CITES-COP19:
PROVISIONAL LIST OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II AS RECEIVED 23 JUNE 2022

Consideration of Proposals for Amendment of Appendices I and II

(*Potamotrygon albimaculata, P. henlei, P. jabuti, P. leopoldi, P. marquesi, P. signata* and *P. wallacei)*

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CONVENTIOON OF INTERNATIONAL TRADE IN ENDANGERED ESPECIES OF WILD FAUNA AND FLORA

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CONSIDERATION OF PROPROSALS FOR AMENDMENT OF APPENDICE II

A. Proposal

This document proposes the inclusion of *Potamotrygon wallacei* and *Potamotrygon leopoldi* in CITES Appendice II in accordance with Article II of the Convention and satisfying criteria A and B for the inclusion of species in Appendix II of Resolution 9.24 (Rev. Cop 17).

Potamotrygon wallacei is an endemic stingray species from the middle Negro River basin, in Brazilian Amazon, with a high habitat specificity (Oliveira et al., 2017; Duncan et al., 2016) and can be found in the areas of small creaks and the flooded forests (igapós) (Araújo, 1998, Carvalho et al, 2016a).

Potamotrygon leopoldi is also an endemic stingray species, to the Xingu River and two of its tributaries, in Brazilian Amazon, and inhabits the rocky bottoms of rivers (Charvet-Almeida, 2006).

Both are k-strategy species, with slow growth, late sexual maturation, and low fecundity, which make them vulnerable. Furthermore, the habitat degradation by deforestation, wildfires in Amazônia Forest, construction and operation of hydroelectric power plant, agricultural expansion, fisheries for food and ornamental trade, are treats that may result in population declines. (Araújo et al., 2004; Charvet-Almeida, 2009, Charvet et al., 2018, Araújo, 2020a; Charvet et al., 2022)

The regulation of trade in the species is required to ensure that the harvest of specimens from the wild is not reducing the wild population to a level at which its survival might be threatened by continued harvesting or other influences, in accordance with the Criteria B of Annex 2a (Conf. 9.24, Rev. CoP17). Although *P. leopoldi* is categorized in the IUCN as DD, and *P. wallacei* was never evaluated, a new assessment is underway, and with the new data on population dynamics and increasing threats to both species, the situation should change to any degree of extinction risk. The regulation of trade in the species is necessary to avoid it becoming eligible for inclusion in Appendix I near future, considering the Criteria A of Annex 2a (Conf. 9.24, Rev. CoP17).

This proposal also includes look-alikes endemic freshwater stingray species that are on the ornamental fish trade legally as *Potamotrygon henlei* and illegally as *Potamotrygon albimaculata, Potamotrygon jabuti* from the black stingray group. The illegally exported species such as *Potamotrygon marquesi* and *P. signata* of the brown stingray group such as *P. wallacei* in accordance with Criteria A of Annex 2b (Conf. 9.24, Rev. CoP17).

Potamotrygon is the most diverse genus within the subfamily, with 31 valid species. Even with several taxonomic studies, difficulties in the precise delimitation of its species persist. The descriptions based on a few individuals with a superficial analysis of characters of significant intraspecific variation, such as the dorsal coloration of the disk, could cause inaccurate taxonomy and are often not the leading cause of illegal trade (Araújo, 2021; Fontenelle et al., 2021; Charvet et al., 2022).

B. Proponent: Brazil*

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* *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

C. Supporting statement

1. Taxonomy

1.1 Class: Chondrichthyes, sub class Elasmobranchii

1.2 Order: Myliobatiformes
1.3 Family: Potamotrygonidae, sub-family Potamotrygoninae
1.4 Genus, species or subspecies: *Potamotrygon leopoldi* (Castex & Castello, 1970)
Potamotrygon wallacei (Carvalho, Rosa & Araújo, 2016);
1.5 Scientific synonyms: *Potamotrygon leopoldi:* No synonyms
*Potamotrygon wallace*i : *Disceus thayer*i; *Potamotrygon histrix*;
Potamotrygon motoro (Carvalho et al, 2016a)
1.6 Common names: *Potamotrygon wallacei:* cururu stingray, Raia, Arraia , porcupine stingray.
Potamotrygon leopoldi: Xingu River Ray, Leopolds Stachelrochen, Hvidplettet flodpigrokke, Witgevlekte zoetwaterrog, White-blotched River stingray, Valgetäpiline jõerai, Mustajokirausku, Arraia, Raia.

1.7 Code numbers: Not applicable

2. Overview

Brazil proposes *Potamotrygon leopoldi* and *P. wallacei* for listing in Appendix II of CITES following Article II. 2(a) of the Convention and Resolution Conf. 9.24 (Rev. CoP17), in recognition that the ornamental trade may have a detrimental impact on the status of the species.

Potamotrygon leopoldi is a neotropical freshwater stingray endemic to the Xingu River and two of its tributaries, the Iriri and Curuá rivers. *P. leopold*i is considered the most valued Brazilian stingray in the ornamental market. It is a medium to large size ray species with a black dorsal pattern, white or beige spots and drawings, white or whitish belly (Charvet-Almeida, 2006). The dorsal coloration patterns of this species make it extremely attractive to aquarists. In addition, those species have a beautiful flashy color pattern that potentiates the interest of ornamental species.

