

THE AMAZON SAILFIN CATFISH *PTERYGOPLICHTHYS PARDALIS*
(SILURIFORMES: LORICARIIDAE), A NEW EXOTIC SPECIES
ESTABLISHED IN THE DOMINICAN REPUBLIC

**El pez gato acorazado del Amazonas *Pterygoplichthys pardalis*
(Siluriformes: Loricariidae), una nueva especie exótica
establecida en República Dominicana**

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ABSTRACT

The correct identity and occurrence of the introduced armored catfish, locally known as “devil fish” or “pleco” in the Dominican Republic, is briefly described. Specimens were collected from six sites in the Dominican Republic. Several meristic and morphometric characters, as well as other external features including coloration, were examined. Results were compared with existing literature on fishes of the family Loricariidae. Examination revealed that specimens of the armored catfish, unofficially reported as *Hypostomus plecostomus*, actually belongs to the species *Pterygoplichthys pardalis* (Castelnau, 1855). It is inferred that this fish is established in Dominican inland waters, also the possible occurrence of more than one species of *Pterygoplichthys* is discussed. This is the first report of this invasive species in the island of Hispaniola.

Keywords: Armored catfish, Caribbean, Hispaniola, invasion, introduced species.

RESUMEN

Se describe brevemente la identidad correcta y la presencia del pez gato acorazado introducido, localmente conocido como “pez diablo” o “pleco” en República Dominicana. Se recolectaron muestras de seis sitios en República Dominicana. Se examinaron varios caracteres merísticos y morfométricos, así como otras características externas, incluida la coloración. Los resultados se compararon con la literatura existente sobre peces de la familia Loricariidae. El examen reveló que los especímenes del pez gato acorazado, reportados extraoficialmente como *Hypostomus plecostomus*, en realidad pertenecen a la especie *Pterygoplichthys pardalis* (Castelnau, 1855). Se infiere que este pez está establecido en aguas internas dominicanas y se discute la posible presencia de más de una especie de *Pterygoplichthys*. Este es el primer reporte de esta especie invasora en la isla La Española.

Palabras clave: Pez gato acorazado, Caribe, Hispaniola, invasión, especies introducidas.

INTRODUCTION

Loricariidae is the most diverse family of catfish (Order Siluriformes) with 1000 species (Fricke *et al.*, 2019). Their most distinctive characteristics are the bony plates that cover their bodies and their sucker-like lips, which provides them with the common name of suckermouth armored catfishes. Although their native range includes South America (except for Chile),

Costa Rica and Panama (Armbruster & Page, 2006), several species have been widely introduced to tropical and subtropical freshwater environments worldwide (Orfinger & Goodding, 2018).

The introduction of these species has been most probably caused by intentional and accidental releases from fish farms and aquariums (Page & Robins, 2006; Nico *et al.*, 2019). Several negative ecological impacts have been linked to their establishment, such as disruption of food chains, erosion of river banks, declining native fish populations, among others (Hubilla *et al.*, 2007; Hoover *et al.*, 2014).

In the last seven to five years in the Dominican Republic, public attention has focused on the occurrence of armored catfish being caught in freshwater systems. This species has been suggested by fishermen as responsible for a decrease in catches of other species of commercial interest such as Tilapia (*Oreochromis* spp.) because they supposedly ingest their eggs and juveniles. In the media, the fish has been referred to as *Hypostomus plecostomus*, pleco, or pez diablo (devil fish), a moniker popularized due to its apparently sinister appearance.

Although local society, as well as governmental agencies have expressed concern for the ecological impacts that this fish might cause and have pointed to them as a serious threat for biodiversity, neither the identity nor the extent of occurrence of this species in the Dominican Republic have been precisely described. Some reports identified the armored catfish as *H. plecostomus* but no records of this species in Dominican Republic have been published, and vouchers of the armored catfish are minimal as well. In order to establish and report the identity as well as the extent of occurrence of this species, a morphological study on this fish in the Dominican Republic was conducted. Its presumed way of introduction, known distribution and potential ecological impacts are discussed.

