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Fish fauna of the trans-Andean Tumbes river basin in northern Peru

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Abstract. To update the knowledge of the ichthyofauna of the Tumbes River basin, we provide a list of species. We report 47 species of fishes, grouped into 23 families and 11 orders. Characiformes was the most diverse order with 12 species (25.5% of the total richness), followed by Carangiformes with eight species (17%). In our study, two species are newly reported from this river basin: *Pseudophallus starksii* (Jordan & Culver, 1895) and *Evorthodus minutus* Meek & Hildebrand 1928. According to salinity tolerance, the ichthyofauna is composed of 20 primary, 14 secondary, and 13 peripheral species. Despite having the highest diversity of fish on the Peruvian Pacific slope, the Tumbes river basin is one of the most polluted coastal drainages. This study compiles information on the ichthyofauna of the entire basin, increases the known diversity of freshwater fish from trans-Andean drainages in Peru, and can be used in the management and conservation of the Tumbes River.

Keywords. Coastal rivers, endemism, ichthyofauna, Pacific slope basins, Peruvian coastal drainages

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Introduction

The Neotropical region is characterized by intertwined geological and climatic histories that shaped the hydrographic basins through the movement of tectonic plates, the capture of headwaters, and orogenic processes such as the uplift of the Andes; these events influenced the formation of the current trans-Andean and cis-Andean patterns of species distribution during the Miocene (Hoorn et al. 2010; Albert and Reis 2011). Of these regions, the trans-Andean zone has long been recognized as a highly endemic and faunistically distinct province of Neotropical freshwater fishes (Eigenmann 1923; Eigenmann and Allen 1942; Rodríguez-Olarte et al. 2011). The fish fauna of trans-Andean river basins in northwestern South America is ancient, diverse, and derives from its geographic and historical proximity to the megadiverse ichthyofaunas of the cis-Andean Orinoco and Amazon basins (Albert et al. 2006; Chakrabarty and Albert 2011).

The trans-Andean region includes continental rivers that flow to the Pacific Ocean; these basins are small with seasonal hydrography (Ortega and Hidalgo 2008). According to Rodríguez-Olarte et al. (2011), these Pacific slope basins are influenced by aridity. In Peru, this region is represented by 62 hydrographic basins (ANA 2013; Ortega et al. 2015). The ichthyofauna of this region has been scarcely studied. Among the rivers in these basins, the Tumbes River is the most representative, presenting a considerable volume of water, with average annual discharges of 118.1 m^3/s (Núñez and Zegarra 2006). According to Ortega et al. (2012), the fish fauna of the Tumbes river basin is the most diverse of the trans-Andean Peruvian rivers, with 33 species, including endemic taxa (Géry and de Rham 1981; Ortega et al. 2012). However, studies on the ichthyofauna in this basin are scarce: Chirichigno (1963) studied the ichthyofauna of the estuaries and lower reaches of the rivers of the department of Tumbes; Mac Donald (1995) listed 18 species in this basin; similarly, Chang (1995) documented 26 species in her unpublished undergraduate thesis (vouchers deposited in MUSM collection); and Luque (2008) reported 36 species from continental aquatic systems of the department of Tumbes in a technical report. However, there is no updated published information on the current diversity of species in this basin.

The Puyango–Tumbes River rises in the Chilla and Cerro Negro Mountain Ranges (El Oro and Loja Provinces) in Ecuador, where numerous tributaries flow to the Tumbes region in Peru (Núñez and Zegarra 2006). This river basin is an important source of water for both countries; however, it is severely contaminated by artisanal gold mining in the Portovelo and Zaruma regions (Ecuador) (Clark and Hakim 2014; Gonçalves et al. 2017; Marshall et al. 2018, 2020) and by domestic wastewater, agricultural effluents, and derivatives of shrimp aquaculture in Peru (Clark and Hakim 2014; PROYECTO GIRHT 2020). This situation places human populations at serious risk, as well as the aquatic fauna that depend directly on the ecological integrity of the river.

The Tumbes River is of major importance for the fish community, as evidenced by its diversity, endemic taxa (Géry and de Rham 1981; Vari et al. 2005), and the presence of recently described species (Lujan et al. 2015). However, this fauna is threatened by diverse anthropogenic activities. In addition, the lack of information on species richness and the conservation status of its component species makes the assessment of this fauna difficult. At this time, scientific data must be generated as a decision-making tool for resource management and conservation actions. Therefore, the objective of this study is to determine the composition of the fish community in the Tumbes River by considering primary information, including the examination of specimens, and a bibliographic review. We also describe the main threats the fish fauna faces.

Study Area

The basin of the Puyango–Tumbes River is shared between Ecuador and Peru. Its headwaters are in the Chilla and Cerro Negro Mountains in Ecuador at 3500 m a.s.l. The main tributaries of this river system are the Pindo, Calera, and Amarillo rivers, and from its confluence with the Yaguachi River, it is called Puyango (Núñez and Zegarra 2006; Mora et al. 2016; Metzger 2019). After its union with the Cazaderos stream, this river takes the name of Tumbes River, forming a delta where it enters the Pacific Ocean (Núñez and Zegarra 2006; Mora et al. 2016). The length of its main channel is 230 km from its source to its mouth, with 94 km flowing through Peruvian territory (ANA 2015).

In Peru, the Tumbes river basin covers the districts of San Juan de la Virgen, Pampas de Hospital, San Jacinto, Corrales, and Tumbes (Núñez and Zegarra 2006) and passes through two protected areas: Cerros de Amotape National Park and Tumbes National Reserve (Figs. 1, 2). It also goes through the dry tropical forests of the Equatorial Pacific, one of the most threatened terrestrial biomes (Espinosa et al. 2012). In addition, this river transports an average of 1.56 hm^3/year of sediments (ANA 2015), serving as the primary supply of sediments for the Tumbes mangroves. Its main tributaries on its right bank are Las Peñas, Angostura, Guanábano, and Garzas streams, and on its left bank, La Jardina, Vaquería, Higuerón, and Ucumares streams; the most important of these tributaries is Cazaderos stream (Prado 2019).

The climate in the study area is subtropical, varying from a desert climate along the entire coastal strip to a semi-arid climate in the mountains; the climate is strongly influenced by the intertropical convergence zone (ZCIT) and the El Niño phenomenon (Ágreda et al. 2003). The Tumbes River presents a permanent water regime, with monthly average flows that fluctuated between 7.7 m^3/s and 1244.2 m^3/s for the 1965–2004 period (ANA 2015). The average annual temperature is 24.85 °C, and the average annual rainfall is 300 mm on the low side, 1150 mm in the middle region, and 2600 mm in the mountains (Núñez and Zegarra 2006).

Methods

The diversity of the ichthyofauna was assessed through the examination of specimens deposited in the ichthyological collection of the Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos (MUSM) and the fish collection of the Laboratorio Costero de Tumbes, Instituto del Mar del Perú (LCT-IMARPE). Secondary information from the literature was also considered.

Specimen identification was corroborated by checking specialized taxonomic keys, such as Géry (1977), Kullander (1986), and Hulen et al. (2005), as well as original descriptions. Chirichigno and Vélez's (1998) manual of marine fish of Peru was used for marine species. The valid scientific names, synonyms, and the current systematic classification was confirmed according to the nomenclature and classification of Thomaz et al. (2015), Fricke et al. (2022a, 2022b), and van der Laan et al. (2022). The map was designed using ArcGIS v. 10.2.2 (ESRI 2014). The category of threat for each species was established according to IUCN (2022). Species listed as

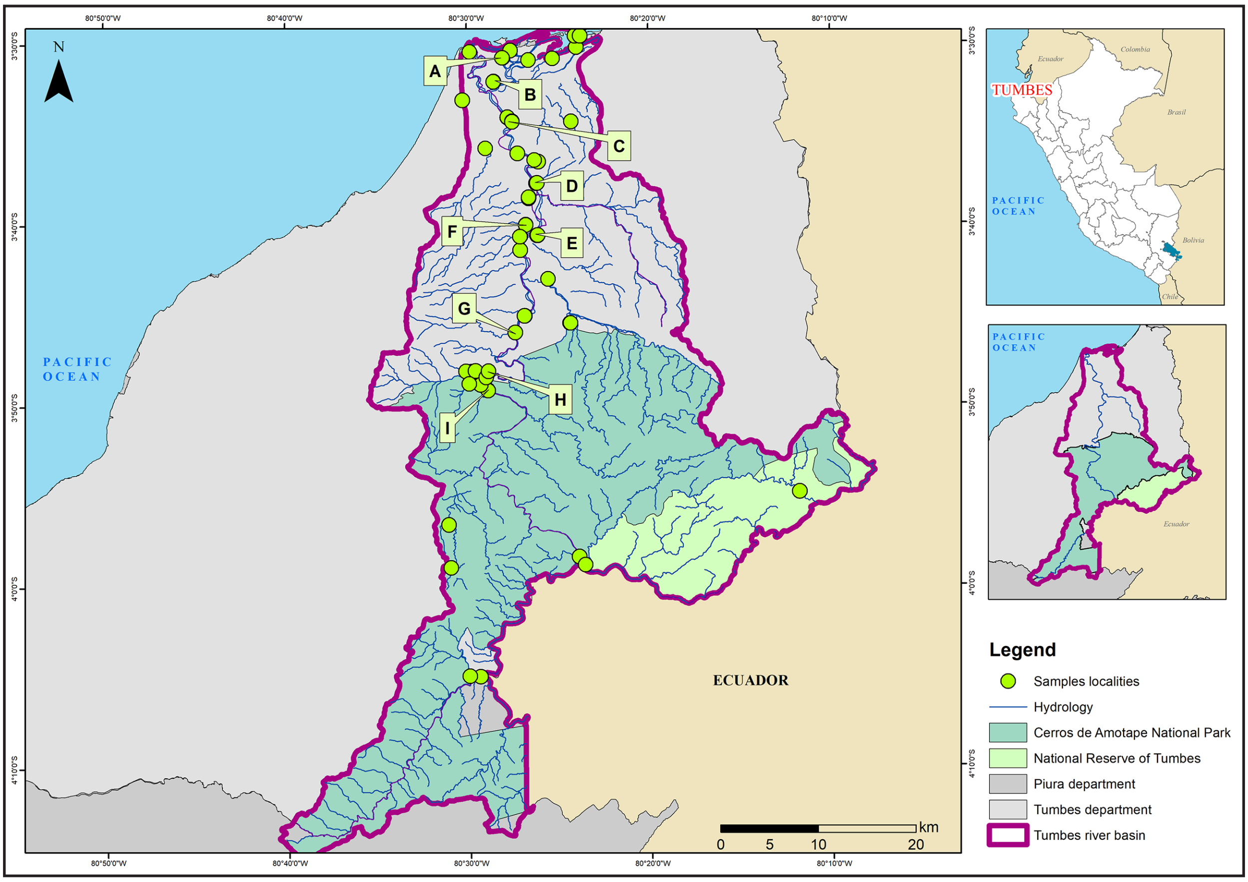

Figure 1. Sampling sites in the Tumbes river basin.

aff. (*affinis* in Latin) are similar, but clearly distinct, to the species to which they are referred.

Coastal river basins have high species richness, where fish species coexist and are classified as primary or secondary freshwater species, or as peripheral species based on salt tolerance (Myers 1949; Blanco-Libreros and Carbajal-Quintero 2015; Jiménez-Prado et al. 2015). Primary species are physiologically intolerant to salinity, whereas secondary species are found largely in estuaries and enter freshwater areas. Secondary species also include freshwater species that are occasionally found in brackish and/or salty coastal habitats, and peripheral species are marine taxa that can enter estuaries and even rivers (Lasso et al. 2004; Jiménez-Prado et al. 2015). Using these definitions, each Tumbes River species was assigned either as primary, secondary, or peripheral. Samples were collected throughout the Tumbes river basin (Fig. 1) in different aquatic environments (Fig. 2).

Results

Richness and composition. The fish fauna of the Tumbes River is composed of 47 species, distributed in 35 genera, 23 families, and 11 orders (Table 1). The most diverse order is Characiformes with 12 species (25.5% of total richness), followed by Carangiformes with eight species (17%), and Gobiiformes and Siluriformes with seven and six species, respectively (27.7% combined). Cichliformes and Acanthuriformes present four and three species, respectively (14.8% combined). The less diverse orders were Mugiliformes and Syngnathiformes with two species each (8.6% of total richness combined), and Clupeiformes, Cyprinodontiformes, and Gymnotiformes with one species each (6.4% combined).

Of the 47 species reported in this study, 42 taxa (89.4%) were taxonomically identified to species, and we use the term "aff." (*affinis*) for five (10.6%) due to their great resemblance to related species. These taxa need more taxonomic study to confirm their identity.

The most diverse families are Achiridae with five species, while Bryconidae, Characidae, Cichlidae, and Gobiidae are represented by four species each. The most representative freshwater families were Bryconidae, Characidae, and Cichlidae; while the most important families of the marine/estuarine group are Achiridae, Gobiidae, Eleotridae, Mugilidae, and Gerreidae.

Pseudophallus starksii and *Evorthodus minutus* were recorded for the first time from the Tumbes river basin. *Pseudophallus starksii* occurs in North, Central, and South America, in Pacific coastal drainages from San José del Cabo, Baja California, Mexico to Río Santa Rosa, Ecuador (Jiménez-Prado et al. 2015; Fricke et al. 2022a). *Evorthodus minutus* occurs from the southern Gulf of California to southern Ecuador in marine, brackish, and freshwater (Valencia-Méndez et al. 2019).