Furthermore, besides being caught as juveniles for ornamental purposes, they are also fished for food. The targeting of fisheries for this last purpose has increased in recent years, especially on adult stocks. Another factor that added mortality to the adult portion of the *P. leopoldi* population was capturing individuals to form a breeding stock for cultivation establishments in Asia, the European Union, and North America. This fact started in 2003, before the Belo Monte Hydroelectric Power Plant construction, and intensified between 2005 and 2011. Nowadays, Brazilian companies are just suppliers of matrices for the ornamental market, which increases the pressure on the wild populations, of species such as *P. leopoldi.* The scenario of being caught in all phases of the life cycle (juveniles and adults) can cause an increase in fishing mortality to values close to the fishing mortality rate that could cause the species to become extinct (Charvet et al., in preparation). In addition, *Potamotrygon leopoldi* has restricted geographical distribution and faces the loss of habitat integrity in the Xingu River, caused by the growth of the agricultural frontier, increase in ranching, mining, and construction of the Belo Monte hydroelectric power plant (Charvet et al., 2018).

Potamotrygon wallacei is a neotropical freshwater stingray from the Middle Negro Rivers basin, Amazonas State, Brazil. It is a small species found in the margins of flooded forest areas (Igapós), has low fecundity and growth, late sexual maturation, is endemic, sedentary, and has high environmental specificity, establishing well-defined populations in its occurrence area. Unfortunately, those features impose low gene flow, reducing its resilience to direct and indirect impacts such as fishing and environmental changes (Carvalho et al., 2016). Demographic studies have indicated that if ornamental fishing mortality has an addictive effect on the population, the equilibrium is compromised, and occurs a reduction in population growth of 3.3% a year. The data point out the necessity to control the trade for freshwater stingrays (Araújo & Lessa, 2015). The species is more vulnerable to changes in its essential habitat than *P. leopoldi*. Recently after fires were observed in the flooded forest in Negro River basin, maintaining the populational equilibrium was compromised, and a reduction in population growth of 4.17 % per year was estimated (Araújo, 2020b).

P. wallacei is a recently described species of stingray. In the ornamental market, this species was called *P. histri*x. *P. histrix* is endemic to Paraná-Paraguay River basin. In the stock list of companies in Peru and Colombia, “True Hystrix” and “Colombian Hystrix” can be seen. However, these denominations refer to

*Potamotrygon orbignyi (*Araújo, 2020a). This confusion makes it difficult to trace P. wallacei in the ornamental market. In addition to *P. orbignyi*, *P. wallacei* can also be confused with another stingray species with a reticulate pattern, *P. marquesi*, and sometimes with *P. signata.*

List potamotrygonins under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix III in 2017 did not improve the necessary trade data. Appendix II is qualified to show the supply and international market demand for these species. Appendix II will also provide valuable support for regional and national fisheries management regulations agencies.

3. Species characteristics

3.1 Distribution

Potamotrygon leopoldi is endemic to Xingu River drainage in the lower part of the Amazon Basin, including the Iriri and Curuá rivers, at Pará State, and the main tributaries of the Xingu River, in Mato Gross State, Brazil. Throughout its distribution, *P. leopoldi* prefers areas with substrates with rocks, pebbles, and sand, which causes the species to occur in a pattern of spots along the Xingu River (Charvet-Almeida, 2006). It reaches a maximum size of 72 cm disc width (DW).

Potamotrygon wallacei is endemic to the middle Rio Negro drainage in Amazonas, Brazil, occurring from Santa Isabel (River Téa) down to Rio Cuieiras in the vicinity of Manaus (Carvalho et al., 2016). However, the population around Manaus was formed after 1997 due discard of ornamental companies located in Manaus City (Duncan et al., 2016). It reaches a maximum size of 31 cm disc width (DW) (Araújo, 1998).

The species occurs only in specific habitats such as black water small streams with low pH and dissolved oxygen levels and bordered with by flooded forests area (Araújo, 1998, Duncan & Fernandes, 2010, Oliveira et al., 2017).

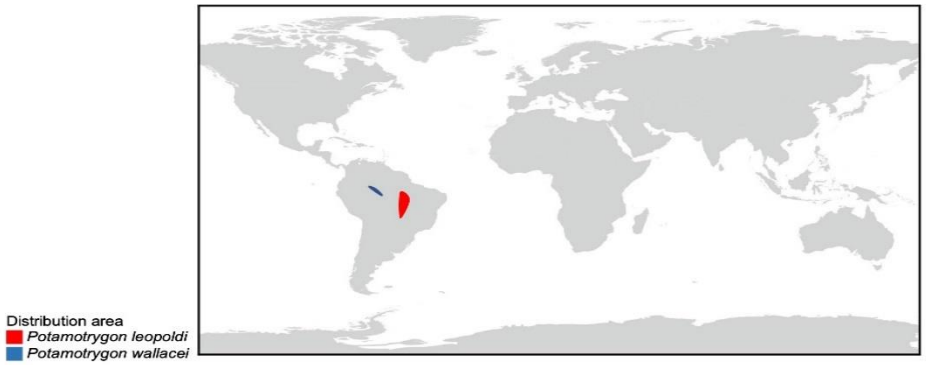

Figure1: Distribution area of *Potamotrygon leopoldi* at Xingu River drainage and *Potamotrygon wallacei* at Negro River drainage, in Brazilian Amazon.

