no longer exists, therefore a more generalized system for grouping fishes already known is used. Another plausible explanation for the loss of fish knowledge is the recent focus on extracting only species of ornamental interest. Species not traded for aquarium purposes lack commercial value and therefore have diminished in cultural importance. With the collapse of the extraction economy in the early 1960s, little by little, agricultural products were sold in urban centers, which produced more significant interaction with non-indigenous societies. Furthermore, during the following decades, efforts were focused on seeking medical care and formal education, and changes in social dynamics and combined knowledge among the people who inhabit or were recently established in the Matavén Forest (de la Hoz 2019).

The use of morphological characteristics to classify fish is also known from various fishing communities in Brazil (Costa-Neto et al. 2002; Mourão and Nordi 2002). In our study, this trend was evidenced in the use of names such as *Bájuto* (Sikuani), *Zebe* (Piapoco), *Mẹrẹćha* (Piaroa), and *Pi* (Puinave) for similar species within different families of the order Characiformes. Thus, these ethnic names are used for different species that have similar morphological characteristics. This shows that the classification systems categorize the fish approximately as they are organized at the level of taxonomic order and family (Nelson 2006).

The fishing methods employed by different ethnic groups give an idea of the influence other cultures have had over the development of fishing in the communities of the Matavén Forest. These cultures no longer use their traditional fishing materials but instead utilize synthetic materials to create most of their equipment, which only became available recently through an external agent of these ethnic groups. This indicates changes in many daily habits (Royero et al. 1999). For example, currently, these groups do not use *barbasco* (poisonous chemical compounds derived from plants) for fishing, as opposed to most indigenous communities that inhabit the Orinoco and Amazon regions (Royero 1993, 1996).

Neotropical freshwater fishes have well-known ecological affinities (Carvalho et al. 2007; Crampton 2011; Bogotá-Gregory et al. 2020). Our results showed that these ecological distributions are recognized for several species by the Piapoco and the Sikuani. Linking environmental characteristics to Amazonian fishes in Colombia is poorly documented. The recognition of indigenous traditional knowledge is fundamental for the conservation of protected areas such as the Matavén Forest.

The principal connection between humans and the fish that live in the study area is based on the use of fishing resources, as opposed to religious or supernatural associations. In many cases, communities depend on fishing as their only source of income, mainly when fishing activities are for ornamental purposes. However, fish are a substantial source of animal protein for indigenous people and therefore vital to their nutrition. This suggests that this natural resource is the most heavily harvested for food, mainly in the dry season, by the communities in this region of Colombia and Venezuela (León-Mata et al. 2006).

The livelihoods of the indigenous communities in the Matavén Forest rely heavily on the environment. The way the groups use natural resources varies depending on the ethnicity and location of the community in the upper, middle, or lower Matavén River basin (Maldonado-Ocampo et al. 2009; Prieto-Piraquive 2012). The Piapoco and Sikuani are sustained by well-developed horticulture and hunting, and the Puinave by slash-and-burn agriculture, supplemented by hunting and gathering (Sanchez 2007). The Piaroa also supplement horticulture with hunting and gathering (Freire 2004). In general, these ethnic groups are forest farmers, but these activities are complemented by fishing (Freire 2004; Sánchez 2007) as documented herein. The fact that we recorded significant differences in the number of fish names among the ethnicities, could be related to the relative difference in the importance of the fishing activities among them. The fishing activities are based on the need and proximity of aquatic habitats. Depending on the water level, the river is the sole source of animal protein for these human

populations (McGoodwin 2002; Maldonado-Ocampo et al. 2009; Agudelo Córdoba 2015).

Future efforts in the Matavén Forest Guard and other areas under the management of native communities should be focused on securing a holistic understanding of their natural resources. Interdisciplinary approaches including local communities that directly depend on these resources are scarce. Integrating such disciplines can provide better guidelines for improving fisheries management and preserving biodiversity.

CONCLUSIONS

The Piapoco, Piaroa, Puinave, and Sikuani ethnic groups which inhabit the Matavén Forest have their perception, at times detailed, of fish groups, their distributions in aquatic habitats (i.e., rivers, streams, and lagoons) and uses. Network analyses provided evidence of consistency between the names given by the ethnic groups and the scientific classification system. The results revealed, in some instances, traditional binomial classification systems in which the organisms are grouped at family and genus levels and categorization is dependent on distribution according to habitat. Our indigenous collaborators did not provide sociocultural or mythological information related to fishes. Changes derived from the influence of external cultures and religions may induce forgetfulness of collective knowledge. The relationships between fauna and indigenous communities involve different contexts that involve various disciplines in social, behavioral, applied, and environmental sciences. Compilation and analysis of the traditional knowledge regarding the use and perception of natural resources is of great relevance, especially considering the significant threats that the Amazon faces. The perception of indigenous communities regarding fish is crucial to fill information gaps and inform management and conservation purposes from a more holistic perspective.