We found two exotic species, both belonging to the family Cichlidae: *Oreochromis aureus* and *Oreochromis* aff. *aureus*. Based on the salinity tolerances, 20 species

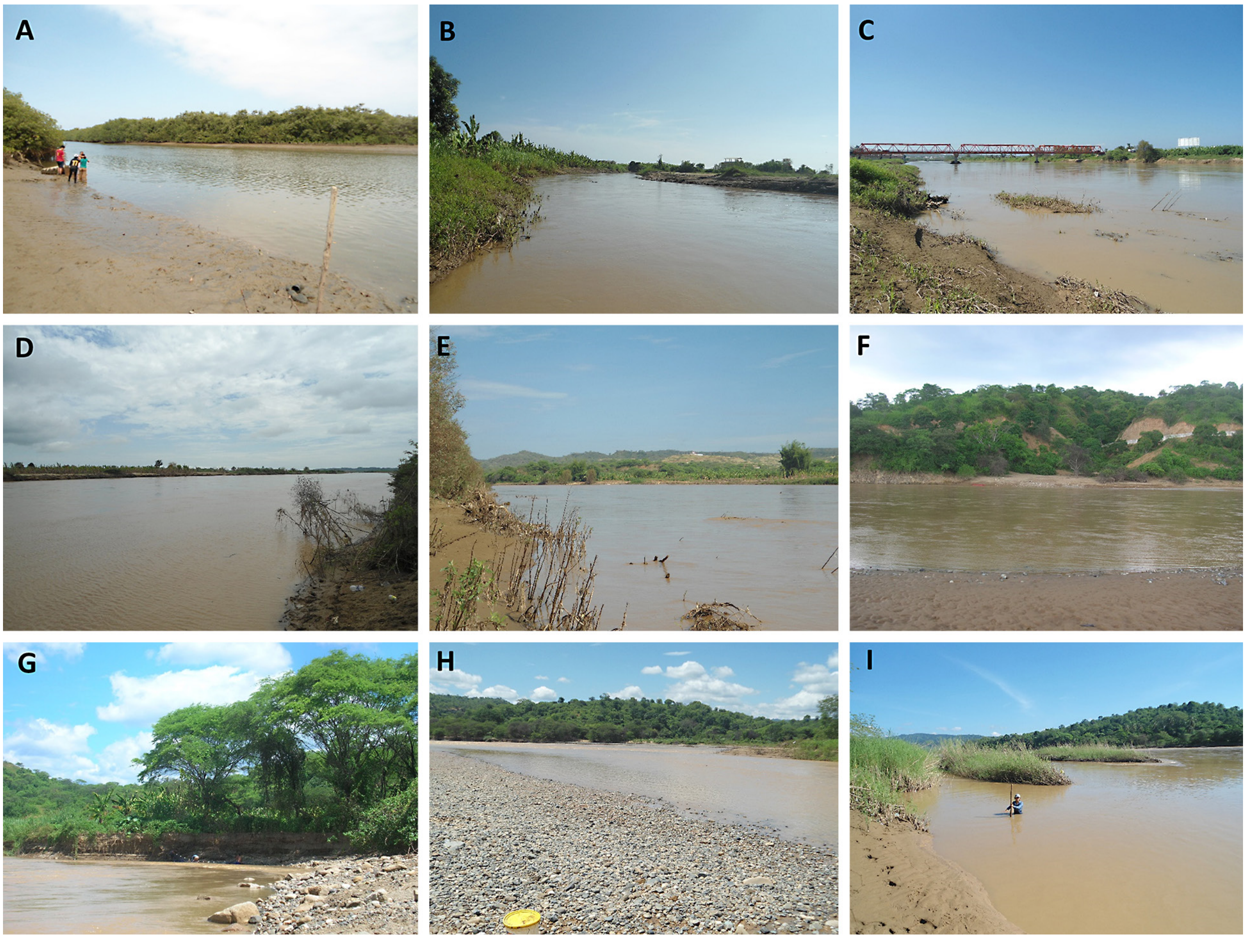

Figure 2. Freshwater environments of the Tumbes river basin. **A.** Estero. **B.** Langostinera. **C.** Tumbes River bridge. **D.** San Juan de la Virgen. **E.** Caserío Santa María, Pampas de Hospital. **F.** Bocatoma La Peña. **G.** Tumbes River at Honda Higuerón stream. **H.** Rica Playa**. I.** Tumbes River at Honda stream.

Table 1. Fish fauna recorded for the Tumbes river basin. Condition: E = exotic, P = primary, Pe = peripheral, S = secondary. IUCN status: LC = Least Concern, NT = Near Threatened, VU = Vulnerable, NE = non-evaluated. (*) = New record. Fish collections: MUSM and LCT-IMARPE.

ORDER, family, and species (number of species in parentheses)	Condition	Local common name	Museum voucher or reference	IUCN status
CLUPEIFORMES (1)				
Engraulidae (1)				
Lycengraulis poeyi (Kner 1863)	Pe	—	MUSM 50270	LC
CHARACIFORMES (12)				
Erythrinidae (1)				
Hoplias microlepis (Günther, 1864)	P	guanchiche	Chirichigno 1963; Ortega and Vari 1986; Luque 2007; Mattox et al. 2014	LC
Parodontidae (1)				
Saccodon wagneri Kner, 1863	P	cholito	MUSM 6536, MUSM 50291, MUSM 66196	LC
Curimatidae (1)				
Pseudocurimata troschelii (Günther, 1860)	P	dica	MUSM 9168	LC
Lebiasinidae (1)				
Lebiasina bimaculata Valenciennes, 1847	P	charcoca, guavina	MUSM 0348, MUSM 3265, MUSM 3268, MUSM 3287, MUSM 5835, MUSM 50241, MUSM 50245	LC
Bryconidae (4)				
Brycon alburnus (Günther, 1860)	P	sábalo	MUSM 5513, MUSM 5517, MUSM 5518, MUSM 41150	NT
Brycon atrocaudatus (Kner, 1860)	P	cascafe	MUSM 2603, MUSM 3272, MUSM 5519, MUSM 5834, MUSM 41147, MUSM 50238, MUSM 50250, MUSM 50277, MUSM 66201	LC
Brycon dentex Günther, 1860	P	cascafe, sábalo	MUSM 2576, MUSM 2577, MUSM 2601, MUSM 3161, MUSM 3169, MUSM 3275, MUSM 3302, MUSM 5730, MUSM 5827, MUSM 11554, MUSM 41152, MUSM 50228, MUSM 50229, MUSM 50243, MUSM 50271, MUSM 50278, MUSM 50288, MUSM 50298	LC

ORDER, family, and species (number of species in parentheses)	Condition	Local common name	Museum voucher or reference	IUCN status
Chilobrycon deuterodon Géry & de Rham, 1981	P	sábalo	MUSM 0026, MUSM 0035, MUSM 2158, MUSM 2292, MUSM 2943, MUSM 3166, MUSM 3170, MUSM 3257, MUSM 3262, MUSM 3276, MUSM 3288, MUSM 5511, MUSM 5731, MUSM 5833, MUSM 6652, MUSM 12899, MUSM 40340, MUSM 40343, MUSM 41149, MUSM 41153, MUSM 50208, MUSM 50219, MUSM 50239, MUSM 50244, MUSM 50252, MUSM 50259, MUSM 50279, MUSM 50289, MUSM 50297, MUSM 50299, MUSM 61198	NT
Characidae (4)				
Eretmobrycon brevirostris (Günther, 1860)	P	mojarrita	MUSM 40341, MUSM 40345, MUSM 40351, MUSM 50296, MUSM 66197 MUSM 66202	LC
Eretmobrycon festae (Boulenger, 1898)	P	mojarra	MUSM 3160, MUSM 3291, MUSM 3292, MUSM 3301, MUSM 5733, MUSM 40347, MUSM 50206, MUSM 50258, MUSM 50276	LC
Eretmobrycon peruanus (Müller & Troschel, 1845)	P	mojarrita	MUSM 2578, MUSM 3450, MUSM 5826, MUSM 5839, MUSM 5843, MUSM 11540, MUSM 11552	LC
Rhoadsia altipinna Fowler, 1911	P	sardina	MUSM 0027, MUSM 5828, MUSM 11562, MUSM 50249	LC
GYMNOTIFORMES (1)				
Sternopygidae (1)				
Sternopygus aff. *arenatus*	P	cola de rata, vaca	MUSM 50222	NE
SILURIFORMES (6)				
Trichomycteridae (2)				
Trichomycterus piurae (Eigenmann, 1922)	P	bagre, vaca, life	MUSM 6569, MUSM 66203	NE
Trichomycterus aff. *dispar*	P	bagre, vaca, life	MUSM 11564	NE
Loricariidae (1)				
Chaetostoma bifurcum Lujan, Meza-Vargas, Astudillo-Clavijo, Barriga Salazar & López-Fernández, 2015	P	raspa	MUSM 3267, MUSM 50293	NE
Cetopsidae (1)				
Paracetopsis atahualpa Vari, Ferraris & de Pinna, 2005	P	bagre ballena, ciego	MUSM 50231, MUSM 50290	VU
Heptapteridae (1)				
Pimelodella elongata (Günther, 1860)	P	bagre, cunshi, pica oreja	MUSM 3277, MUSM 3285, MUSM 3290, MUSM 11558, MUSM 50220, MUSM 50230, MUSM 50253, MUSM 50260, MUSM 50274, MUSM 50284, MUSM 50292	LC
Ariidae (1)				
Ariopsis seemanni (Günther 1864)	Pe	bagre	LCT-IMARPE 212	LC
SYNGNATHIFORMES (2)				
Syngnathidae (2)				
Pseudophallus starksii (Jordan & Culver, 1895) *	S	—	MUSM 50233	LC
Syngnathus acicularis Jenyns, 1842	S	—	Chang 1995	LC
GOBIIFORMES (7)				
Eleotridae (3)				
Dormitator latifrons (Richardson, 1844)	S	chalaco, chame, menengue	MUSM 50203, MUSM 50212, LCT-IMARPE 908	LC
Eleotris picta Kner, 1863	S	vieja, ñalojo, guavina durmiente	LCT-IMARPE 993	LC
Gobiomorus maculatus (Günther, 1859)	S	camotillo, guavina	MUSM 2574, MUSM 2584, MUSM 3172, MUSM 3284, MUSM 50213, MUSM 50223, MUSM 50235, MUSM 50267, MUSM 50285, MUSM 50295	LC
Gobiidae (4)				
Awaous transandeanus (Günther, 1861)	S	camotillo, guavina	MUSM 2575, MUSM 2945, LCT-IMARPE 847	LC
Ctenogobius sagittula (Günther, 1862)	S	gobio	LCT-IMARPE 433	LC
Ctenogobius aff. *sagittula*	S	—	MUSM 50204	NE
Evorthodus minutus Meek & Hildebrand, 1928 *	S	—	MUSM 50263	LC
CARANGIFORMES (8)				
Centropomidae (2)				
Centropomus nigrescens Günther, 1864	Pe	robalo	LCT-IMARPE 990	LC
Centropomus unionensis Bocourt ,1868	Pe	robalo	MUSM 50262, LCT-IMARPE 441	LC
Cyclopsettidae (1)				
Citharichthys gilberti Jenkins & Evermann, 1889	Pe	lenguado	LCT-IMARPE 994, LCT-IMARPE 1412	LC
Achiridae (5)				
Achirus mazatlanus (Steindachner, 1869)	Pe	lenguado redondo	MUSM 3325, MUSM 3326, MUSM 50224	LC
Achirus klunzingeri (Steindachner, 1880)	Pe	lenguado	LCT-IMARPE 1751	LC
Achirus scutum (Günther ,1862)	Pe	lenguado	Chirichigno 1963	LC
Trinectes fluviatilis (Meek & Hildebrand, 1928)	Pe	lenguado	LCT-IMARPE 1032	LC
Trinectes fonsecensis (Günther, 1862)	Pe	lenguado rayado	LCT-IMARPE 1396	LC
CICHLIFORMES (4)				
Cichlidae (4)				
Andinoacara rivulatus (Günther, 1860)	P	vieja, mojarra, green terror	MUSM 1051, MUSM 1089, MUSM 1235, MUSM 2590, MUSM 3159, MUSM 3263, MUSM 3280, MUSM 3324, MUSM 5849, MUSM 6525, MUSM 11553, MUSM 50281, MUSM 50294	LC
Mesoheros festae (Boulenger, 1899)	P	vieja, mojarra	MUSM 3327, MUSM 5831	NE

ORDER, family, and species (number of species in parentheses)	Condition	Local common name	Museum voucher or reference	IUCN status
Oreochromis aureus (Steindachner, 1864)	S, E	tilapia	MUSM 3320, MUSM 5512, MUSM 5832, MUSM 40350, MUSM 50211	NE
Oreochromis aff. *aureus*	S, E	tilapia	MUSM 47439	NE
CYPRINODONTIFORMES (1)				
Poeciliidae (1)				
Poecilia aff. *gillii*	S	gupi, millionaria	MUSM 1844, MUSM 3286, MUSM 3300, MUSM 3323, MUSM 22218, MUSM 40344, MUSM 40348, MUSM 50200, MUSM 50210, MUSM 50254, MUSM 50261, MUSM 50275, MUSM 50280	NE
MUGILIFORMES (2)				
Mugilidae (2)				
Mugil cephalus Linnaeus, 1758	S	lisa	LCT-IMARPE 1332	LC
Mugil setosus Gilbert, 1892	S	lisa	MUSM 3171, MUSM 50265, LCT-IMARPE 440	LC
ACANTHURIFORMES (3)				
Gerreidae (3)				
Eucinostomus currani Zahuranec, 1980	Pe	mojarra	LCT-IMARPE 1367	LC
Eugerres brevimanus (Günther, 1864)	Pe	mojarra, periche	MUSM 3321, LCT-IMARPE 1738, LCT-IMARPE 2056	LC
Diapterus peruvianus (Cuvier, 1830)	Pe	mojarra, periche	LCT-IMARPE 1354	LC

are primary freshwater taxa (42.6% of total richness), 14 are secondary taxa (29.7% of total species), and 13 are peripheral taxa (27.7% of total species) (Table 1).

Endemic species. Two endemic fish species were found: *Chilobrycon deuterodon* and *Paracetopsis atahualpa*. Furthermore, we believe that *Sternopygus* aff. *arenatus*, a probable new species, is only distributed in the Tumbes River. In addition, 14 species regionally endemic to northern Peru and southwestern Ecuador are reported here: *Andinoacara rivulatus*, *Mesoheros festae*, *Saccodon wagneri*, *Pseudocurimata troschelii*, *Eretmobrycon brevirostris*, *Eretmobrycon festae*, *Rhoadsia altipinna*, *Hoplias microlepis*, *Brycon alburnus*, *Brycon atrocaudatus*, *Brycon dentex*, *Pimelodella elongata*, *Chaestostoma bifurcum*, and *Trichomycterus piurae*.