3.2 Habitat

During the hydrological cycle of the Negro River, the habitat of *P. wallacei* undergoes periodic expansions depending on the rainfall regime. In the dry season, the species occupied the margins of islands and black water streams and flooded forests in the rainy season. This stingray strongly prefers habitats with a leafy bottom and shallow water (50 cm depth). The water is poor in oxygen (2.0 mg/l), has low pH (3.0-4.0 pH), and has an average temperature of around 25 ºC) (Araújo, 1998; Duncan & Fernandes, 2010; Carvalho et al., 2016; Duncan et al., 2016). At least 42 essential areas are essential habitats for this species throughout its range distribution. In the other habitats identified in the Middle Rio Negro as a sandy beach, sandbank, and river channel, this species does not occur. This fact restricts the area occupied by the species throughout its distribution (Araújo, 1999;2004).

Potamotrygon leopoldi has preferred to inhabit water up to 3.0 m in areas with substrates with rocks, pebbles, and sand. Near the city of Altamira, the Xingu River presented an area named “Cotovelo,” where *P. leopoldi* occurred mainly (Charvet-Almeida, 2006).

3.3 Biological characteristics

All freshwater stingrays have matrotrophic viviparity with lipid histotrophic as a mode of reproduction (Charvet et al, 2005).

Potamotrygon wallacei has an annual reproductive cycle, with copulation in the ebb of Negro River and parturition in the dry season. The sex ratio is 1♂:1♀. The female first maturation size is 173 mm in disc

width, and the male 170 mm. The gestation time is three months, and an average uterine fecundity of 2 embryos/female ranges from 1 to 5 embryos/female (Araújo, 1998, Charvet et al., 2005, Morales-Gamba et al., 2021). The brood size correlates with the mother's size (Araújo, 1998, Charvet et al., 2005). The birth size is 90 - 100 mm in disc width. In years of strong El Nino, there are rising numbers of pregnancies per reproductive cycle, and the average fecundity of the population increases to 4.0 embryos/female. However, in the following breeding season, the average fecundity of the population is reduced to 1.0 female/embryos (Araújo, 1998). The maximum observed age for males was six years old, and for females, the maximum age was eight years old. Therefore, the generation length was estimated to be 3.9 years from 1996 to 2006. For this period, demographic studies indicate that with the regulation of a quota of 6000 units of stingrays allowed for export by ornamental fishing and the habitat not degraded, this species presented a population growth rate of 1.056 year (Araújo & Lessa, 2015; Araújo, 2020a).

Potamotrygon leopoldi has an annual reproductive cycle, with copulation in the flooding of the Xingu River. Birth starting with the dry season. The female first maturation size is 431- 460 mm in disc width, and the male 341- 370 mm. The gestation time is four months, and an average uterine fecundity of 4.84 embryos/female ranges from 1 to 11 embryos/female. The brood size correlates with the mother's size. The birth size is 109 - 149 mm in disc width (Charvet-Almeida, 2006). The age of first maturation is 3 - 4 years for males and 5 - 6 years for females . The maximum observed age for males was seven years old, and for females, the maximum age was fourteen years old. Therefore, the generation length was estimated to be 7.3 years from 2003 to 2006 (Charvet et al., 2018). For this period, demographic studies indicate that with the regulation of a quota of 5000 units of stingrays allowed for export by ornamental fishing and the habitat not degraded, this species presented a population growth rate of 1.007 year (Charvet et al, in preparation).

3.4 Morphological characteristics

All species of the genus *Potamotrygon* exhibit polychromatism, making coloration a dubious criterion in separating some species for an inexperienced observer.

Potamotrygon leopoldi is a medium to large species with a dark greyish to black dorsal pattern, with white or beige ocelli and letter-like drawings, a white or whitish ventral color; tail with small ocelli (Charvet-Almeida, 2006) and at least two roughly parallel rows of thorns along the tail and tail defensive spines. It is endemic to the Xingu River basin. The dorsal coloration patterns of this species make it extremely attractive and valued by aquarists. It resembles *P. henlei*, an endemic of the Tocantins-Araguaia River Basin, but differs in dentition (teeth more numerous and smaller) and number of tail thorns (more numerous) (Carvalho, 2016a). In the ornamental fish trade, some color patterns of P. leopoldi cause mistaken identification as *P. motoro,* species with wide distribution in neotropical regions. From 1990 to 2002, this was a strategy used to illegally export P. leopoldi (Araújo et al., 2004). *P. motoro* has no ocelli in the tail. Other species that can lead to misidentification with *Potamotrygon leopoldi* are *Potamotrygon albimaculata* and P*otamotrygon jabuti*, both endemic species of the Tapajós River. Both species are prohibited from being exported from Brazil.

P. jabuti has dorsal disc greyish brown, grey to greenish black, with an ornate variable pattern composed of yellow or golden spots grouped within larger, golden irregular outlines forming large ocelli (Carvalho, 2016b). *P. jabuti* has no ocelli in the tail.

P. albimaculata has dark brown to black dorsal disc, covered with numerous round white small spots on the dorsal disc, pelvic fins, and tail base; larger spots are usually on mid-disc, but smaller white specks are present on the tail and along the disc margins (Carvalho, 2016b). In the ornamental fish trade, the species is named P-14, or Itaituba Stingray.