OBJECTIVES

- To identify the introduced armored catfish currently present in the Dominican Republic.
- To report the extent of occurrence of this fish in the Dominican Republic.
- To discuss the origin of this fish in the Dominican Republic and its potential ecological impacts.

MATERIALS AND METHODS

Between 2014 and 2019, 19 specimens of the armored catfish were collected from seven different localities in five river basins of the Dominican Republic. These specimens were captured using seines, hand nets, gill nets and manually. Counts of fin elements, as well as morphometric measurements and coloration patterns were performed to obtain a proper species identification. Measurements were taken in millimeters using digital calipers (± 0.1 mm). The identification of the specimens followed Armbruster and Page (2006); observations from Chavez *et al.* (2006) and Wu *et al.* (2011) were also taken into consideration. Examined material is deposited in the ichthyological collection of the Museo Nacional de Historia Natural “Prof. Eugenio de Jesús Marcano” (MNHNSD), Santo Domingo, Dominican Republic. The localities map is based on the collection sites of the vouchers deposited in the museum as well as observations when collection was not possible, made by the author and other collaborators.

RESULTS

The morphological identification made in this study, shows that the exotic loricariid fish collected in the Dominican Republic, previously thought to be *Hypostomus plecostomus* (Linnaeus, 1758), is actually *Pterygoplichthys pardalis* (Castelnaud, 1855), known as “Amazon sailfin catfish”.

Pterygoplichthys pardalis is characterized by having 10 or more dorsal-fin rays and a ventrally depressed body, covered with rough, bony plates. The mouth is placed ventrally, forming a sucking disc and it also possesses a pair of maxillary barbels. Lines forming geometric patterns on the head as well as discrete dark ventral spots, rarely forming vermiculations and usually forming leopard-like spots, are also very characteristic of this species (Weber, 1992; Armbruster & Page, 2006; Page & Robins, 2006). See Figure 1.

The examined specimens had a wide range in size (31.9–310.0 mm SL), including both juveniles and adult specimens. The selected morphometric and meristic measurements of the specimens are shown in Tables I and II. These measurements showed little variation with the ones reported for this species in previous studies (Wakida-Kusunoki & Amador del Angel, 2008; Chavez *et al.*, 2006; Wu *et al.*, 2011). These individuals had little variation in color but it was observed that juveniles had a brownish coloration while adult specimens are darker; ventral spots are more conspicuous in adults.



Figure 1. Adult specimen of *Pterygoplichthys pardalis*. a) dorsal, b) lateral, c) ventral view. Collected in Ozama River, Santo Domingo, Dominican Republic (MNHNSD-22.10556; 320.0 mm SL).

Table I. Selected morphometric measurements of specimens of *Pterygoplichthys pardalis* (N = 19) collected in the Dominican Republic

Measurement	Range (mm)	Mean (mm)	SD
Standard L.	31.9–310.0	114.3	85.4
Predorsal L.	12.7–104.8	43.3	29.1
Head L.	9.1–70.0	27.1	19
Mouth W.	2.6–16.7	7.5	5.3
Snout L.	5.6–44.5	17.8	12.5
Orbit diameter	2.0–10.1	5.3	2.4
Interorbital W.	3.6–34.0	14.2	9.7
Dorsal spine L.	7.8–71.7	27.3	20.9
Dorsal fin base L.	10.9–101.1	37.2	27
Interdorsal L.	3.1–46.0	17.4	13.5
Anal spine L.	4.3–49.2	18.3	13.4
Pectoral spine L.	7.7–80.9	32.4	23.8
Pelvic spine L.	6.1–65.6	25.2	18.3
Postanal L.	10.5–109.9	40.3	30.2
Adipose spine L.	2.0–21.4	8.4	5.8

Table II. Fin rays counts of specimens of *Pterygoplichthys pardalis* (N = 19) collected in the Dominican Republic