Conservation status. Most of the ichthyofauna reported from the Tumbes river basin have been evaluated according to the IUCN criteria. Among them, *Paracetopsis atahualpa*, is Vulnerable (Lyons 2021b), while *Brycon alburnus* and *Chilobrycon deuterodon* are Near Threatened (Arguello 2016; Lyons 2021a). Thirty-five species are in the Least Concern category (Table 1). Nine species have not yet been evaluated by the IUCN: *Sternopygus* aff. *arenatus*, *Trichomycterus piurae*, *Trichomycterus* aff. *dispar*, *Chaetostoma bifurcum*, *Ctenogobius* aff. *sagittula*, *Mesoheros festae*, *Oreochromis aureus*, *Oreochromis* aff. *aureus*, and *Poecilia* aff. *gillii*.

Order Clupeiformes
Family Engraulidae

***Lycengraulis poeyi* (Kner, 1863)**

Material examined. PERU – Tumbes • Tumbes River; 03°34′8″S, 080°27′46″W; 30.IX.2012; S. Valenzuela et al. leg.; MUSM 50270 (1 spec., 28 mm).

Identification. Upper jaw protruding or projecting; mouth large, subinferior; maxilla very long, beyond the rear edge of the eye. Elongate teeth on jaws, 16–18 gill rakers on upper branch and 20–23 on lower branch of first gill arch; pelvic fin inserted almost mid-base of pectoral fin and vertical line descending from the origin of dorsal fin (Chirichigno and Vélez 1998).

Order Characiformes
Family Parodontidae

***Saccodon wagneri* Kner, 1863**
Figure 3A

Material examined. PERU – Tumbes • Bosque Nacional de Tumbes; 03°59′S, 080°31′W; 8.XII.1993; F. Chang leg.; MUSM 6536 (3 spec., 84–104 mm) • Rica Playa, Tumbes River, Rica Playa; 03°48′28″S, 080°29′00″W; 03.X.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50291 (1spec., 91 mm) • Pampas de Hospital, Tumbes River; 03°48′18″S, 080°29′55″W; 18.VIII.2018; N. Lujan et al. leg.; MUSM 66196 (1 spec., 112.81 mm).

Identification. Relatively small head and lower mouth with snout extended anteriorly over mouth. Complete lateral line with 39–41 scales; pectoral fins ii, 15–16 rays; dorsal fin ii, 9 rays; anal fin iii, 8 rays (Géry 1977). Moniliform lateral spots, juveniles tend to have a single stripe, but usually extends to the tail fin; tail fin pale without spots; adipose fin with a black spot on the tip (Jiménez-Prado et al. 2015).

Family Curimatidae

***Pseudocurimata troschelii* (Günther, 1860)**
Figure 3B

Material examined. PERU – Tumbes • Tumbes River; [03°48′28″S, 080°29′57″W]; 01.VIII.1989; Universidad de Tumbes leg.; MUSM 9168 (2 spec., 85 and 92 mm).

Identification. Body moderately elongated, somewhat compressed. Dorsal profile of head straight or slightly concave. Absence of discrete dark dots aligned in longitudinal rows on scales along lateral and dorsolateral surfaces of body; dark spot on medial lateral surface of caudal peduncle in the shape of a moderately elongated horizontally triangle; no discrete spot at the base of median caudal fin rays. Complete lateral line with 39–47 scales. Pored lateral line scales from supracleithrum to

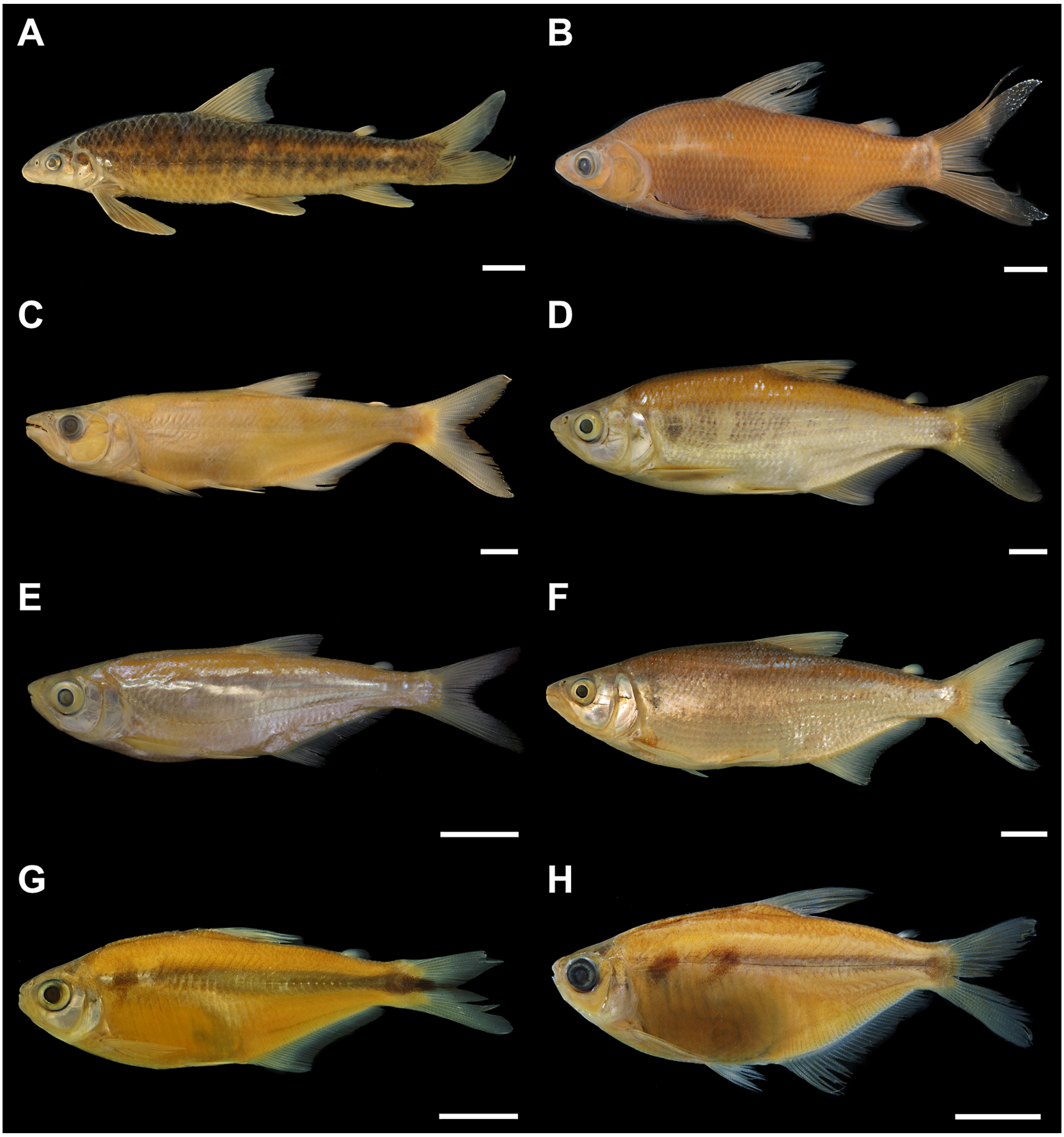

Figure 3. Fish species from the Tumbes River. **A.** *Saccodon wagneri* MUSM 66196, 112.81 mm SL. **B.** *Pseudocurimata troschelii* MUSM 9168, 92 mm. **C.** *Brycon alburnus* MUSM 5513, 114 mm SL. **D.** *Brycon atrocaudatus* MUSM 50238, 114.55 mm SL. **E.** *Brycon dentex* MUSM 50298, 58.74 mm SL. **F.** *Chilobrycon deuterodon* MUSM 50244, 97.79 mm SL. **G.** *Eretmobrycon brevirostris* MUSM 40345, 57.58 mm SL. **H.** *Eretmobrycon festae* MUSM 3160, 55 mm. Scale bars = 10 mm.

hypural joint 42–47. Dorsal fin rays ii, 9 or 10, or iii, 9; anal fin rays ii, 7 or iii, 7; branched pectoral fin rays 13–15; pelvic fin rays i, 8 (Vari 1989).

Family Lebiasinidae

Lebiasina bimaculata **Valenciennes, 1847**
Figure 4C

Material examined. PERU – Tumbes • Tumbes River; [03°48′28″S, 080°29′57″W]; 11.XI.1978; W. Gutiérrez leg.; MUSM 0348 (3 spec., 85–87 mm) • Quebrada Honda; 03°49′12″S, 080°28′54″W; 4.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3265 (1 spec., 65 mm) • Quebrada Honda; 03°49′12″S, 080°28′54″W; 4.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3268 (1 spec., 62 mm) • El Huaco stream; 03°48′08″S, 080°30′07″W; 3.VII.1992; F. Chang, C. Palma, and F. Rodriguez et al. leg.; MUSM 3287 (1 spec., 67 mm) • El Huásimo stream; 03°56′37″S, 080°31′07″W; 12.XII.1993; F. Chang leg.; MUSM 5835 (11 spec., 35–90 mm) • Tumbes River; Higuerón stream; 03°46′00″S, 080°27′24″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50241 (1 spec., 51 mm) • Rica Playa, Tumbes River; 03°48′24″S, 080°29′00″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50245 (2 spec., 40 and 65 mm).

Identification. Fusiform body; terminal mouth with short maxilla; two rows of tricuspid teeth at least in lower jaw; small pectoral fins; anal fin with 11 rays and bilobed caudal fin (Eigenmann 1922). Body height 25-28.5% of standard length (SL); presence of a large rounded black spot at the base of the caudal fin, a dark humeral spot behind the head, and a bright red dot located behind it (Jiménez-Prado et al. 2015).

Family Bryconidae

***Brycon alburnus* (Günther, 1860)**
Figure 3C

Material examined. PERU – Tumbes • Tumbes River; 04°05′S, 080°30′W; 10.XII.1993; F. Chang leg.; MUSM 5513 (1 spec., 114 mm) • Honda stream; 03°49′12″S, 080°28′54″W; 04.VII.1992; F. Chang, F. Rodriguez, and C. Palma leg.; MUSM 5517 (2 spec., 38 and 47 mm) • Carrillos stream; 03°48′50″S, 080°29′57″W; 04.VII.1992; F. Chang, F. Rodriguez, and C. Palma leg.; MUSM 5518 (2 spec., 33 and 42 mm) • Tumbes River; 18.I.1997; M. Nopravnik and Choy leg.; MUSM 41150 (1 spec., 292 mm).

Identification. Body with an almost straight dorsal profile in juveniles and convex in adults; snout pronounced and pointed, dorsal fin with ii, 9 rays. Anal fin with iv, 26–30 rays, pectoral fin with i, 13 rays; pelvic fin with i, 7 rays (Howes 1982). Pectoral fin extends beyond the pelvic fin origin; snout length 25% of the head length (Jiménez-Prado et al. 2015).

***Brycon atrocaudatus* (Kner, 1863)**
Figure 3D

Material examined. PERU – Tumbes • Puyango River; 03°58′25″S, 080°23′56″W; 02.XI.1977; MUSM 2603 (1 spec., 183 mm) • Honda stream; 03°49′12″S, 080°28′54″W; 04.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3272 (3 spec., 57–126 mm) • Carrillo stream; 03°48′50″S, 080°29′57″W; 04.VII.1992; F. Chang, F. Rodriguez, C. Palma leg.; MUSM 5519 (4 spec., 23–35 mm) • Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 5834 (10 spec., 31–93 mm) • Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 41147 (15 spec., 60–95 mm) • Tumbes River; 03°40′43″S, 080°27′07″W; 02.V.2012; MUSM 50238 (6 spec., 49–120 mm) • Rica Playa, Tumbes River; 03°48′23″S, 080°29′00″ W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50250 (9 spec., 31–84 mm) • Pampas de Hospital, Tumbes River; 03°40′38″S, 080°26′08″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50277 (3 spec., 27–96 mm) • Tumbes River; 03°45′05″S, 080°26′53″W; 18.VIII.2018; N. Lujan et al. leg.; MUSM 66201 (2 spec., 42–57 mm).

Identification. Body moderately elongated, snout pointed with 10 or 11 homogeneous teeth in the mandible and three series of teeth in the premaxilla, 7 or 8 homogeneous teeth in the external series, 4–6 teeth in the internal series, and 2 or 3 teeth in the intermediate series. Complete lateral line with 56–59 scales. It has a dorsal fin with 11 rays and an anal fin with 31 rays, and the number of gill rakers is 14 (Eigenmann 1922). Pectoral fin does not reach the pelvic fin origin; snout length 29-33.3% of the head length (Jiménez-Prado et al. 2015).

***Brycon dentex* Günther, 1860**
Figure 3E

Material examined. PERU – Tumbes • Tumbes River; [03°48′28″S, 080°29′57″W]; 10.VIII.1986; R. Vari et al. leg.; MUSM 2576 (23 spec., 26–850 mm) • Tumbes River; 09.VIII.1986; R. Vari et al. leg.; MUSM 2577 (28 spec., 21–35 mm) • Tumbes River; 03°36′34″S, 080°26′05″W; 09.VIII.1986; MUSM 2601 (16 spec., 29–36 mm) • Tumbes River, Bocatoma; 03°40′04″S, 080°26′47″W; 09.VIII.1986; F. Chang leg.; MUSM 3161 (30 spec., 25.3–115.7 mm) • Tumbes River, 11.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3169 (2 spec., 68–142 mm) • Tumbes River, Bocatoma; 03°40′03″S, 080°26′47″W; 06.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3275 (6 spec., 30–145 mm) • Tumbes River; 05.VII.1992; F. Chang and C. Palmas leg.; MUSM 3302 (7 spec., 27–75 mm) • Tumbes River; 16.VIII.1994; P. De Rham and F. Chang leg.; MUSM 5730 (3 spec., 67–87 mm) • Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 5827 (40 spec., 40–62 mm) • Cabo Inga, Tumbes River; 14.I.1997; M. Nopravnik and Choy leg.; MUSM 11554 (3 spec., 90–121 mm) • Tumbes River; 03°48′54″S, 080°29′18″W; 04.VII.1992; F. Chang et al. leg.; MUSM 41152 (30 spec., 20–52 mm) • Tumbes River; 03°40′38″S, 080°26′08″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50228 (2 spec., 45–51 mm) • Pampas de Hospital, Tumbes River; 03°40′38″S, 080°26′08″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50229 (2 spec., 81–102 mm) • Tumbes River; Higuerón stream; 03°46′00″S, 080°27′24″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50243 (2 spec., 74–82 mm) • Tumbes River; 03°34′06″S, 080°27′46″W; 30.IX.2012; S. Valenzuela et al. leg.; MUSM 50271 (2 spec., 58–65 mm) • Pampas de Hospital, Tumbes River; 03°40′37″S, 080°26′08″W; 01.X.2012; S. Valenzuela et al. leg.; MUSM 50278 (4 spec., 50–57 mm) • San Jacinto, Tumbes River; 03°46′00″S, 080°27′24″W; 03.X.2012; S. Valenzuela et al. leg.; MUSM 50288 (5 spec., 25–63 mm) • San Jacinto, Tumbes River; 03°49′10″S, 080°28′56″W; 03.X.2012; S. Valenzuela et al. MUSM 50298 (11 spec., 26–59 mm).