P. wallacei is small freshwater stingray with dorsal surface of disc light brown, with black irregularly shaped vermiculate markings forming an amphora- or Ω-shaped figure on mid-disc, delimiting light brown reniform areas at disc center, and with subcircular light brown ocellate markings on disc margins (Carvalho et al., 2016).

The vermiculated pattern presented by the species in the dorsal region caused it to be confused with *Potamotrygon histrix. P. histrix* is confined to Paraná-Paraguay basin. According to Carvalho (2016a), *P. wallacei* resembles the *Potamotrygon orbigny* in being pale brown with darker brown or blackish markings but lacking its fine reticulations.

In ornamental trade, *P. wallacei* until now is named *P. histrix.* In CITES stingray export records, Peru and Colombia appear as exporting countries of the *Potamotrygon histrix* species in South America, along with Brazil. In Peru and Colombia, the species is named “Colombian Hystrix” to export data. However, these designations refer to the species *Potamotrygon orbignyi.* When purchasing “hystrix,” importers believe they are buying *P. wallacei* (known in the market as “True Hystrix”) (Araújo, 2020a).

The black stingrays (*P. leopoldi*, *P. henlei, P. albimaculata)* used to be the most common in the market.

Mainly the *P. leopoldi* with “Black Diamond” color pattern. The interest in the black ray *P. henlei* and *P. albimaculata* seems to have decreased in the last five years, mainly after the appearance on the market of *P. boesemani* (endemic o Suriname) and *P. marquesi.* However, interest in the *P. jabuti* remains with high value. In addition to the color pattern, this species can easily hybridize and produce albino offspring (Prang, 2020a).

Potamotrygon marquesi has a dorsal disc background, usually beige with grey tonalities, and light to dark brown mixed with shades of grey (Silva & Loboda, 2019) and a vermiculated pattern like *P. orbignyi.*

3.5 Role of the species in its ecosystem

Freshwater stingrays are opportunistic species. The availability of prey items in the environment where these stingrays live influence their diets (Shibuya et al, 2009). No natural predators for freshwater stingrays' species have been recorded in the literature.

Potamotrygon leopoldi is an opportunistic species with teeth adapted for durophagy. It consumes various food items and there are ontogenetic variations but with a preferentially malacophagous diet. It plays a role as a top predator in the Xingu River food web (Charvet-almeida, 2006).

The diet of *Potamotrygon wallacei* indicates generalist feeding habits based on the consumption of crabs, shrimps, and gomphid dragonflies. Although the fish teleostean occurs in diet, this prey item contributed very little to the diet of this stingray species. The trophic level was identified as intermediate, suggesting that *P. wallacei* plays a role as a mesopredator in the food web in the “igapó” environment (Shibuya et al., 2009).

4. Status and Trends

4.1 Habitat trends

In general, freshwater habitats and the biodiversity they support are especially vulnerable to human actions and environmental changes (Dungeon et al., 2006).

Potamotrygon wallacei has high habitat specificity (Araújo, 1998; Duncan et al., 2010; Oliveira et al, 2016). In this case, the species' susceptibility to population reduction is increased. Therefore, changes in the environment caused by external factors can alter the rate of population renewal by compromising survival or reproductive potential (Pierce and Bennett, 2010), such as observed in *P. wallacei* and as well *P. leopoldi.* Between September 2015 and March 2016, fires occurred in Middle Rio Negro, and they affected the essential habitat of P. wallacei. As a result, around 30% of flooded forest in the area with the highest abundance of the species was lost. In this scenario, Araújo (2020) observed the reduction of the generational length from 3.9 to 2.9 years, only with natural mortality. The maximum age observed was five years old (Araújo, 2022). The reduction of the maximum observed disc width from 31.0 cm to 24.0 cm and the absence of females over five years old indicate the loss of the population reproductive potential caused by habitat damage.

P. leopoldi prefers rocky or sand-rock substrates. Unfortunately, part of the essential habitat of Potamotrygon leopoldi located downstream of Xingu River near the city of Altamira was flooded by the construction of the Belo Monte Hydroelectric Power Plant in 2011 (Charvet in prep.). As a result, it interfered with the hydrodynamics of the Xingu River and it changed the biotic and abiotic factors of the area (Coura et al., 2021). This fact has caused the disappearance of an essential habitat of P. leopoldi in the Xingu River (Charvet et al., 2018). Charvet (2022) observed the reduction of females' minimum maturation size ten years after the construction and complete operation of the Belo Monte Hydroelectric Power Plant. It is significant in reducing the reproductive potential of this species because, according to Charvet –Almeida (2006), the uterine fecundity of P. leopoldi is influenced by the size of the female, which impacts the species' number of offspring and consequently the population demography. Besides the Belo Monte power plant, there is an increase in mining in the Xingu River with confirmation of environmental contamination by heavy metals (main mercury) in the mid and upper Xingu River, with sediment runoff coming mainly from the Fresco River (Charvet-Almeida, 2006, Araujo, 2016, Ribeiro et al. 2017, Tófoli et al. 2017, P. Charvet and Y. Torres pers. obs. 2021). In addition, embryo malformations have been observed in litters caught in the middle Xingu River (Charvet-Almeida, 2006).

4.2 Population size

Direct quantification of the population size of freshwater stingrays is difficult due to the difficulty of accessing the entire range of their distribution. Nonetheless, Charvet et al. (2018) and Charvet et al. (in

prep.) provide population information for *P. leopoldi* based on validated growth studies, and population dynamics models see sections 4.3 and 4.4.