Characters	Count	%
Dorsal fin rays	10	21.1
	11	52.6
	12	26.3
Anal fin rays	4	100
Caudal fin rays	14	100
Pectoral fin rays	6	100
Pelvic fin rays	5	100

DISCUSSION

Taxonomy and invasiveness of the group. It has been common to refer to nearly all large-bodied lorocariids of the subfamily Hypostominae as *Hypostomus plecostomus* in the pet trade despite the fact that the species has rarely, if ever, been exported for the pet trade. Species of the genus *Pterygoplichthys* Gill, 1858, are often confused with those of *Hypostomus* Lacepède, 1803 (mainly with *H. plecostomus*), but they can be easily distinguished by having more than nine dorsal rays (usually 10–11), while *Hypostomus* spp., almost always has seven (Armbruster, 2004; Armbruster & Page, 2006).

Pterygoplichthys species have been reported as introduced in 21 countries, including the U. S., the Philippines, Taiwan, Mexico, Poland, Israel, India, Turkey, China, Serbia, Vietnam, among others (Orfinger & Goodding, 2018). The detritivorous and algivorous feeding habits of species in the genus as well as their hardiness, have made them popular in the aquarium trade because they keep the fish tanks free of organic waste and algae. Unfortunately, their large adult sizes have resulted in releases from aquarists, and escapes from fish farms have also been common.

The first established nonnative population was reported from Florida in the United States, in the late 1950s (Fuller *et al.*, 1999). According to Bunkley-Williams *et al.* (1994), *P. multiradiatus* has been established since 1990 in several of Puerto Rico's river basins; however, *P. pardalis* was registered from Puerto Rico in 1999 (Nico *et al.*, 2019), and *P. multiradatus* was a misidentification. *Pterygoplichthys pardalis* was also identified from Jamaica and Cuba (Jones, 2008; García-González *et al.*, 2016). No other reports of *Pterygoplichthys* spp., from the Caribbean region have been issued, except for the present study.

Out of the 15 valid species in the genus, the most popular ones in the pet trade, and therefore the most commonly introduced in the world are *P. ambrosetti*, *P. pardalis*, and *P. disjunctivus*. Although *P. multiradiatus* has been reported as introduced in the past, it is easily identified by having small, separate spots all over the body, and the only specimens examined that could be identified as this are from around Miami, Florida, USA (Jonathan W. Armbruster pers. obs.). *P. ambrosetti* (formerly referred to as *P. anisitsi*) is the least commonly kept species, and it has light vermiculations on a dark body (vs. dark spots or vermiculations with a brown background color). *P. disjunctivus* and *P. pardalis* are morphologically and ecologically very similar, the main diagnostic trait being the pattern of ventral spots. *P. disjunctivus* differs from *P. pardalis* in having dark spots coalesced to form a vermiculate pattern on the abdomen (vs. spots or vermiculations of no more than five combines spots in *P. pardalis*) and spots on the head (vs. light lines forming a geometric pattern on the head in *P. pardalis*), (Weber, 1992; Armbruster & Page, 2006; Page & Robins, 2006). All the material examined shows discrete dark ventral spots rarely forming vermiculations and radiating light lines on the head, therefore the identification of the specimens is as *P. pardalis*, which occurs naturally in the lower, middle, and upper Amazon River basin of Brazil and Peru (Weber, 2003; Fig. 1).