Identification. Body elongated and tall, long snout that projects well beyond the lower jaw, exposing the teeth of the upper jaw. Premaxillary teeth are distributed in three rows. Anal fin elongated (anal base 31.25–32.25% of the SL) (Géry and de Rham 1981), with 31 or more branched rays. Dorsal fin with ii, 9 rays; anal fin with iv, 31–32 rays; pectoral fin with i, 11–12 rays; pelvic fin

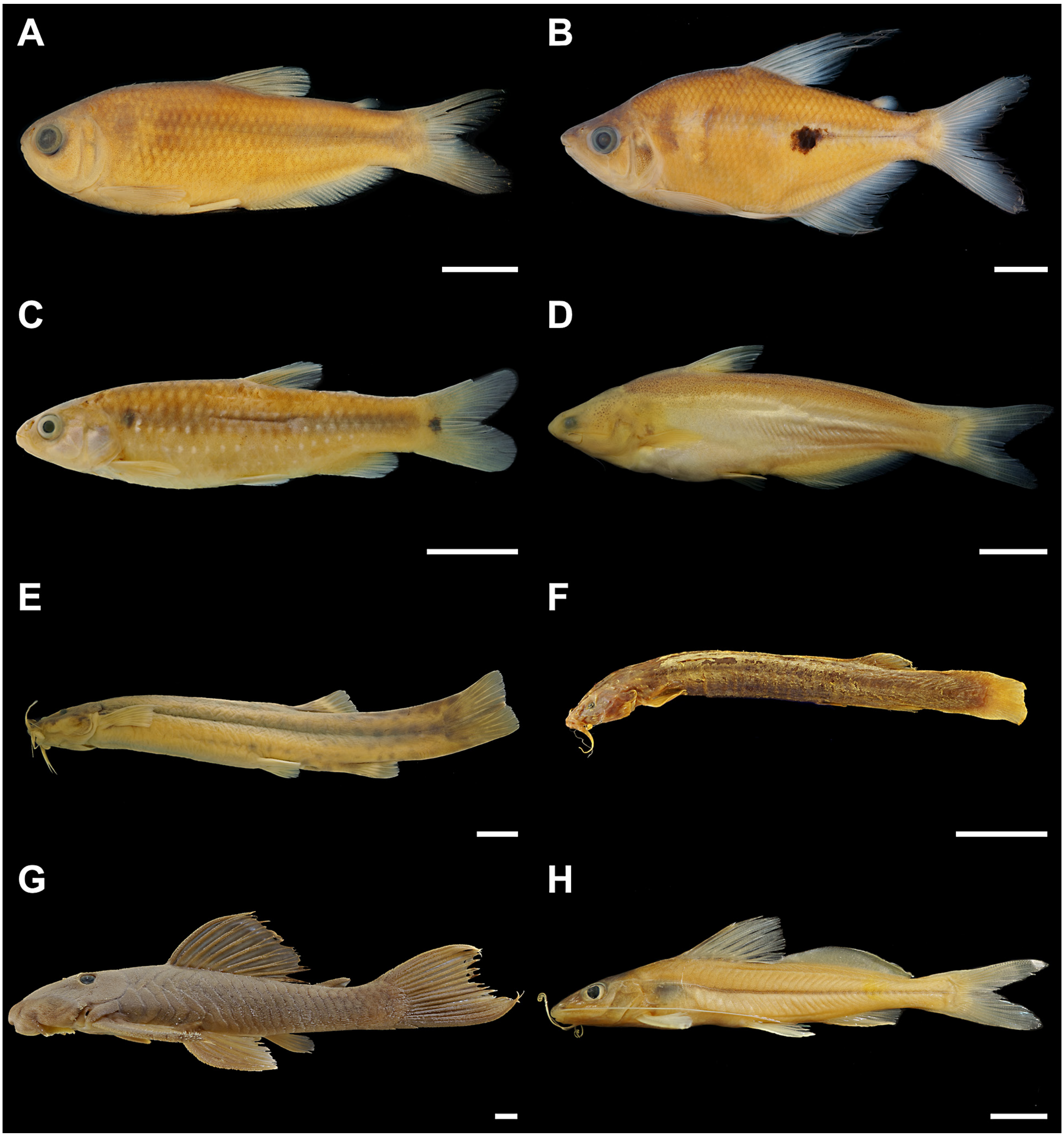

Figure 4. Fish species from the Tumbes River. **A.** *Eretmobrycon peruanus* MUSM 5839, 59 mm SL. **B.** *Rhoadsia altipinna* MUSM 5828, 71.69 mm SL. **C.** *Lebiasina bimaculata* MUSM 50241, 51 mm SL. **D.** *Paracetopsis atahualpa* MUSM 50231, 62 mm SL. **E.** *Trichomycterus piurae* MUSM 66203, 105.1 mm SL. **F.** *Trichomycterus* aff. *dispar* MUSM 11564, 47 mm SL. **G.** *Chaetostoma bifurcum* MUSM 50293, 130 mm SL. **H.** *Pimelodella elongata* MUSM 50274, 72.5 mm SL. Scale bars = 10 mm.

with i, 7 rays, number of vertebrae 46–47, and number of gill rakers 46 or 47 (Howes 1982).

Chilobrycon deuterodon **Géry & de Rham, 1981**
Figure 3F

Material examined. PERU – Tumbes • Tumbes River; [03°48′28″S, 080°29′57″W]; 11.XI.1978; MUSM 0026 (10 spec., 73–113 mm) • Tumbes River; 03°58′25″S, 080°23′56″W; 02.XI.1977; MUSM 0035 (2 spec., 148 and 180 mm) • Tumbes River; 11.IX.1978; MUSM 2158 (1 spec., 102 mm) • Tumbes River, 15.IX.1978; MUSM 2292 (2 spec., 88 and 90 mm) • Tumbes River; 03°48′07″S, 080°29′36″W; 04.VII.1992; MUSM 2943 (81 spec., 29–92 mm) • Tumbes River; 03°48′54″S, 080°29′18″W; 11.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3166 (1 spec., 122 mm) • Tumbes River; 03°34′19″S, 080°27′31″W; 11.XII.1991; F. Chang and C. Riofrio leg; MUSM 3170 (1 spec., 121 mm) • Rica Playa, Tumbes River; 03°48′07″S, 080°29′36″W; 03.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3257 (21 spec., 25–73 mm) • Honda stream; 03°49′12″S, 080°28′54″W; 04.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3262 (111 spec., 17–105 mm) • Tumbes River, Bocatoma; 03°40′04″S, 080°26′47″W; 06.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3276 (7 spec., 75–86 mm) • El Huaco stream;

03°48′08″S, 080°30′07″W; 06.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3288 (51 spec., 25–92 mm) • Cabo Inga, Tumbes River; 04°05′00″S, 080°30′00″W; 06.VII.1992; F. Chang leg.; MUSM 5511 (15 spec., 125.6–151.2 mm) • Tumbes River; 03°38′35″S, 080°26′37″W; 16.VIII.1994; P. De Rham and F. Chang leg.; MUSM 5731 (2 spec., 80 and 88 mm) • Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 5833 (73 spec., 41–131 mm) • Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 6652 (2 spec., 95–97 mm) • Cabo Inga, Tumbes River; 18.I.1997; M. Nopravnik and J. Choy leg.; MUSM 12899 (1 spec., 145 mm) • Cabuyal stream; 03°43′03″S, 080°25′34″W; 14.VII.2010; C. Oliveira et al. leg.; MUSM 40340 (12 spec., 60–118 mm) • Cabuyal stream; 03°43′03″S, 080°25′34″W; 14.VII.2010; C. Oliveira et al. leg.; MUSM 40343 (12 spec., 34–110 mm) • Cabo Inga, Tumbes River; 18.I.1997; M. Nopravnik and J. Choy leg.; MUSM 41149 (1 spec., 152 mm) • Honda stream; 09.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 41153 (99 spec., 28–84 mm) • Tumbes River; 03°30′49″S, 080°28′01″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50208 (1 spec., 30 mm) • San Juan de la Virgen, Tumbes River; 03°37′44″S, 080°26′10″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50219 (1 spec., 30 mm) • Tumbes River; 03°40′42″S, 080°27′06″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50239 (2 spec., 30–32 mm) • Tumbes River; Higuerón stream; 03°46′00″S, 080°27′24″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50244 (5 spec., 49–111 mm) • Rica Playa, Tumbes River; 03°48′24″S, 080°29′00″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50252 (1 spec., 121 mm) • Tumbes River, Honda stream; 03°49′11″S, 080°28′55″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50259 (2 spec., 21 and 38 mm) • Pampas de Hospital, Tumbes River; 03°40′37″S, 080°26′08″W; 01.X.2012; S. Valenzuela et al. leg.; MUSM 50279 (85 spec., 51–82 mm) • Pampas de Hospital, Tumbes River; 03°40′37″S, 080°26′08″W; 01.X.2012; S. Valenzuela et al. leg.; MUSM 50289 (12 spec., 74–103 mm) • San Jacinto, Tumbes River; 03°49′10″S, 080°28′56″W; 03.X.2012; S. Valenzuela et al. leg.; MUSM 50297 (5 spec., 22–92 mm) • Rica Playa, Tumbes River; 03°49′10″S, 080°28′56″W; 03.X.2012; S. Valenzuela et al. leg.; MUSM 50299 (17 spec., 64–131 mm) • Pampas de Hospital, Tumbes River; 03°48′18″S, 080°29′56″W; 18.VIII.2018; N. Lujan et al. leg.; MUSM 61198 (2 spec., 73 and 90 mm).

Identification. Body elongated; premaxillary teeth in three series; teeth flattened and trilobed almost spatulate; absence of the upper lip; jaw with 13 flattened, trilobed, slightly overlapping teeth. When mouth closed, a small internal conical tooth is present on both sides of the symphysis. Fin rays: D = ii, 9; P = i, 13; V = i, 7, and A = iii or iv, 23–25. Complete lateral line, with 53–57 scales on the lateral line and 18–22 scales on the predorsal series. Short head 24–26% of the SL, postorbital distance 37–42.5% of the head length. Pointed and elongated snout (Géry and de Rham 1981).

Family Characidae

***Eretmobrycon brevirostris* (Günther, 1860)**
Figure 3G

Material examined. PERU – Tumbes • San Jacinto, Tumbes River; 03°48′13″S, 080°29′53″W; 14.VII.2010; C. Oliveira et al. leg.; MUSM 40341 (1 spec., 53 mm) • Cabuyal stream; 03°45′30″S, 080°24′21″W; 14.VII.2010; C. Oliveira et al. leg.; MUSM 40345 (8 spec., 45–61 mm) • El Garbanzal, Tumbes River; 03°36′28″S, 080°26′18″W; 15.VII.2010; C. Oliveira et al. leg.; MUSM 40351 (33 spec., 24–43 mm) • San Jacinto, Tumbes River; 03°49′10″S, 080°28′56″W; 03.X.2012; S. Valenzuela et al. leg.; MUSM 50296 (5 spec., 36–84 mm) • Pampas de Hospital, Tumbes River; 03°48′18″S, 080°29′55″W; 18. VIII.2018; N. Lujan et al. leg.; MUSM 66197 (1 spec., 71 mm) • Tumbes River; 03°45′05″S, 080°26′52″W; 18.VIII.2018; N. Lujan et al. leg.; MUSM 66202 (1 spec., 58 mm).

Identification. Compressed body. Complete lateral line with 43–50 scales, anal fin with 36–43 rays (Eigenmann 1927; Géry 1977). Two inconspicuous dark humeral spots on seventh and eighth scales of lateral line, median caudal rays conspicuously black (Eigenmann, 1927). Maxilla with 2–4, confined to anterior part (Jiménez-Prado et al. 2015).

***Eretmobrycon festae* (Boulenger, 1898)**
Figure 3H

Material examined. PERU – Tumbes • Tumbes River; [03°48′28″S, 080°29′57″W]; 12.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3160 (2 spec., 43 and 55 mm) • Tumbes River; 10.VIII.1986; R. Vari and H. Ortega leg.; MUSM 3291 (20 spec., 30–50 mm) • Tumbes River; 03°40′03″S, 080°26′47″W; 06.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3292 (2 spec., 40 and 42 mm) • Tumbes River; 05.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3301 (5 spec., 38–41 mm) • Tumbes River; 03°38′32″S, 080°26′36″W; 16.VIII.1994; P. De Rham and F. Chang leg.; MUSM 5733 (3 spec., 42–55 mm) • Cabuyal stream; 03°45′30″S, 080°24′22″W; 14.VII.2010; C. Oliveira et al. leg.; MUSM 40347 (14 spec., 37–58 mm) • Tumbes River; 03°30′49″S, 080°28′01″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50206 (10 spec., 28–40 mm) • Honda stream; 03°49′11″S, 080°28″W W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50258 (1 spec., 29 mm) • Pampas de Hospital, Tumbes River; 03°40′37″S, 080°26′08″W; 01.X.2012; S. Valenzuela et al. leg.; MUSM 50276 (3 spec., 48–60 mm).