To *P. wallacei* there are information for overall populations in the distribution area based on age and growth studies and population dynamics models (Araújo & Lessa, 2015; Freire, 2015; Araújo, 2022; Araújo & Lessa, in prep.) see sections 4.3 and 4.4.

4.3 Population structure

Charvet (2006) identified at least two different populations of *Potamotrygon leopoldi* at Xingu River. The construction of the Belo Monte impoundment certainly caused changes in the Xingu River hydrologic cycle and therefore changes in the reproductive cycle of this species. Other predicted impoundments along the Xingu River and projected to ensure the water supply to Belo Monte Hydroelectric Plant would certainly interfere with the genetic flow and genetic diversity of this species in this basin.

P. leopoldi exhibits sexual segregation. The population sex ratio is 1♂: 1♀, and the ratio between the immature and mature is 1:1 (Charvet-Almeida, 2006).

Potamotrygon wallacei is a sedentary species, with well-structured populations in its distribution area, with a pattern of sexual segregation and ontogenetic segregation (Araújo, 1998; Oliveira et al, 2016, Belém, 2020). At least 14 different populations were identified in Middle Rio Negro. The genomic studies identified hierarchical genetic structuring of the *P. wallacei* population along its distribution area. The structure is caused to the geographic distance among populations and the partial isolation between the margins (Belém, 2020). The sex ratio is 1♂: 1♀, and the ratio between the immature and mature parts of the population is 1:1. The species has sexual and ontogenetic segregation in the flooded forest (igapó). Newborns, young of the year, and pregnant females at the end of gestation occur in the same area. Juveniles and adult male occur together, and pregnant female in the early and middle gestation occurs in an area with a high oxygen level (Araújo, 1998, Oliveira et al., 2016).

Demography studies indicate that the year classes 3 and 4 for *P. leopoldi* (Charvet et al., in prep) and 1.5 to 3 for *P. wallacei* are the most significant classes that affect population growth (Araújo, 2020a; Araújo & Lessa, in preparation).

4.4 Population trends

According to Charvet et al. (in prep.), the mean natural mortality rate (M) of the *P. leopoldi* is 0.27 (range from 0.19 to 0.36) prior to the Belo Monte Power Plant construction. With the addition of hypothetical fishing mortalities (F) to the stochastic natural mortality by age, it was observed that only those lower than 0.150 allow the population to remain in equilibrium ($\lambda = 1$). The interest in the ornamental market on this species is high; *P. leopoldi* fishing mortality is probably up 0.15. The Leslei matrix indicated that when the maximum limit of F for maintaining the populational equilibrium (0.150) at different ages classes was added to the values of M, the only scenario it was possible to estimate positive population growth values (with an annual increase of 2.8%), was with catches up to three years of age class. These ages correspond to a 20-30 cm disc width (DW). They are considered of high interest for the aquarium trade. In all scenarios, F values greater than 0.150 will lead to important population declines. This value is below the estimated fishing mortality rate that could lead the species to extinction 0.36 (Charvet et al. In preparation).

Potamotrygon leopoldi is the most valuable freshwater stingray exported from Brazil. These data suggested that any additional fishing mortality up to 0.2 can lead the species to a high extinction risk.

The trend of population is probably decreasing in area named “Cotovelo,” around Altamira city.

*P. wallace*i has a mean natural mortality rate (M) of 0.52 (ranging from 0.32 to 0.64) from 1996 through 2006. The natural mortality of the first-year class was 0.75. The fishing mortality (F) based on the fishery monitoring program in the area with high fishing pressure has a value of 0.7. The target part of the population for the ornamental market is stingrays between 0 to 1.5 years. If the fishing activity is captured from the population, stingrays which die naturally, the population grows ($\lambda = 1.056$) (Araújo, 2020a).

The Leslei matrix indicated that when F has an additive effect on the population, maintaining the populational equilibrium is compromised, and occurs a reduction in population growth of 3.3% a year. The data point out the necessity to control the trade for freshwater stingrays (Araújo & Lessa, 2015).

Data recent after fires (2015-2016), in the flooded forest of the area with a high density of *P.wallacei,* the estimated mean natural mortality rate was (M) 0.58 (range from 0.28 to 0.92). The Leslei matrix indicated that maintaining the populational equilibrium is compromised, and a reduction in population growth of 4.17 % per year was estimated. Therefore, a closed fishery for four years and a quota reduction for the species were suggested for this area (Araújo, 2022).

The trend of population is decreasing in 30% of its distribution area and stable in 70 % of its distribution area (Araújo, 2022).

4.5 Geographic trends

P. leopoldi is distributed along the Xingu River. However, the connectivity of populations along the middle and upper Xingu course is unknown. In their study, Charvet and collaborators (in preparation) identified two distinct populations, one located in the area of Cotovelo in the Municipality of Altamira, and another located next to the Fresco River in the Municipality of São Felix do Xingu. The population parameters for the two populations indicate that in the two localities, the minimum size of maturation was lower than that determined by Charvet-Almeida (2006) for the Altamira locality in the period 2003-2006.

For *Potamotrygon wallacei*, the populations observed in its natural distribution area are in two different situations. In the region of the Itu-Bafuana- Daraquá River System, the population is decreasing by a 4.17% year. In the other eleven different populations on left and right margins of Negro River and around Barcelos Municipality the population situation is stable (Araújo,2022).