According to Wu *et al.* (2011) and Godwin *et al.* (2016), most exotic populations introduced around the world are comprised of hybrids of *P. pardalis* and *P. disjunctivus* with specimens showing pure *P. pardalis* morphologies, pure *P. disjunctivus* morphologies, and intermediate morphologies. This has led to the identification in some countries to sympatric and allopatric populations of both species being identified, as well as intermediate forms, being reported in Mexico (Wakida-Kusunoki & Amador del Ángel, 2008), Israel (Golani & Snovsky, 2013), China (Wei *et al.*, 2017), the Philippines (Chavez *et al.*, 2006), Taiwan (Wu *et al.*, 2011), United States (Nico *et al.*, 2012), and India (Bijukumar *et al.*, 2015). In this sense, Wu *et al.* (2011) found that specimens identified morphologically as *P. pardalis* had *P. disjunctivus* mitochondrial DNA and vice versa, thus suggesting that *P. disjunctivus* is not valid or that most exotic populations might be a product of early hybridization, making identification to the specific level based solely in morphological traits, complicated. Wu *et al.* (2011) also stated the possibility that the superiority of the hybrids may have helped increase their fitness during invasion, providing better chances of survival and colonization of new habitats.

Even though, the specimens collected in the Dominican Republic corresponds to the *P. pardalis* morphotype, the possibility of some degree of hybridization could not be ruled out. A large collection series of the fish from around the country, complemented with molecular analysis could lead to the identification of other species or more clearly differentiated hybrid swarms.

It is unlikely that *H. plecostomus* is introduced, as there are no known vouchers of this species in the country, (Jonathan W. Armbruster, pers. obs.) also this species has never been in the pet trade.

Introduction and distribution in the Dominican Republic. There are no records documenting the date and causes of introduction of sailfin catfish in the Dominican Republic. Importation records for pet trade on plecocs in the Dominican Republic could not be found, but based on anecdotal information, it is believed that the introduction of the species occurred in the early-2000s. In 2011, Nelson Marcano and other technicians from the Biodiversity Department of the Ministry of Environment and Natural Resources of the Dominican Republic performed multiple confiscations in pet shops around the country, where plecocs were first detected. Their first observation in the wild was a few years later, in 2013, in Monte Plata province although it is possible the fish was introduced long before. Most probably, multiple human related introductions in the wild led to the wide and fast spread of this fish in the country. According to Hoover *et al.* (2014), populations expand rapidly, becoming abundant within 5–10 years of initial detection and presumed introduction.