Identification. Body deep and compressed. Complete lateral line with 41–47 scales. Presence of two vertical black humeral spots; premaxillary teeth in two rows; dorsal fin with ii, 9 rays and 33–40 rays in the anal fin (Glodek 1978). It lacks maxillary teeth (Jiménez-Prado et al. 2015).

***Eretmobrycon peruanus* (Müller & Troschel, 1845)**
Figure 4A

Material examined. PERU – Tumbes • Tumbes River; [03°48′28″S, 080°29′57″W]; IX.1977; MUSM 2578 (1 spec., 29 mm) • Tumbes River; 03°48′09″S, 080°29′49″W; 21.V.1978; W. Gutiérrez leg.; MUSM 3450 (2 spec., 97–105 mm) • Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 5826 (4 spec., 47–56 mm) • Quebrada Chica; 09.XII.1993; F. Chang leg.; MUSM 5839 (5 spec., 50–59 mm) • Quebrada Chica; 9.XII.1993; F. Chang leg.; MUSM 5843 (5 spec., 56–77 mm) • Tumbes River; 18.V.1994; Napravnik leg.; MUSM 11540 (1 spec., 82 mm) • Naranjal; 9.II.1996; Napravnik and Choy leg.; MUSM 11552 (14 spec., 42–70 mm).

Identification. Compressed body. Complete lateral line with 36–40 scales; body height 35–40% of the SL. Anal fin with 25–32 rays, dorsal with 11 rays; dark humeral blotch on lateral line; tail blotch continues to mid-ray of tail fin (Géry 1977). Head length 27.7–30.2% of the SL (Glodek 1978).

***Rhoadsia altipinna* Fowler, 1911**
Figure 4B

Material examined. PERU – Tumbes • Tumbes River; [03°48′28″S, 080°29′57″W]; 11.II.1978; W. Gutierrez leg.; MUSM 0027 (117 spec., 43–98 mm) • Cabo Inga, Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 5828 (16 spec., 31–76 mm) • Cabo Inga, Tumbes River; 20.I.1997; Napravnik and Choy leg.; MUSM 11562 (6 spec., 46–55 mm) • Rica Playa, Tumbes River; 03°48′23″S, 080°29′00″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50249 (17 spec., 29–52 mm).

Identification. Body high and compressed. Complete lateral line with 37–41 scales; characteristic large black spot on body, at posterior level of dorsal fin. In juveniles with few maxillary teeth, narrow based and expanded distally. Jaw lengthens with growth and caniniform teeth appear that occupy almost entire jaw (Géry 1977). Body depth 40–44.4% of SL (Glodek 1978).

Order Gymnotiformes
Family Sternopygidae

Sternopygus* aff. *arenatus
Figure 5A

Material examined. PERU – Tumbes • San Juan de la Virgen, Tumbes River; 03°37′44″S, 080°26′10″W; 01.V.2012; Valenzuela and L. Santamaria leg.; MUSM 50222 (1 spec., 303.5 mm).

Identification. Body laterally compressed, knife-shaped; dorsal margin of rostrum slightly convex, snout short; terminal mouth; upper jaw slightly larger and projecting over lower jaw; nasal capsule closer to eyes than to tip of snout; eyes with free orbital margin, eye diameter small, 7% of head length. Gill opening 33% of head length. Long anal fin with 240–250 rays; pectoral fin length 40–50% of head length. Differs from *S. arenatus* by the absence of a straight profile on the dorsal margin of rostrum, gill opening 33% of head length (vs. straight profile and gill opening 16–17% of head length) (Hulen et al. 2005). Also differs from *S. macrurus* by having a completely cream body color and no humeral spot (vs. very distinctive dark humeral spot) (Hulen et al. 2005). Our specimen appears closest to *S. arenatus* (body coloration and absence of humeral spot). It is evident that the specimen identified as *S.* aff. *arenatus* needs a more detailed review, and more individuals are necessary for the formal description of the species.

Order Siluriformes
Family Trichomycteridae

***Trichomycterus piurae* (Eigenmann, 1922)**
Figure 4E

Material examined. PERU – Tumbes • Tumbes River; 18.V.1994; M. Napravnik and J. Choy leg.; MUSM 6569 (1 spec., 30 mm) • El Prado, Tumbes River; 03°45′05″S, 080°26′53″W; 18.VIII.2018; N. Lujan et al. leg.; MUSM 66203 (1 spec., 105.1 mm).

Identification. Maxillary barbels do not reach the middle of the pectoral fin. Long pectoral rays. Large, regular spots evenly distributed over sides and back, spots uniformly larger than eye size. Dorsal fin origin located vertically behind pelvic fin base. Dorsal fin entirely in front of anal fin (Eigenmann 1922).

Trichomycterus* aff. *dispar
Figure 4F

Material examined. PERU – Tumbes • Tumbes River; [03°48′28″S, 080°29′57″W]; 19.II.1996; Napravnik; MUSM 11564 (8 spec., 36–47 mm).

Identification. Maxillary barbels do not reach the middle of the pectoral fin. Long pectoral rays. Dorsal fin origin located vertically behind pelvic fin base. Dorsal fin in part over the anal fin. Our specimens appear closest to *T. dispar* (dorsal in part over the anal fin) (Eigenmann 1922), but they differ in several pigmentation characteristics and by the geographical distribution since *T. dispar* is described for streams of the Andean Cordillera (Ferraris 2007). It is evident that the specimen identified as *T.* aff. *dispar*, need a more detailed review. Based on this distribution, *Trichomycterus* aff. *dispar* is the first specimen found in a different geographical area, and recommend reviewing the different populations of *Trichomycterus dispar*, to confirm if the species is widely distributed in both regions (Andes and Pacific coast).

Family Loricariidae

***Chaetostoma bifurcum* Lujan, Meza-Vargas, Astudillo-Clavijo, Barriga-Salazar & López-Fernández, 2015**
Figure 4G

Material examined. PERU – Tumbes • Honda stream; 03°49′12″S, 080°28′54″W; 04.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg., MUSM 3267 (2 spec., 92 and 96 mm) • Tumbes River; Higuerón stream; 03°46′00″S, 080°27′24″W; 02.X.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50293 (1 spec., 130 mm).

Identification. Presents one or two evertible odontodes on the cheek; four branched rays in the anal fin and eight branched rays in the dorsal fin. Ossified dermal plates with small odontodes covering flanks of head and body; no plates around margin of snout and abdomen; cheek plates bearing up to two slightly enlarged distal hooked odontodes; odontodes typically obscured by a thick, fleshy lobe. Pectoral fin that extends beyond the base of the pelvic fin and the spine of the pelvic fin reaches the middle of the base of the anal fin (Lujan et al. 2015).

Family Cetopsidae

Paracetopsis atahualpa **Vari, Ferraris & de Pinna, 2005**
Figure 4D

Material examined. PERU – Tumbes • Tumbes River; 03°40′38″S, 080°26′08″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50231 (4 spec., 43–62 mm) • Rica Playa, Tumbes River; 03°48′23″S, 080°29′00″W; 02.X.2012; S. Valenzuela et al. leg.; MUSM 50290 (1 spec., 215 mm).

Identification. Relatively robust body slightly compressed anteriorly and posteriorly. Presents vomerine dental patch with more than one row of teeth and a median separation of the contralateral components of the patch. Operculum has a distinctive patch of dark pigmentation, and the overall pigmentation of the body is dark. Vomeral tooth patches with a distance between them equivalent to the space between one or two teeth. Total number of vertebrae 50. Pelvic fin extending posteriorly to completely overlap vent and nearly reaching to anal-fin origin; pectoral fin elongated, extends past mid-portion of dorsal fin (Vari et al. 2005).

Family Heptapteridae

Pimelodella elongata **(Günther, 1860)**
Figure 4H

Material examined. PERU – Tumbes • Bocatoma La Peña; 03°40′04″S, 080°26′47″W; 06.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3277 (25 spec., 45–52 mm) • Tumbes River, El Piojo bridge; 03°35′49″S, 080°28′58″W; 06.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3285 (21 spec., 38–59 mm) • Tumbes River; 05.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3290 (64 spec., 37–76 mm) • Cabo Inga, Tumbes River; 18.I.1997; M. Napravnik and J. Choy leg.; MUSM 11558 (3 spec., 118–140 mm) • San Juan de la Virgen, Tumbes River; 03°37′44″S, 080°26′10″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50220 (113 spec., 38–82 mm) • Tumbes River; 03°40′38″S, 080°26′10″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50230 (7 spec., 39–55 mm) • Rica Playa, Tumbes River; 03°48′08″, 080°28′53″; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50253 (4 spec., 69–85 mm) • Honda stream; 03°49′11″S, 080°28′55″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50260 (1 spec., 62 mm) • Corrales, Tumbes River; 03°37′45″S, 080°26′12″W; 01.X.2012; S. Valenzuela et al. leg.; MUSM 50274 (40 spec., 42–94 mm) • San Jacinto, Tumbes River; 03°40′43″S, 080°27′07″W; 02.X.2012; S. Valenzuela et al. leg.; MUSM 50284 (12 spec., 44–72 mm) • San Jacinto, Tumbes River; 03°40′43″S, 080°27′07″W; 02.X.2012; S. Valenzuela et al.; MUSM 50292 (16 spec., 40–76 mm).

Identification. Body elongated and compressed posteriorly. Eye diameter 25% of head length; interorbital distance 28.5% of head length. Pelvic fin inserted behind the dorsal fin, not reaching anal opening; caudal fin deeply forked, with acute lobes; upper lobe longer than lower lobe, and the pelvic length is a fifth of total length. Back of the body uniform gray, ventrally whitish. Lateral line black. Dorsal and caudal fin with black spots (Günther 1860). Maxillary barbicels can reach anal opening; adipose fin long, < 28.5% of SL (Jiménez-Prado et al. 2015).

Family Ariidae

Ariopsis seemanni **(Günther, 1864)**

Material examined. PERU – Tumbes • Puerto Pizarro; [03°30′51″S, 080°25′17″W]; 07.V. 2016; R. Siccha, R. Britzke, R. Campaña and R. Flores leg.; LCT-IMARPE 212 (1 spec., 280 mm).

Identification. Head moderately long and wide, depressed in the lateral ethmoid and frontal area, profile slightly raised posteriorly. Snout rounded and moderately long. Presence of a bony medial groove; lateral margin of sphenotic notched, narrower medially than anteriorly; medial fleshy groove of the neurocranium, not exceeding the posterior margin of the eyes. Presence of 30–36 gill rakers on the first and second gill arches; narrow mouth 9.7–12.7% of SL. Rounded vomerine dental plates (Marceniuk et al. 2017).

Order Syngnathiformes
Family Syngnathidae

Pseudophallus starksii **(Jordan & Culver, 1895)**
Figure 5C

New record. PERU – Tumbes • Pampas de Hospital, Tumbes River; 03°40′38″S, 080°26′08″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50233 (1 spec., 137 mm).

Identification. Body elongated, covered by a series of bony rings, two confluent lateral keels on the back of the body; snout tubular, mouth small: no pelvic fins,

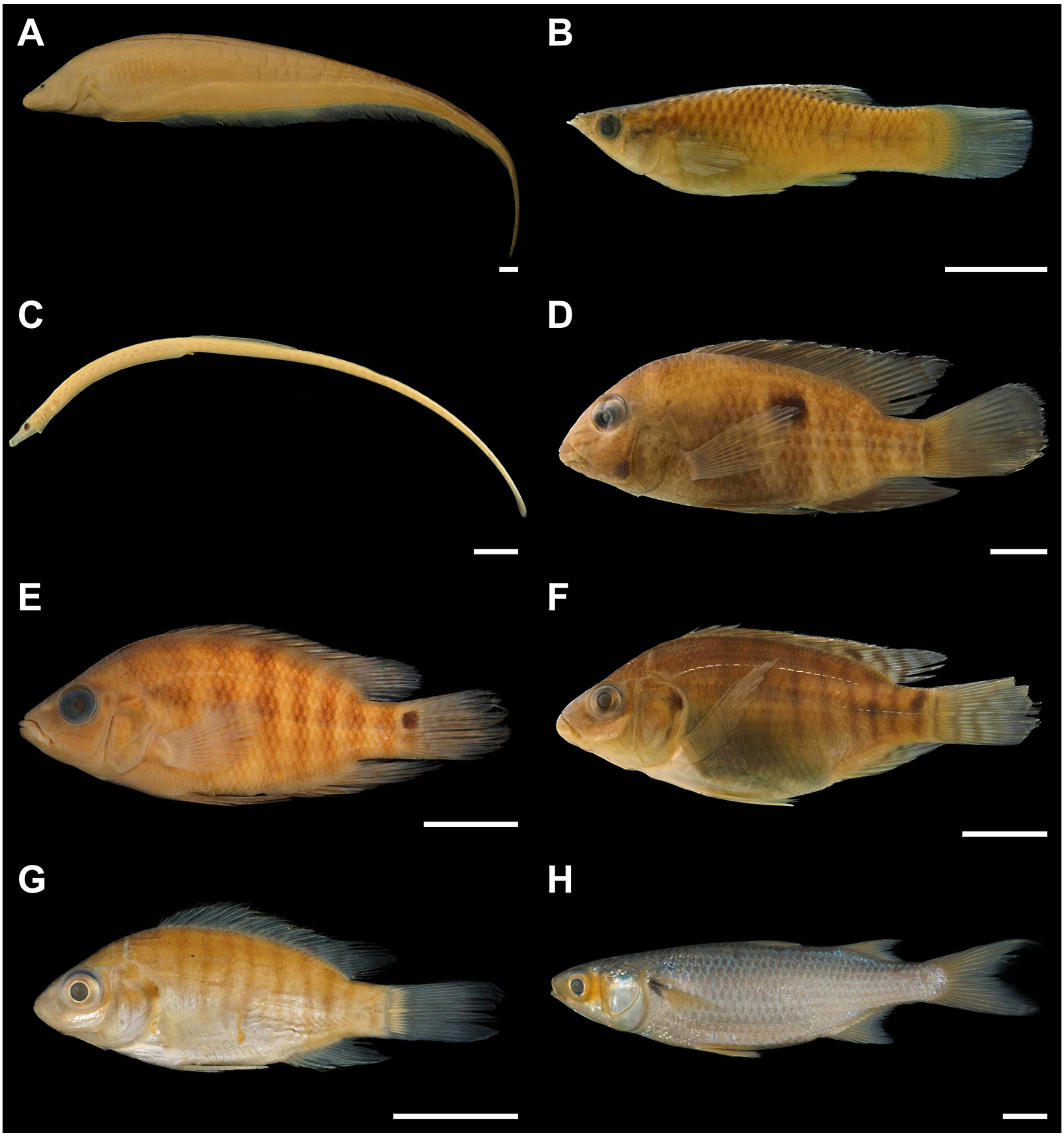

Figure 5. Fish species from the Tumbes River. **A.** *Sternopygus* aff. *arenatus*. MUSM 50222, 303.5 mm SL. **B.** *Poecilia* aff. *gillii*. MUSM 50210, 42 mm SL. **C.** *Pseudophallus starksii* MUSM 50233, 137 mm. **D.** *Andinoacara rivulatus* MUSM 50294, 70 mm SL. **E.** *Mesoheros festae* MUSM 5831, 46.2 mm SL. **F.** *Oreochromis aureus* MUSM 40350, 51 mm. **G.** *Oreochromis* aff. *aureus* MUSM 47439, 30 mm. **H.** *Mugil setosus* MUSM 50265, 100.76 mm SL. Scale bars = 10 mm.

dorsal fin 37–44 rays. Dark stripe between the tip of the lower jaw and the anterior border of the eye and another from the posteroventral border of the eye (Bussing 1998; Jiménez-Prado et al. 2015).