The population in the vicinity of Manaus the status is unknown.

See 4.4 section

5. Threats

Ornamental fishing is the greatest direct threat to The Xingu Freshwater Stingray. Besides, P*. leopoldi* populations are under additional threats, such as mining, agricultural development, cattle grazing expansion, dams, and climate change (Charvet et al. in preparation). The fishery pressure for the international ornamental aquarium trade is a serious concern to this species. The species was intensively fished for the international ornamental aquarium trade from the 1990s to 2006 (especially in the area around the city of Altamira (Charvet-Almeida, 2006). However, after 2006, because of the Belo Monte Hydroelectric Power Plant construction, the ornamental fishing effort moved upstream to the São Félix do Xingu city region. The ornamental fishers have visited the ornamental capture areas in São Felix do Xingu to catch specific color patterns of *P. leopoldi* since 2002, such as black diamonds stingrays. Nowadays, most specimens traded as ornamental fish come from the São Félix do Xingu region (Y. Torres and P. Charvet pers. obs. 2021).

The increase in fishing *P. leopoldi* for human consumption and observations of stingrays killed by local community act like additional fish mortality and can put the species near extinction (see section 4.4). Other stingrays are discarded or have tails mutilated by fishers.

The increase of mining in the Xingu River vicinity is a severe threat to this species. Environmental contamination by heavy metals (primary mercury) in the mid and upper Xingu River is already registered in the water. Alteration of water turbidity caused by sediment runoff coming mainly from the Fresco River modified the water quality of the Xingu River (Charvet-Almeida, 2006, Araujo 2016, Ribeiro *et al.* 2017, Tófoli *et al.* 2017), P. Charvet and Y. Torres pers. Obs. 2021

According to The Observatório do Clima study, in 2018, the municipality of São Felix do Xingu emitted 29.7 million tons of CO2 equivalent into the atmosphere. The origin was deforestation (for agricultural development) and cattle ranching. Climate changes have already been observed in the Xingu River drainage area. The length of the wet and dry seasons and fluctuations in the pluviometry levels along this basin has already altered (Lucas *et al.,* 2021). These likely impact the species as the reproductive cycle of the Xingu Freshwater Stingray is linked to these seasonal changes (wet and dry periods) (Charvet-Almeida, 2006). Furthermore, water temperature in the Xingu River has risen at least 2ºC in the past 20 years, which can alter the life cycle of *P. leopoldi* (P. Charvet unpubl. data 2022).

Potamotrygon wallacei has been under fishing pressure for the international ornamental fish trade since the end of the 70 decades. It is the second stingray of Negro River to suffer from tail mutilation, and due to injuries caused by sting, local riverine people used to kill Wallace stingray (Araújo, 1998).

The ornamental fishery discards many animals in intermediation points at Barcelos and Manaus municipality. As a result, the individuals do not return to the original population, and a new population has been established in the Manaus vicinity (Araújo, 2005; Belém, 2020).

According to Araújo (1999, 2004), the post-capture mortality and rejection of some individuals cause the difference observed between the capture number and export numbers of *Potamotrygon wallacei.* The rejected animals did not return to their original population, which causes fishing mortality in these populations to range from 0.46 to 0.7 (Araújo, 2020a; 2022).

More rigorous control of the ornamental trade will better understand the factors that influence fishing mortality.

The preferred habitat for cururu stingray is under intense degradation caused by fire and deforestation (Araújo, 2020). Recent studies have demonstrated that the igapo area has a medium risk of plastic contamination in the Middle Rio Negro (Amazonas et al., 2022). Climate change has a strong influence on the cururu stingray reproductive cycle, as demonstrated by Araújo (1998), Marcon et al. (2020), Morales-Gamba et al. (2021). The duration of the dry and rainy season can affect the species' reproductive potential see section 4.2. Moreover, compromise the recruitment of parental stock.

6. Utilization and trade

6.1 National utilization

The traditional use of individuals of the *Potamotrygon* genus is for international ornamental trade. In Brazil, the local trade for stingrays is not regulated. In social media, it is common to find the individuals of P*otamotrygon leopoldi* and *P. wallacei* to sell outside the limits established by Brazilian law (Prang, 2020b).

Recently, *P. wallacei* was commercialized in the southern states of Brazil with the name of *Potamotrygon motoro* (Araújo, 2022). Nowadays, São Felix do Xingu is the area with the highest concentration of fishing activity due to having the airport with access to Manaus, Belém, Recife, Fortaleza, and São Paulo, which facilitates access to export warehouses (personal comm. Patricia Chavert). This cause the exportation of *P. leopoldi* from different Brazilian states, which can difficult the quota control by the brazilian regulatory agency and CITES Management Authority.

Besides *Paratrygon aiereba* and *Potamotrygon motoro*, the fishing of *P. leopoldi* for human consumption is rising. At least to *Paratrygon aiereba*, the stock has declined already (Araújo, 2011), and MMA classifies the species as critically endangered (ICMBIO, 2018). As demonstrated in section 4.4, additional mortality in fishery mortality can put *P. leopoldi* at extinction risk.