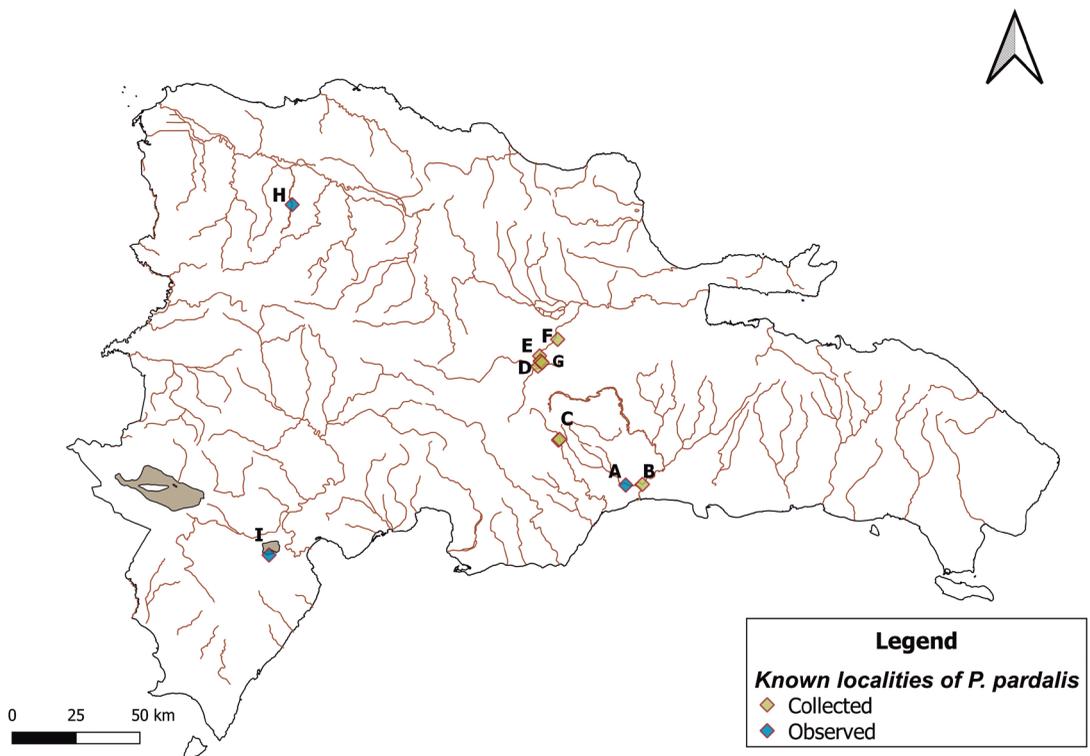


Figure 2. Map of localities of collected and observed specimens of *Pterygoplichthys pardalis* in the Dominican Republic. A, Isabela River. B, Ozama River, both in Santo Domingo province. C, Haina River, San Cristobal Province. D, Maimon River, Sanchez Ramirez province. E, Hatillo Reservoir, Sanchez Ramirez province. F, Yuna River, Sanchez Ramirez province. G, Margajita River, Sanchez Ramirez province. H, Gurabo River, Santiago Rodriguez province. I, Cabral Lagoon, Barahona province. Some points are overlapped.



Figure 3. Carcasses of *Pterygoplichthys pardalis* in Cabral Lagoon, Barahona province, during runoff caused by drought. Photo by M.A. Landestoy.

Even though sightings of *Pterygoplichthys* specimens have been reported from all over the country in national media, the occurrence of more than one species is not ruled out. Since closer examination is needed to verify the identification as *P. pardalis*, just the ones examined in this study as well as observations made by the author and collaborators, when collection was not possible, are taken in consideration in the map of localities (Fig. 2).

In some sites, locals have reported the presence of hundreds of this fish and it constitutes one of the main catches in traps and gill nets of fishermen of the Ozama and Isabela rivers in Santo Domingo. In the last year, there has been a severe drought in the Dominican Republic causing severe runoff in many rivers, streams, and reservoirs, and as a result, dozens of carcasses of armored catfishes have been seen in some locations, such as in the Hacienda Estrella Reservoir in Monte Plata province and in Cabral Lagoon in Barahona province (Fig. 3). Even though across their native range of occurrence, armored catfishes are consumed in various forms (Moroni *et al.*, 2015), in the Dominican Republic, fishermen and consumers show little interest in this species, so it is usually discarded when caught.

Based on the high number of sightings around the country and the high abundance reported in those sites, as well as the fish that have been collected in several of the main river basins, reservoirs and lagoons of the country, it is inferred that *P. pardalis* is already established and widely distributed in the inland water systems of the Dominican Republic.

Potential ecological and socioeconomic impacts. Many characteristics of the group make them very invasive and virtually impossible to exterminate once established. Fecundity of loricariids is from 500 to 3 000 eggs per female, they provide parental care as well. They are facultative air breathers (Armbruster, 1998), highly tolerant of polluted and hypoxic waters and can adapt rapidly to varying water quality conditions; their armored body and strong spines offer protection against potential predators (Mendoza-Alfaro *et al.*, 2009). The air-holding structure is the stomach, and it is always full of air allowing the fishes to use the water column unlike most loricariid catfishes which are exclusively found attached to the substrate (Jonathan W. Armbruster, pers. obs.). *Pterygoplichthys* spp. are also capable of surviving mesohaline conditions (up to 10 ppt salinity) for extended periods of time, allowing for the use of estuarine and coastal areas for dispersal (Capps *et al.*, 2011).