Order Gobiiformes
Family Eleotridae

Dormitator latifrons **(Richardson, 1844)**
Figure 6A

Material examined. PERU – Tumbes • Corrales, Tumbes River; 03°30′49″S, 080°28′01″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50203 (2 spec., 65–72 mm) • Tumbes River; 03°32′07″S, 080°28′31″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50212 (1 spec., 162 mm) • Tumbes River, Manglares; 03°30′29″S, 080°29′50″W; 16.VI.2016; F. Pacaya leg.; LCT-IMARPE 908 (1 spec., 170 mm).

Identification. Short and stocky body; body depth 33.3% of total length; head wide and flat dorsally, terminal mouth; lower jaw slightly protruding. Dorsal fin with soft spines VII, 8–9, anal fin I, 9–10, and caudal fin with rounded edge; 31 scales in longitudinal series; 13 series of scales from pectoral to pectoral (Eigenman and Fordice 1885).

***Eleotris picta* Kner, 1863**

Material examined. PERU – Tumbes • Tumbes River, Manglares; 03°30′29″S, 080°29′50″W; 11.I.2017; F. Pacaya leg.; LCT-IMARPE 993 (1 spec., 30 mm).

Identification. Robust body, head length 30.3–33.3% of total length, narrow gill opening. Slightly projecting lower jaw (Revelo and Laaz 2012). First dorsal fin VI–VII; second dorsal fin I, 8; pectoral fin 11–19 (mean 18); scales in lateral line 56–68 (mean 61). The vertical opercular rows intersect at the posterior operculum forming a sharp forked opening to the posterior margin. Body dark or brown with darker pigment laterally on trunk and pale abdomen (Pezold and Cage 2002).

***Gobiomorus maculatus* (Günther, 1859)**
Figure 6B

Material examined. PERU – Tumbes • Tumbes River; XI.1977; S. Delgado leg.; MUSM 2574 (1 spec., 105 mm) • Tumbes River mouth; 03°30′24″S, 080°27′35″W; 10.VIII.1986; R. Vari et al. leg.; MUSM 2584 (17 spec., 48–105 mm) • Tumbes River; 10.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3172 (66 spec., 18–91 mm) • Tumbes River, El Piojo bridge; 03°35′49″S, 080°28′58″W; 06.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3284 (1 spec., 59 mm) • Tumbes River; 03°32′07″S, 080°28′31″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50213 (1 spec., 104 mm) • San Juan de la Virgen, Tumbes River; 03°37′44″S, 080°26′10″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50223 (1 spec., 115 mm) • Tumbes River; 03°40′37″S, 080°26′08″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50235 (1 spec., 120 mm) • Tumbes River; 03°32′08″S, 080°28′32″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50267 (7 spec., 70–163 mm) • San Jacinto, Tumbes River; 03°40′43″S, 080°27′07″W; 02.X.2012; S. Valenzuela et al. leg.; MUSM 50285 (1 spec., 134 mm) • San Jacinto, Tumbes River; 03°46′00″S, 080°27′24″W; 02.X.2012; S. Valenzuela et al. leg.; MUSM 50295 (1 spec., 82 mm).

Identification. Elongated and cylindrical body. Small, conical head; eyes relatively large 15.4–16.6% of head length; mouth large and oblique; lower jaw slightly projecting. Large gill opening; with 17 to 24 gill rakers on first gill arch. Dorsal fins two; dorsal fin with VI, 9; anal fin with I, 10; pectoral fins with 15 or 16 rays; tail fin with rounded edge and 55–60 scales on lateral line (Jiménez-Prado et al. 2015).

Family Gobiidae

***Awaous transandeanus* (Günther, 1861)**
Figure 6C

Material examined. PERU – Tumbes • Tumbes River; XI.1977; S. Delgado leg.; MUSM 2575 (1 spec., 111 mm) • Tumbes River; 03°48′07″S, 080°29′36″W; 04.VII.1992; F. Chang et al. leg.; MUSM 2945 (1 spec., 133 mm) • Francos; Tumbes River; 03°41′26″S, 080°27′06″W; 20.X.2016; M. Vera, F. Pacaya, R. Campaña leg.; LCT-IMARPE 847 (1 spec., 90 mm).

Identification. Body cylindrical and laterally compressed. Pelvic fins joined to form a sucker. Snout long; eyes small. Upper jaw projecting compared to lower; jaw opening reaches to front margin of eye; small teeth, a band on each jaw. Scales on lateral line 56–61 (Jiménez-Prado et al. 2015).

***Ctenogobius sagittula* (Günther, 1862)**

Material examined. PERU – Tumbes • Tumbes River; Manglares; 03°30′29″S, 080°29′50″W; 30.VI.2016; F. Pacaya leg.; LCT-IMARPE 433 (1 spec., 80 mm).

Identification. Slender body, somewhat compressed in the posterior region. Dorsal rays VI+I, 12–13; anal rays I, 13; pectoral rays 17; pelvic disc present; 55–65 scales on lateral line; caudal fin lanceolate. The predorsal scales extend forward to the level of the middle of the operculum; rest of head scaleless; head pores end above preoperculum; an oblique row of papillae at the rear of operculum. Light tan with four dark brown spots along the midline of the side, and a dark brown spot in the middle of the base of the caudal fin (Angulo et al. 2015; Jiménez-Prado et al. 2015).

Ctenogobius* aff. *sagittula
Figure 6E

Material examined. PERU – Tumbes • Tumbes River, Estero; 03°30′49″S, 080°28′02″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50204 (1 spec., 90 mm).

Identification. Body elongated and dark, cylindrical in the anterior part and compressed in the posterior part. Head depressed and wide. Subterminal mouth. Large eyes. It has two dorsal fins, the first with six spines, and the second with 12 filamentous spines; 14 elements in the anal fin. The pelvic fins fused in a complete disc. Caudal fin lanceolate. Similar to *C. sagittula* but body uniformly dark (vs. with four dark brown blotches along middle of side and a dark brown spot at middle of caudal fin base) (Angulo et al. 2015; Jiménez-Prado et al. 2015). We recommend reviewing populations of *C. sagittula* to confirm their coloration.

***Evorthodus minutus* Meek & Hildebrand, 1928**
Figure 6D

New record. PERU – Tumbes • Corrales, Tumbes River; 03°34′06″S, 080°27′46″W; 30.IX.2012; S. Valenzuela et al. leg.; MUSM 50263 (1 spec., 38 mm).

Identification. Body elongated, cylindrical anteriorly and compressed posteriorly. Dark brown spots form indistinct bars on body; first bar at base of first dorsal fin and covers first spine; base of tail fin with two spots: upper one slightly darker and smaller than lower one; D1 = VI, D2 = I, 10, A = I, 11, P = 14. Head short, compressed; snout abruptly rounded in profile. Slightly large eyes (Valencia-Méndez et al. 2019).

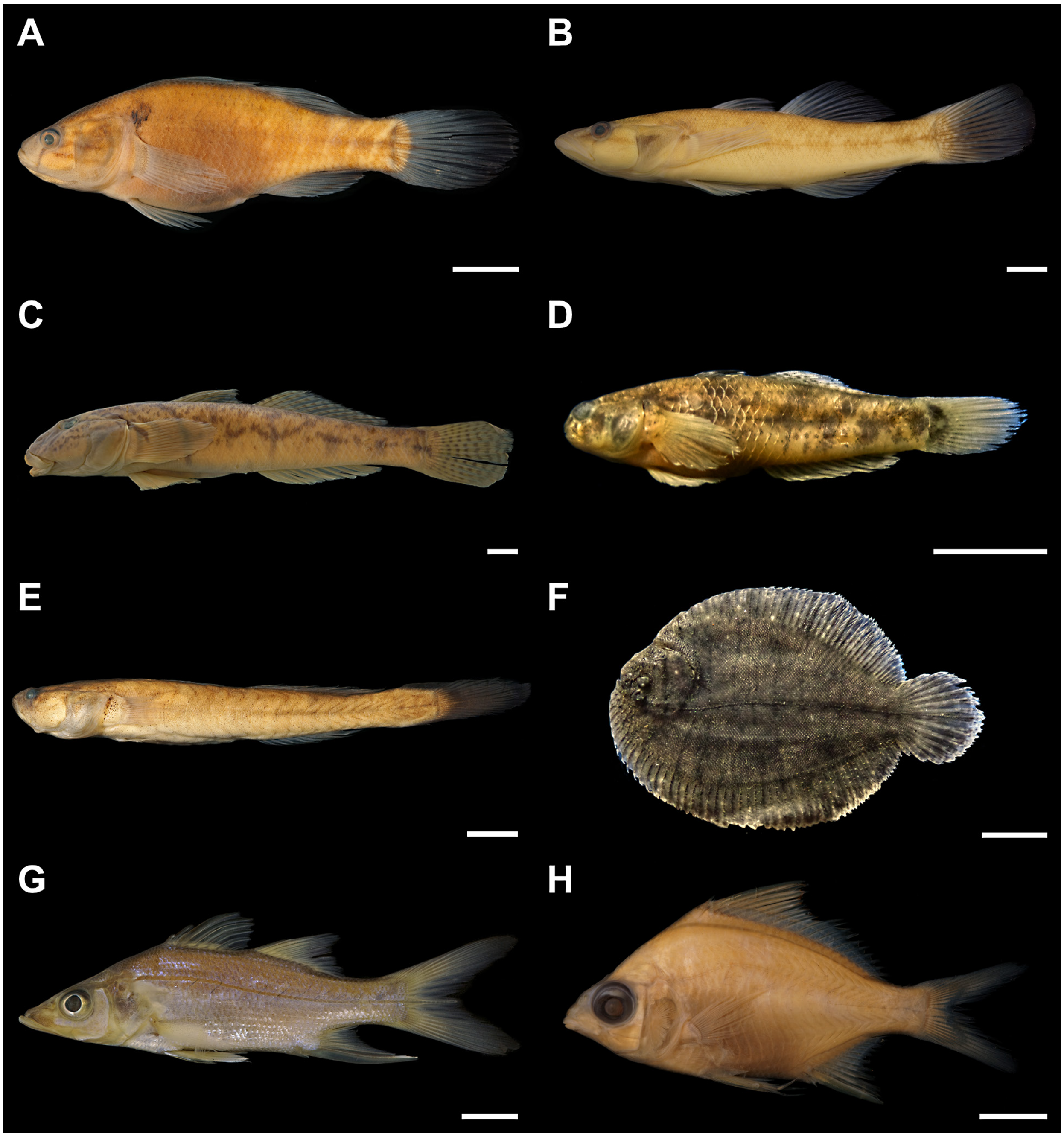

Figure 6. Fish species from the Tumbes River. **A.** *Dormitator latifrons* MUSM 50203, 65 mm SL. **B.** *Gobiomorus maculatus* MUSM 50213, 104 mm SL. **C.** *Awaous transandeanus* MUSM 2945, 133 mm SL. **D.** *Evorthodus minutus* MUSM 50263, 38 mm SL. **E.** *Ctenogobius* aff. *sagittula* MUSM 50204, 90 mm. **F.** *Achirus mazatlanus* MUSM 50224, 45 mm SL. **G.** *Centropomus unionensis* MUSM 50262, 71.02 mm SL. **H.** *Eugerres brevimanus* MUSM 3321, 53 mm. Scale bars = 10 mm.

Order Carangiformes
Family Centropomidae

Centropomus nigrescens Günther, 1864

Material examined. PERU – Tumbes • Manglar Alcade; 03°30′56″S, 080°26′36″W; 11.VII.2017, F. Pacaya leg.; LCT-IMARPE 990 (1 spec., 180 mm).

Identification. Pectoral fins short, almost reaching tip of pelvic fins, pectoral fin length 50–66.6% of head length; 2nd and 3rd anal fin spines relatively short, about equal in length, not exceeding longest anal ray, scales small 60–80 in a longitudinal series. Anal fin with six rays (rarely seven). Dorsal fin with 10 rays (rarely 9–11); 8 or 9 gill rakers on lower branch of first gill arch, 3rd spine usually longer than 4th (Chirichigno and Vélez 1998).

Centropomus unionensis Bocourt, 1868

Figure 6G

Material examined. PERU – Tumbes • Tumbes River; 03°30′49″S, 080°28′02″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50262 (3 spec., 35–75 mm) • Manglares; 03°30′29″S, 080°29′50″W; 30.VI.2016, F. Pacaya leg.; LCT-IMARPE 441 (1 spec., 70 mm) • Manglar; 03°30′29″S, 080°29′50″W; 30.VI.2016, F. Pacaya leg.; LCT-IMARPE 441 (1 spec., 70 mm).