6.2 Legal trade

The current legislation IN No. 204/2008 (MMA/IBAMA, 2008) determines a quota of five freshwater stingrays' species (*Potamotrygon henlei, P. leopoldi, P. orbignyi, P. schroederi and P. wallacei)*, which can be exported legally from Brazil. Furthermore, a limit of the maximum export size in disk width permitted to be exported for each species has been established. However, the quota system has poor compliance and monitoring and represents threats to the species as handling and transportation can increase mortality (Rincón & Charvet-Almeida, 2006).

The black rays are the most sought-after ornamental freshwater stingrays in all ornamental markets (Asia, Europe and North America). Potamotrygon *leopoldi* is the most popular stingray in Asian countries, followed by the *P. jabuti.* The variety of species and variations is much smaller in the Asian market than in the North American and European markets. However, the trade emphasizes varieties and color patterns that generally generate higher prices. In this sense, the most sought-after coloration patterns of *P. leopoldi* are those from fishing areas located in São Félix do Xingu. The international demand for the aquarium trade has declined due to captive breeding facilities supplying more attractive and valuable color pattern hybrids to the aquarium market (P. Charvet pers. obs. 2021). The hybridization process by Asian breeders began around the year 2000. By 2020, they have two decades of crossbreeding to create animals of varying patterns and colors, that of value far above the animals of nature (Prang, 2020b). Nowadays, the international demand for the aquarium trade has declined due to captive breeding facilities supplying more attractive and valuable color pattern hybrids to the aquarium market (P. Charvet pers. obs. 2021).

The European market seems to be the most complex, as the stingrays come from nature (South America Countries), from local breeders, and are imported from Asian countries and the United States. It also has a larger domestic market than in Asia and North America. *Potamotrygon leopoldi* is the most popular stingray, particularly the albino individuals and hybrids of the species with *P. jabuti (*Prang, 2020b)

Potamotrygon leopoldi is the most popular stingray in the United States and Canada. P. leopoldi, *P. henlei,* and *P. jabuti* get the high prices in North America ornamental trade, particularly albinos and hybrids with larger spots and/or atypical dorsal color patterns (Prang, 2020b).

After the inclusion of the species in Appendix III of CITES on January 3, 2017, there was no record of exports of *P. leopoldi* from Brazil, despite the capture. However, in the CITES records (CITES, 2020), there is only the exportation of *P. leopoldi* from Asian countries. Furthermore, in the CITES records, the export of species identified only as Potamotrygon spp. The consumer market for *Potamotrygon* spp is like that for *P. leopoldi.* Therefore, it reinforces the assumption that a significant percentage of *Potamotrygon* spp exported from Brazil may be constituted by *P. leopoldi* above the size allowed for exportation (disc width >35.0 cm) and/or *P. jabuti* (Prang, 2020b; Charvet et al, 2022) (Table 1).

There is a record of P. *leopoldi* exported from the Czech Republic to the United States. In the register,

the animal origin is wild. This fact could indicate the re-export of the species from Brazil since this record appears as an animal from nature. The other records of *P. leopoldi* refer to animals from cultivation, where one of the matrices comes from nature (Prang, 2020b).

Traceability of individuals from cultivation is easier in the European Union and the United States than in Asia. There is a capillarity of the ornamental market within Asia, which prevents understanding the dynamics of commercialization in these places. The difficulty is caused by the high number of domestic breeders and points of sale such as local markets and fairs (Prang, 2020c).

Since 1998, *P. wallacei* can be exported under a quota regime from the state of Amazonas. Nevertheless, interruptions have occurred in the periods 1999 - 2001 and 2006 – 2007 (Araújo, 2020a). Germany is the primary importing market for the species (Araújo, 2020a). During this period, more than 50% of the export quota of the species from Amazon state referred to a company that operated by selling only to one major distributor in each country. This distributor either sold to physical stores or exported the product within the Asian continent. The scope of this company's production chain allowed the insertion of *P. wallacei* in a significant number of markets (Araújo, 2005; Araújo, 2020a). The rest of the quotas, approximately 50% of the total exported, were divided by three other exporters, which operated differently. One of the exporters only worked with a large distributor in the Netherlands, which received the product and distributed the stingrays to its branch in the United States and physical stores in different European countries. Two other exporters company worked selling both to large distributors and physical stores. Moreover, only one exported mainly to physical stores (small buyers) (Araújo, 2005). The closed of the leading exporter from the Amazonas state in 2009 changed the market profile for this species. As a result, the number of import markets decreased by 24%, mainly in Asia. Another fact that influenced the shrinking market for *P. wallacei* in Asia was the difficulty in reproducing this species in captivity on a large scale (Araújo, 2020a). No offer of breeder *Potamotrygon wallacei* was found in any Asian country. This difficulty is due to the specificities of the species' reproductive cycle. *P. wallacei* is outside the group of black stingrays and compare of other stingrays listed in the group of brown rays as *P. marquesi,* its reproduction in captivity is difficult. *P. marques*i is an illegal species exported from Brazil and used in hybrid production (Araújo, 2020a; Prang, 2020b). However, captive breeding of *P. wallacei* on a small scale has occurred in the United Kingdom, Germany, and the Netherlands. In addition, the production of hybrids with *Potamotrygon motoro* has been reported in the United States and the United Kingdom. (Ara[ujo, 2020b).