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DATA AVAILABILITY

All the fish material collected, on which the present study is based, was deposited in the freshwater fish collection of the Alexander von Humboldt Biological Resources Research Institute (IAvHP) located in Villa de Leyva, Boyacá, Colombia. All the taxonomic and field information associated with the fish specimens is available online at: http://i2d.humboldt.org.co/ceiba/resource.do?r=peces_coleccion_instituto_humboldt.

SUPPLEMENTARY MATERIAL

Bogotá Gregory *et al*. Ethnoichthyology of the Piapoco, Piaroa, Puinave and Sikuani ethnic groups inhabitants of the Matavén Forest (Vichada, Colombia)

Table S1. Localities and their geographical coordinates where fish were sampled for the biodiversity characterization of the Matavén Forest (Maldonado-Ocampo et al. 2009) in the lower Matavén River, Vichada, Colombia (see Figure 1 for sampling site distribution).

Site code	Locality	Latitude	Longitude
ICT 1.1	Cajaro Stream	4°33'9.3"N	68°7'7.2"W
ICT 1.2	Lake at the Cajaro Stream	4°33'7.6"N	68°6'51.5"W
ICT 1.3	Cajaro Stream in front the camp	4°33'44"N	68°10'13"W
ICT 1.4	Lake at the Cajaro Stream	4°32'9.6"N	68°5'13.7"W
ICT 1.5	Cajaro Stream, 2 hr. upstream the camp	4°34'1.3"N	68°11'3"W
ICT 1.6	Cajaro Stream, 30 min. upstream from its confluence with the Matavén River	4°31'57.4"N	68°3'51.5"W
ICT 1.7	Lake at Cajaro Stream, 30 min. upstream from its confluence with the Matavén River	4°31'32.9"N	68°3'25.1"W
ICT 1.8	Confluence of the Cajaro Stream with Matavén River	4°30'36.2"N	68°3'27.5"W
ICT 2.1	Lake at the Matavén River	4°29'44.2"N	68°6'45.8"W
ICT 2.2	Matavén River	4°29'57.5"N	68°4'35.9"W
ICT 2.3	Lake at the Matavén River, upstream of the Cajaro Stream confluence	4°30'33.7"N	68°3'42.3"W
ICT 2.4	Lake at the Matavén River, 90 min. downstream of the Cajaro Stream confluence	4°30'41.9"N	67°58'55"W
ICT 2.5	Lake at the Matavén River, 45 min. downstream of the Cajaro Stream confluence		
ICT 2.6	Confluence of the Matavén River and Orinoco River	4°32'5.4"N	67°52'8.5"W
ICT 2.7	Lake at the Matavén River, 1 hr. upstream the confluence with the Orinoco River	4°31'41.6"N	67°56'55.5"W
ICT 2.8	Beach at the Matavén River	4°29'22"N	68°0'26"W
ICT 2.9	Lake at the Matavén River, 500 m upstream the confluence with the Orinoco River	4°32'10.1"N	67°53'9.5"W
ICT 3.1	Fruta Stream, 1 hr. upstream from Sarrapia	4°26'28.8"N	67°55'28.1"W
ICT 3.2	Fruta Stream, 30 min. upstream from Sarrapia	4°27'12.8"N	67°54'41.6"W
ICT 3.3	Fruta Stream, 20 min. upstream from Sarrapia	4°27'13.2"N	67°55'1.2"W
ICT 3.4	Fruta Stream, 20 min. upstream from Sarrapia	4°28'7.1"N	67°53'53.3"W
ICT 3.5	Confluence of the Fruta Stream with Matavén River	4°31'46.2"N	67°53'1.3"W
ICT 3.6	Fruta Stream	4°31'3.8"N	67°53'0"W
ICT 3.7	Confluence of the Negro Stream and the Fruta Stream	4°30'30.8"N	67°52'33.1"W
ICT 3.8	Negro Stream, 500 m East from Sarrapia	4°29'25"N	67°52'19"W
ICT 4.1	Confluence of the Orinoco River with the Matavén River	4°32'16.5"N	67°51'53.6"W
ICT 4.2	Orinoco River, downstream the confluence with the Matavén River	4°36'48.9"N	67°51'9.3"W
ICT 4.3	Rocky Island at the Orinoco River, downstream the confluence with Matavén River	4°36'25.9"N	67°50'59"W
ICT 4.4	Beach at the Orinoco River, downstream the confluence with the Matavén River	4°35'36.8"N	67°51'10.6"W
ICT 4.5	Lake at rocky formation, approximately 1 km from the Orinoco River	4°36'33"N	67°51'52"W
ICT 4.6	Stream affluent of the Orinoco River at the Mono Hill	4°36'10"N	67°51'20"W