Identification. Body high, 27.8–34.5% of SL; concave predorsal profile above eyes. Second anal spine not reaching a vertical line through tail fin base, large specimens with strong nuchal protuberance (Bussing 1995). Long pectoral fins, usually reaching the end of the pelvic fins; <66.7% of head length; scales large 46–57 in a longitudinal series. Second anal spine much stronger than third and slightly longer surpasses longest anal ray; lateral line pale; dorsal fin with nine rays, occasionally 10; border of the back of the head low or narrow, those of the center well separated (Chirichigno and Vélez 1998).

Family Cyclopsettidae

Citharichthys gilberti **Jenkins & Evermann, 1889**

Material examined. PERU – Tumbes • Tumbes River, Manglares; 03°30′29″S, 080°29′50″W; 11.I.2017, F. Pacaya leg.; LCT-IMARPE 994 (1, 70 mm) • Estero La Ramada; 03°30′52″S, 080°25′17″W; 14.IX.2017, A. Ordinola leg.; LCT-IMARPE 1412 (1 spec., 90 mm).

Identification. Interorbital edge low and narrow; maxilla long, <33.3% of head length; 43–50 scales in a lateral series; 33–36 vertebrae. Eye small, >22.2% of head length (varies with growth); space between eyes narrow, never much wider than the pupil; gill rakers long, as long as or longer than pupil, 13 or 14 gill rakers on lower branch of first arch; 44–50 scales in a lateral series (Chirichigno and Vélez 1998).

Family Achiridae

Achirus mazatlanus **(Steindachner, 1869)**
Figure 6F

Material examined. PERU – Tumbes • Tumbes River; 03°48′54″S, 080°29′19″W; 11.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3325 (1 spec., 162 mm) • Tumbes River bridge 10.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3326 (1 spec., 18 mm) • San Juan de la Virgen, Tumbes River; 03°37′44″S, 080°26′10″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50224 (1 spec., 45 mm).

Identification. Body coloration pale brown and usually 6–11 very narrow dark vertical lines; fins with or without spots; interbranchial septum perforated, with a round opening connecting both gill chambers. Dorsal fin with 55–57 rays; anal fin with 41–44 rays; pectoral fin with 1–4 rays; black hairs or cilia on scales (Chirichigno and Vélez 1998).

Achirus klunzingeri **(Steindachner, 1880)**

Material examined. PERU – Tumbes • Puerto Pizarro; [03°30′51″S, 080°25′17″W]; 08.II.2018; C. Chimbor, R. Asmat and R. Infante leg.; LCT-IMARPE 1751 (1 spec., 220 mm).

Identification. Interbranchial septum perforated, with a round opening connecting both gill chambers. Dorsal fin with 59–66 rays; anal with 46–51 rays; pectoral fin with about six rays; almost uniform brown body coloration, sometimes with dark spots and with faint dark vertical lines; scales with black hairs (Chirichigno and Vélez 1998).

Trinectes fluviatilis **(Meek & Hildebrand, 1928)**

Material examined. PERU – Tumbes • Maval; 03°36′06″S, 080°27′13″W; 07.I.2017; R. F. Pacaya and R. Campaña leg.; LCT-IMARPE 1032 (1 spec., 120 mm).

Identification. No pectoral fins; body usually with dark spots and very narrow vertical lines; scales without cilia; dorsal fin with 53–57 rays and anal fin with 41–43 rays; scales in lateral series 90–98 (Chirichigno and Vélez 1998).

Trinectes fonsecensis **(Günther, 1862)**

Material examined. PERU – Tumbes • Estero La Chepa; 03°33′8″S, 080°30′14″W; 19.IX.2017, A. Ordinola leg.; LCT-IMARPE 1396 (1 spec., 30 mm).

Identification. Body coloration dark brown to grey, with 11–13 black bars, at least as wide as pupil, extending to fins; with dark spots between bars and fins; dorsal fin with 58–60 rays; anal with 43–46 rays; interbranchial septum not perforated (Chirichigno and Vélez 1998).

Order Cichliformes
Family Cichlidae

Andinoacara rivulatus **(Günther, 1860)**
Figure 5D

Material examined. PERU – Tumbes • Cazaderos; 04°05′02″S, 080°29′25″W; 30.X.1977; S. Delgado leg.; MUSM 1051 (8 spec., 27–118 mm) • Tumbes River; 21.X.1968; IMARPE leg.; MUSM 1089 (2 spec., 75 and 96 mm) • Bocana Murcielago; 03°54′51″S, 080°11′46″W; 27.X1977; S. Delgado leg.; MUSM 1235 (11 spec., 51–122 mm) • Tumbes River; 11.XI.1978; W. Gutierrez leg.; MUSM 2590 (42 spec., 65–111 mm) • Tumbes River, Bocatoma; 03°38′32″S, 080°26′37″W; 12.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3159 (1 spec., 65 mm) • Honda stream; 03°49′12″S, 080°28′54″W; 04.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3263 (2 spec., 76 and 94 mm) • Tumbes River, Bocatoma La Peña; 03°40′04″S, 080°26′47″W; 06.VII.1992; F. Chang, C. Palma, and F. Rodriguez leg.; MUSM 3280 (1 spec., 105 mm) • Rica Playa, Tumbes River; 03°48′54″S, 080°29′19″W; 11.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3324 (1 spec., 91 mm) • Cabo Inga, Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 5849 (8 spec., 26–83 mm) • Cabo Inga, Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 6525 (23 spec., 26–106 mm) • Cabo Inga, Tumbes River; 14.I.1997; M. Napravnik and J. Choy leg.; MUSM 11553 (20 spec., 57–105 mm) • Pampas de Hospital, Tumbes River; 03°40′37″S, 080°26′08″W; 01.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50281 (8 spec., 42–74 mm) • Tumbes River; Higuerón stream; 03°46′00″S, 080°27′24″W; 02.X.2012; Valenzuela and L. Santamaria leg.; MUSM 50294 (1 spec., 70 mm).

Identification. Body deep; lips large. Lateral line interrupted lateral line. Lateral stripes 9 or 10. Middle of body with a black spot; a black spot in middle of base of caudal fin and another tear-shaped spot under eye, and six iridescent green spots on cheeks. Teeth conical. Dorsal fin long and continuous, with 14 spines and 11 branched rays; pectoral fin with 14 rays; pelvic fin with 6 rays; anal fin with 3 spines and 11 rays; caudal fin with 16 branched rays (Wijkmark et al. 2012).

Mesoheros festae **(Boulenger, 1899)**
Figure 5E

Material examined. PERU – Tumbes • Tumbes River; 03°34′21″S, 080°24′16″W; 11.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3327 (1 spec., 34 mm). • Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 5831 (3 spec. 45–48 mm).

Identification. Body slightly compressed laterally, body height 40% of total length. Terminal mouth with small canines, the maxilla does not reach the anterior edge of the eye. Caudal peduncle taller than long; interrupted lateral line, upper lateral line has 26 or 27 scales. Anal fin with five spines; tail fin with rounded edge; a dark round spot on the caudal peduncle on each side (Revelo and Laaz 2012).

Oreochromis aureus **(Steindachner, 1864)**
Figure 5F

Material examined. PERU – Tumbes • Tumbes River; 03°34′21″S, 080°27′31″W; 10.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3320 (2 spec., 27–70 mm) • Tumbes River; 04°05′S, 080°30′W; 10.XII.1993; F. Chang leg.; MUSM 5512 (1 spec., 106 mm) • Cabo Inga, Don Pablo stream; 03°58′52″S, 080°23′36″W; 11.XII.1993; F. Chang leg.; MUSM 5832 (2 spec., 47–57 mm) • Cabuyal stream; 03°45′30″S, 080°24′21″W; 14.VII.2010; C. Oliveira et al. leg.; MUSM 40350 (23 spec., 12–51 mm) • Tumbes River; 03°30′49″S –80°28′02″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50211 (5 spec., 41.18–64 mm).

Identification. Compressed body with interrupted lateral line, upper lateral line contains 20–23 scales, lower lateral line with 14–18 scales. Scales cycloid. First gill arch with 28–31 gill filaments. Dorsal fin with 14–18 spines and 11–15 rays. Anal fin with three spines and 8–10 rays (Trewavas 1983).

Oreochromis **aff.** ***aureus***
Figure 5G

Material examined. PERU – Tumbes • Corrales, Tumbes River; 03°30′49″S, 080°28′02″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 47439 (1 spec., 30 mm).

Identification. Body compressed, small. Mouth terminal. Dorsal fin with 14–16 spines and 11–13 branched rays. Anal fin with three spines and 8–10 branched rays. Several meristic features are similar to *O. aureus* (Trewavas 1965, 1983), but coloration differs mainly in the number of vertical bars on body, diffuse vertical bars on caudal fin, and absence of a dorsal spot on the final portion of dorsal fin.

Order Cyprinodontiformes
Family Poeciliidae

Poecilia **aff.** ***gillii***
Figure 5B

Material examined. PERU – Tumbes • Estanque de Langostinos; 10.XII.1988; C. Mantilla leg.; MUSM 1844 (2 spec., 43–52 mm) • El Piojo bridge; 03°35′49″S, 080°28′59″W; 06.VII.1992; F. Chang, C. Palma, and F. Rodríguez leg.; MUSM 3286 (63 spec., 27–41 mm) • Tumbes River; 05.VII.1992; F. Chang and F. Rodriguez leg.; MUSM 3300 (8 spec., 18–45 mm) • Tumbes River; 03°34′21″S, 080°27′31″W; 10.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3323 (1 spec., 20 mm) • Sapotal stream; 22.VII.2003; CESEL leg.; MUSM 22218 (6 spec., 18–22 mm) • Cabuyal stream; 03°43′03″S, 080°25′34″W; 14.VII.2010; C. Oliveira et al.; MUSM 40344 (9 spec., 18–50 mm) • Cabuyal stream; 03°45′30″S, 080°24′22″W; 14.VII.2010; C. Oliveira et al. leg.; MUSM 40348 (21 spec., 33–54 mm) • Tumbes River; 03°30′49″S, 080°28′02″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50200 (46 spec., 36–53 mm) • Tumbes River, Langostinera; 03°32′08″S, 080°28′31″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50210 (59 spec., 13–58 mm) • Tumbes River, Rica Playa; 03°48′24″S, 080°29′01″W; 02.V.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50254 (1 spec., 30 mm) • San Jacinto, Tumbes River; 03°30′49″S, 080°28′02″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50261 (13 spec., 14–34 mm) • Tumbes River, Corrales; 03°37′45″S, 080°26′12″W; 01.X.2012; S. Valenzuela et al. leg.; MUSM 50275 (4 spec., 20–43 mm) • Pampas de Hospital, Tumbes River; 03°40′38″S, 080°26′08″W; 01.X.2012; S. Valenzuela et al. leg.; MUSM 50280 (4 spec., 31–64 mm).

Identification. Body fusiform and compressed posteriorly, covered with cycloid scales (26–30 on lateral line); body height abruptly reduced after dorsal fin; mouth protruding and somewhat oblique; head broad and flattened at back. Dorsal fin origin always behind anal fin origin in both sexes; 29–35 lateral scales. Dorsal fin with 6 or 7 rays; tail fin rounded. In males, anal fin modified to form gonopodium by transformation of rays 3–5 (Poeser 2003; Meyer et al. 2002). Our specimens appear closest to *Poecilia gillii* (29–35 lateral scales, dorsal fin with 6 or 7 rays) but differ in several characteristics, mainly characters of gonopodium in males and pelvic fins of males and females. *Poecilia* aff. *gillii* is currently in the process of description by Figueiredo et al. (Britzke pers. comm.).

Order Mugiliformes
Family Mugilidae

***Mugil cephalus* Linnaeus, 1758**

Material examined. PERU – Tumbes • Estero La Ramada; 03°30′51″S, 080°25′17″W; 15.IX.2017; A. Ordinola leg.; LCT-IMARPE 1332 (1 spec., 100 mm)

Identification. Body silvery, back slightly darker. Second dorsal fin origin almost directly over anal fin origin; no silver line or band on sides. Flanks with a series of black horizontal stripes; total number of anal fin elements (spines plus rays) 11, rarely 10 (Chirichigno and Vélez 1998).

***Mugil setosus* Gilbert, 1892**
Figure 5H

Material examined. PERU – Tumbes • Tumbes River; 03°34′21″S, 080°24′16″W; 11.XII.1991; F. Chang and C. Riofrio leg.; MUSM 3171 (20 spec., 33–70 mm) • Tumbes River; 03°32′08″S, 080°28′32″W; 30.IV.2012; S. Valenzuela and L. Santamaria leg.; MUSM 50265 (20 spec., 77–120 mm) • Tumbes River, Manglares; 03°30′29″S, 080°29′50″; 15.IX.2017; F. Pacaya leg.; LCT-IMARPE 440 (1 spec., 70 mm).

Identification. Flanks without black stripes; anal fin with 12 elements (spines plus rays). Pectoral fin with ii, 13 or 14 rays. With 34–36 scales on the lateral line; lower lip not thickened or retracted; small setiform teeth visible; outer rows of larger teeth, and more internally several smaller and scattered teeth (mainly visible in adults larger than 150 mm) (Britzke et al. 2019).

Order Acanthuriformes
Family Gerreidae

***Eucinostomus currani* Zahuranec, 1980**

Material examined. PERU – Tumbes • Estero La Ramada; 03°30′52″S, 080°25′17″W; 14.IX.2017, O. Ordinola leg.; LCT-IMARPE 1367 (1 spec., 70 mm).

Identification. Premaxilla very protractile and basal processes very long. Anterior interhemal skeleton (hemal spines of vertebrae that connect with anal fin) not very elongated, forming a hollow cone that receives posterior end of swim bladder. No blackish spot on inner part of operculum (most with some scattered melanophores); with diagonal dark bars. Body moderately tall (height almost always <33.3% of standard length). Spiny portion of the dorsal fin with three well-defined color zones, the dorsal third gray, the middle region light, and the distal third black (Chirichigno and Vélez 1998).