Various serious socioeconomic and ecological implications have been linked to the establishment of *Pterygoplichthys* species in nonnative ranges. Male *Pterygoplichthys* dig holes in banks as nests, and in Hawaii and Puerto Rico. These burrows have been linked to erosion, sedimentation, and elevated turbidity in reservoirs and streams (Devick, 1989; Bunkley-Williams *et al.*, 1994). *Pterygoplichthys* species in the Philippines and in Florida are thought to be competing with native fishes for resources and may be altering food web dynamics (Hubilla *et al.*, 2007; Hoover *et al.*, 2014). In Lake Okeechobee, Florida, population increases of *P. multiradiatus* between 2005 and 2006 were associated with reduced Catch Per Unit Effort of native fishes (Mendoza-Alfaro *et al.*, 2009).

Pterygoplichthys species graze on algae, benthic organisms, and detritus, and they may potentially affect indigenous invertebrate communities as well as alter the ecology of a water body by reducing the amount of energy available to other herbivores (Nico *et al.*, 2009). They might consume the eggs of native species of fish and invertebrates as well as compete for food with other herbivores, causing declines in the abundance and biodiversity of fish and invertebrates populations (Hoover *et al.*, 2014). An experimental study in Thailand showed that *P. pardalis* in aquarium conditions, fed on eggs and fry larvae of *O. niloticus* (Chaichana & Jongphadungkiet, 2012). It is possible they predate on eggs of species that are important for the river fisheries of the country. They also could feed on the eggs of other native egg-laying fishes such as the ones of the genus *Rivulus*, *Eleotris*, *Dormitator*, *Gobiomorus* and *Nandopsis*.

Sailfin catfishes have been observed burrowing in the nests of blue tilapia (*O. aureus*), this disturbance could lead to the fish abandoning the nest therefore reducing reproductive success. (Hoover *et al.*, 2014). In the Dominican Republic no risk assessment on the impact of this species has been done, but local fishermen consider it responsible for the decline in catches of commercial species, which has had a direct impact in the quality of life of the communities that depend on fisheries.

Recommendations. Eradication of this species, once established, is not typically feasible (Hill & Sowards, 2015), hence the aim should be preventing future introductions of this and other potential invasive species in the wild. The best way of accomplishing this is by developing policies that hinder the introduction of potential invasive species and educating the public on the importance of not releasing unwanted aquarium fishes into natural water bodies.

Extensive monitoring in particularly vulnerable ecosystems such as mangroves, estuaries, lagoons, and streams must be made across the country. In particular, a combination of collection and environmental DNA (eDNA) sampling might generate important insights. eDNA is useful in detecting the early stages of an invasion when traditional sampling methods cannot yet detect the presence of a species (Ardura *et al.*, 2015; Dougherty *et al.*, 2016). Early detection would be more likely to aid in the successful contention and eradication of the invasives.

The governmental authorities along with civil society (mainly the most impacted sectors such as fishermen) must make an assessment of the risks and impacts of this species as well as present a management plan. The economic feasibility of exploitation of the fish should be evaluated. The use of the fish in various ways should be promoted, in order to take advantage of their abundance and as a way of possibly reducing their numbers in specific locations. The feasibility of this fish for human consumption in the country should be studied. Although the species is edible, Chavez *et al.* (2006) did not recommend the consumption of *Pterygoplichthys* spp., collected in a lagoon in the Philippines, as food due to potential bioaccumulation of heavy metals and *E. coli*. However, in some areas of South America, *Pterygoplichthys* species are among the most common fishes collected by fishers (Garcia *et al.*, 2009; Castello *et al.*, 2013).

This fish could be used for the production of commercial animal food, as has been recommended in Thailand (Panase *et al.*, 2018). In the Philippines, Hubilla *et al.* (2007) recommended its use as fertilizer as well as the skin for home décor and crafting.

CONCLUSIONS

The Amazon sailfin catfish (*Pterygoplichthys pardalis*) is inferred to be established and widely distributed in the Dominican Republic and presents many potential threats to biodiversity and fisheries. This constitutes the first report of the species for Hispaniola. Dates and cause of introduction are uncertain but it might be the result of an intentional aquarium release. The possibility of more than one species of the genus presented is discussed as well as the need for a management plan for the control of the species.

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