***Eugerres brevimanus* (Günther, 1864)**
Figure 6H

Material examined. PERU – Tumbes • Tumbes River; 10. XII. 1991, F. Chang and C. Riofrio leg.; MUSM 3321 (1 spec., 53 mm) • Puerto Pizarro; [03°30′52″S, 080°25′17″W]; 08.II.2018, C. Chimbor, R. Asmat and R. Infante leg.; LCT-IMARPE 1738 (1 spec., 180 mm) • Manglar El Tanque; 03°30′15″S, 080°23′58″W; 23.IV.2018, A. Ordinola leg.; LCT-IMARPE 2056 (1 spec., 160 mm).

Identification. Premaxillae very protractile and basal processes very long. Scales large, about 35–45 in lateral series. Anterior hemal spines moderately elongated. Edge of preopercle serrated; no dark vertical bars; fin spines strong; very high body. Preorbital edge serrated; with well-pronounced blackish lines along scale rows (Chirichigno and Vélez 1998).

***Diapterus peruvianus* (Cuvier, 1830)**

Material examined. PERU – Tumbes • Estero La Ramada; 03°30′52″S, 080°25′17″W; 14.IX.2017, O. Ordinola leg.; LCT-IMARPE 1354 (1 spec., 60 mm).

Identification. Edge of preopercle serrated, without dark vertical bars; fin spines strong; body tall. Preorbital margin smooth. No sharp blackish lines along scale rows. Lateral line low, curved downwards, and running along body axis on caudal peduncle. Premaxillary groove free of scales. Fin spines strong (Chirichigno and Vélez 1998).

Discussion

According to the literature, a total of 42 freshwater species have been recorded on the Peruvian Pacific slope (Ortega et al. 2012). Our study reports the presence of 23 of these 42 species in the Tumbes river basin, representing 54.8% of the total diversity of coastal fishes, reaffirming the Tumbes River as Peru's most diverse coastal river. In terms of material analyzed, geographical area covered, and species reported, the present study is the most comprehensive doe the Tumbes river basin.

Compared to previous studies (e.g., Chirichigno 1963; Chang 1995; Mac Donald 1995; Ortega et al. 2015), our work increases the diversity of fishes in the Tumbes River to 47 species. The richness reported here support the findings by other authors, who have indicated that fish diversity in the Peruvian coastal river systems is highest in the north and lowest in the south (Ortega et al. 2015), and that the Tumbes river basin has the most diverse ichthyofauna of any river on the western slopes of the Peruvian Andes (Berger et al. 1979; Ortega et al. 2015). However, many tributaries and systems of this basin have not yet been studied, so the richness in this region is estimated to be higher. The diversity reported for this basin is comparable to other Pacific coastal drainages. For instance, in the Chira River, the second most diverse river on the Peruvian coast, 27 species were reported (Ortega et al. 2015; Meza-Vargas et al. 2022). In Ecuador, there were 70 species reported in the Guayas River and 62 in the Santiago–Cayapas River (Jiménez-Prado et al. 2015).

Several factors contribute to the high diversity of this basin. One of the main factors is its geographical position; from its source in Ecuador to its mouth in the Pacific Ocean, the Puyango–Tumbes river basin crosses through a variety of climates, from humid temperate in the upper part to semi-arid tropical in the middle portion, and tropical arid in the lower basin (ANA 2013; Mora et al. 2016). Additionally, it is situated in the intertropical convergence zone, where the Peruvian Humboldt current and other factors affect the rainfall frequency (Berger et al. 1979). This fluctuation causes significant seasonal rains similar to those in the lowlands of the Amazon, which favors recharging tributary streams, maintaining the Tumbes River's flow and assuring habitats for the ichthyofauna.

The Tumbes river basin hosts 34 fish species of mainly freshwater habits (20 primary and 14 secondary), representing 3.2% of the total diversity of continental fish for Peru (1064 species), as reported by Ortega et al. (2012). The dominance of primary species (42.6% of the total richness) in the ichthyofauna of the Tumbes river basin is consistent with findings from other coastal basins, such as the Chira, Guayas, Esmeraldas, Santiago Cayapas, and Catamayo rivers, and in the Serrania del Baudó basin (Blanco-Libreros and Carbajal-Quintero 2015; Jiménez-Prado et al. 2015; Meza-Vargas et al. 2022), where primary species contribute more than 60% to the overall richness.

There are several Amazonian genera present among the primary species of the Tumbes river basin, including *Brycon* Müller & Troschel, 1844, *Hoplias* Gill, 1903, *Pimelodella* Eigenmann & Eigenmann, 1888, and *Sternopygus* Müller & Troschel, 1846. The occurrence of Amazonian lineages in coastal drainages has been reported for the Ecuadorian Pacific slopes (Maldonado-Ocampo et al. 2005) and for the Magdalena River (Colombia) (Lundberg et al. 1986; Lundberg and Chernoff 1992; Ibagón et al. 2020). This occurrence would be related to past geological events. Wesselingh and Hoorn (2011) pointed out that aquatic systems now separated by the uplift of the Andes were previously part of the Amazon ecosystem. A connection between the Amazon and the Pacific is also known to have occurred through water corridors between regions now on separate sides of the Ecuadorian Andes (Katzer 1903; Steinmann et al. 1999). The Andes' uplift caused ecological transformations in the local fish fauna, with the current composition of the fish fauna in each basin the result of the geomorphological and hydrographic history (Lundberg et al. 1998; Albert and Reis 2011).

The secondary freshwater and peripheral species reported here in our study have already been listed from the Tumbes River by Chirichigno (1963), Chirichigno and Vélez (1998), and Luque (2008). The composition of marine and estuarine families described here was comparable to that of the Chira River (Ortega et al. 2015; Meza-Vargas et al. 2022), except for some absent families in the Chira River like Syngnathidae and Achiridae. The species composition in the Tumbes River was similar to that reported in other coastal drainage rivers of Ecuador (Barriga 2015; Jiménez-Prado et al. 2015). Similar results have been reported for basins in the Venezuelan Caribbean (Lasso et al. 2004; Rodríguez-Olarte et al. 2006) and the northern Colombian Pacific (Blanco-Libreros and Carbajal-Quintero 2015), where marine families contribute many species to the overall richness.

Amphidromous fauna predominates in coastal basins (Mcdowall 2009; Bauer 2013). Amphidromy involves larval migration to the sea, where they spend their early development, before migrating to freshwater as post-larvae or juveniles (Blanco-Libreros et al. 2015). According to various authors, some of the species found in our study exhibit amphidromous behavior. *Dormitator latifrons*, *Eleotris picta*, *Gobiomorus maculatus*, and *Awaous transandeanus* are amphidromous species from the Pacific region (Bussing 1998; Revelo and Laaz 2012; Ruiz-Campos 2012; Sánchez-Garcés 2017). Similarly, amphidromous species are found in the family Mugilidae (Blanco-Libreros et al. 2015). Information is still scarce on amphidromous species and their migration and reproduction patterns in the Tumbes River. However, there are reports of mugilids in the middle basin of the Puyango River (Berger et al. 1979) and of *Centropomus* Lacepède, 1802, *Eucinostomus* Baird & Girard, 1855, *Ariopsis* Gill, 1861, *Eugerres* Jordan & Evermann, 1927, and *Achirus* Lacepède, 1802 migrating upstream, likely for trophic purposes (Gutierrez et al. 1980).

The presence of *Trichomycterus piurae* in this river basin represents an extension of its distribution, previously reported from the Piura and Chira rivers (de Pinna and Wosiacki 2003; Meza-Vargas et al. 2022).

Oreochromis aureus and *Oreochromis* aff. *aureus* were found near the mouth of the Tumbes River and in the shrimp farming area. *Oreochromis* Günther, 1889 is considered to included major invasive species (Martin et al. 2010; Insani et al. 2020). Exotic species were introduced into Peruvian waters for fish farming, human health, and aquarism, and they are widely distributed in coastal rivers (Ortega et al. 2012). Exotic species are considered one of the five major threats to native species (Hogue and Breon 2022), leading to biodiversity loss, impacting food webs, and altering habitats (Carey and Wahl 2010; Tierney et al. 2020). Studies of the impact of exotic species on native fish populations in the Tumbes River are recommended.

The Tumbes river basin harbors two endemic species: *Chilobrycon deuterodon*, which was described from the Trapazol River, a tributary of the Tumbes River (Géry and de Rham 1981), and *Paracetopsis atahualpa*, reported in the Tumbes and Zarumilla rivers (Vari et al. 2005). These endemic species represent 4.1% of the total richness in the basin, a low number considering the endemism of the neighboring basins of the Ecuadorian western watersheds, such as the Guayas and Esmeraldas, which report more than 20% of endemic species (Jiménez-Prado et al. 2015). We believe that the rate of endemism is higher in this area, but more data collecting in understudied areas and extensive taxonomic revisions are required in families such as Sternopygidae, Poecilidae, and Trichomycteridae. *Sternopygus* aff. *arenatus* is the only gymnotiform found in coastal drainages of Peru and differs from its congeners such as

S. arenatus from the Catamayo and Guayas rivers and *S. macrurus* from the Santiago–Cayapas, Esmeraldas, and Guayas drainages (Barriga 2015; Jiménez -Prado et al. 2015).

The species that have only been reported for the Tumbes River and southern Ecuador include *Saccodon wagneri*, which has been recorded from the Guayas and Catamayo river basins to northern Peru (Barriga 2015), *Mesoheros festae*, distributed in Ecuador from Esmeraldas to Huaquillas and in the Tumbes River (Kullander 2003), and *Eretmobrycon brevirostris* and *Eretmobrycon festae* both in the Guayas (Barriga 2012, 2015) and Tumbes rivers (Chirichigno 1963; Ortega and Vari 1986; Ortega et al. 2015). Additionally, *Pimelodella elongata* is distributed in the Esmeraldas River (Barriga 2015), as well as the Tumbes River (Ortega and Vari 1986; Ortega et al. 2012), and *Chaestostoma bifurcum* was described from the coastal drainages of western Ecuador and northwestern Peru (Lujan et al. 2015). Although we did not examine specimens of *Hoplias microlepis*, there are records in the literature from the Tumbes River (Chirichigno 1963; Ortega and Vari 1986; Luque 2008; Mattox et al. 2014) and from the Guayas River (Barriga 2015). Finally, *Brycon alburnus* occurs in the Santiago–Cayapas and Guayas basins (Howes 1982; Barriga 2015).

Most species in the Tumbes basin are not assessed as threatened under IUCN criteria. However, three species are classified as Near Threatened and Vulnerable. *Paracetopsis atahualpa*, assessed as Vulnerable, has a restricted geographic range and is threatened by a decline in quality of habitat due to informal mining, wastewater discharge, and agriculture (Lyons 2021b). *Brycon alburnus*, accessed as Near Threatened, is under threat from pollution and habitat alteration (Arguello 2016). Similarly, *Chilobrycon deuterodon* is threatened by a reduction in habitat quality and availability due to mining activities in the upper Puyango–Tumbes basin, agriculture and livestock, and shrimp aquaculture in the middle and lower basin (Lyons 2021a).

Our study area includes protected areas such as the Cerros de Amotape National Park and the Tumbes National Reserve, which have a fundamental role in the preservation of this river system's ichthyofauna. These areas protect the headwater tributaries of the Tumbes River, and the continued protection of these areas against binational water-use projects is essential. Minimal research has been done in both areas. Only 17 fish species were reported in the Tumbes National Reserve (Napravnik 1998) and an updated inventory is needed.

Only a small portion of the fish resources in coastal rivers are used for commercial fishing; most are used for subsistence fishing (Ortega et al. 2015). Fishermen occasionally catch *Chaetostoma bifurcum* and *Brycon atrocaudatus* in the upper portion of the Tumbes River (Berger et al. 1979; Ortega et al. 2012). Species belonging to *Pseudocurimata* as well as *Oreochromis*, *Mugil*, and *Dormitator* are captured in the lower portion of the river, whereas species of *Centropomus*, *Diapterus*, *Eucinostomus*, *Gerres*, and *Ariopsis* are caught in the river mouth. Fishermen and locals report that *Chaetostoma bifurcum*, previously an important part of their diet and once common in fishing (Gutierrez et al. 1980), has gone extinct in the Puyango river basin in Ecuador (SGAB and PRODEMINCA 2000) and in the Tumbes river basin in Peru.

The fish fauna of the Tumbes river basin is threatened mostly by contamination from artisanal mining that takes place in Ecuador's highlands. Some areas of the Puyango River, impacted by this operation, have reduced biodiversity (Tarras-Wahlberg et al. 2000, 2001). Likewise, the disappearance of *Chaetostoma bifurcum* in fishing locations is probably due to exposure by ingestion of contaminants derived from this activity (Tarras-Wahlberg et al. 2000, 2001). In addition, high metal concentrations in macroinvertebrates and fish in the Puyango–Tumbes river basin have been reported (SGAB and PRODEMINCA 2000; Tarras-Wahlberg et al. 2000), as well as a high level of metal in fish tissue (Espinoza and Falero 2015). Finally, the potential construction of the Cazaderos Dam (PEBPT 2022), must be properly studied because it could severely impact the aquatic biodiversity (Berger et al. 1979; Gutierrez et al. 1980). In general, dams affect the physiography and natural flow of water within a river system, resulting in ecological changes and negative impacts on biodiversity (Berger et al. 1979; Agostinho et al. 2008; Barbarossa et al. 2020).

In this work, we present an updated list of fish species to increase the known diversity of the Tumbes river basin ichthyofauna. This list represents a useful and critical tool for the management and conservation of aquatic fish fauna in a highly impacted area. However, the ichthyofauna of this river basin is not yet fully known, and more research is needed to increase the knowledge of its fish species, especially in the headwaters and tributary streams. Furthermore, studies on the ecology and taxonomic reviews of certain genera are needed. Likewise, the aquatic fauna of this basin is exposed to high environmental pressures, which make studies on the biodiversity, ecology, and conservation a high priority.

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Author Contributions

Conceptualization: SV, RB, JA, LC. Data curation: JA, RB, LC, SV. Formal analysis: SV, RB. Methodology: MA, AMC, JA, VMV. Software: LC. Supervision: HO, RB. Validation: HO. Visualization: SV. Writing – original draft: SV. Writing – review and editing: RB, SV, MA, VMV, LC, AMC, HO.

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