P. wallacei species has been on the market since the late 70s but was named *P. histrix.* However, the species *P. wallacei* was only described in 2016 (Carvalho et al., 2016) (See section 3.4). In CITES stingray export records, Peru and Colombia appear as exporting countries of the *Potamotrygon histrix* (the wrong identification of *P. wallacei* species) in South America beyond Brazil. However, this would not occur if, Normative Instruction N$^{o.}$ 204/2008 (MMA/IBAMA, 2008) corrected the name of *Potamotrygon* cf. h*istrix* to *Potamotrygon wallacei*. Therefore, the data of “True Hystrix” and “Colombia Hystrix” in CITES need to be clarified to proper species reference if it is *P orbignyi* or *P. wallacei* (Araújo, 2020; Prang, 2020b). (See section 3.4).The registration of Indonesia as an exporting country of *P. wallacei* in the CITES records can indicate an error in the identification. Otherwise, it could be the species imported by Indonesia from other countries such as the United States and Germany prior to registration in CITES (CITES,2020). For example, in official records from Brazil, in the period 2003 as of 2018, there are no records of exports from Brazil to Indonesia of the species *P. wallacei* (Araújo, 2020a).

6.3 Illegal trade

In the seizure records of freshwater stingrays between the years 2002 to 2018, 54.7% represents *P. leopoldi.* In the seizure records of P. wallacei, the quantities are not noted. The greatest cause of occurrences of *P. leopoldi* was attributed to the lack of license from the competent body to capture, transport or export species (SIFSC Freeland, IBAMA (2020)

A total of five companies requested an exportation quota of 4.498 for the export of *P. wallacei* to 2022 (MAPA-SAP, 2020). This number represents 75% of the quota allowed for export (6000 units). Therefore, it exceeds the new quota suggestion for this species of 2.500 individuals (Araújo,2022).

6.4 Parts and derivatives in trade

See section 6.2

The species *P. leopoldi* is the main species exported and the first in the number of individuals seized in Brazil's official record of seizures of stingrays. According to Araújo (pers. com.), 30% of the stingrays identified as *Potamotrygon motoro* exported from Amazonas state were P. leopoldi (Araújo, 2005; Prang, 2020b). In 2003, prior to the Belo Monte Hydroelectric Power Plant construction, there was a search for

adult individuals of P. leopoldi, aiming at breeding in captivity. These adults were illegally exported from Brazil. After 2005, commercial breeders were willing to pay premium prices for P. leopoldi adults to start breeding the species immediately, which caused the export of individuals above the maximum size allowed by IN 204/2008 (IBAMA, 2008). In 2009, the productive sector of Pará state requested to increase the size limit of the export of P. leopoldi (Ramos et al., 2009).

The analyses of CITES records (CITES, 2020) allow identifying the number of freshwater stingrays illegally exported from Brazil. In Brazilian law, IN No. 204/208, any species nominated as sp, such as Potamotrygon sp, could not be exported from Brazil. However, the registration occurred only by the importing country because the species cannot be marketed and exported as ornamental in Brazil. The export records identified as Potamotrygon spp may refer to prohibited species exported from the black stingray group *Potamotrygon jabuti* and *P. albimaculata;* or *P. marquesi* from the brown stingray group. As well the adult individuals of P. leopoldi. In the register, the importing countries indicate that the origin (captivity or nature) of the species is unknown (Prang, 2020b).

Potamotrygon jabuti appears in the CITES registry as bred in captivity, indicating that at least one of the matrices came from nature. *P. jabuti* is endemic to Brazil and is the second species in number in the seizures carried out by IBAMA (Prang, 2020b).

Other worried situation was the record of Par*atrygon aiereba,* a critically endangered species in MMA Ordinance No. 445 of December 17, 2014., and illegal to be exported from Brazil (Table 1).

In the records of Potamotrygon hybrids, all are identified as bred in captivity, but with the possibility that one of the matrices originates in nature and refers to nominal species illegally exported. Although the export quota control occurs in Brazil, containing the illegal exit of species from the country requires a more effective way than including freshwater stingrays in Appendix III.

Table 1: Export Data of freshwater stingray from Brazil. The data 2003 – 2005 refered only to Amazonas states export. Export data between 2003 - 2005 (IN036/2003, and IN052/2005) and 2009 - 2016 (IN 204/2008). (Source 2003 –2016, IBAMA database; 2017 – 2018 CITES database).

Years	***Species***						**Observation**
	P. henlei	*P. leopoldi*	*P. motoro*	*P. orbigny*	*P. schroederi*	*P. wallacei*	
2003	343	375	7367	1058	545	3524	From 2003 to 2005 about 1108 individuals of *P. henlei* exported were in fact *P. albimaculata,* and 7122 individuals of *P. motoro* were *P. jabuti* 5341 individuals of *P. motoro* were *P. leopoldi*, 315 individuals of *P. orbignyi* were *P. marquesi* and about 315 individuals of *P. schroederi* were *P. wallacei* (Araújo in prepration) IN 036/2003 and IN 052/2005
2004	758	806	7166	1236	218	6041	
2005	562	1259	3271	533	286	1111	
2006	Legal export was suspended						Illegal capture and export of stingrays, mainly *P. leopoldi*, *P. jabuti*, and *P. albimaculata*, occurred.
2007							
2008	13	57	110	62	18	14	The leading exporting company of ornamental fish in Amazonas has closed, which cause a reduction in *P. wallacei* export numbers (Araújo, 2020a).IN 204/2008
2009		37	296	50	0	51	Illegal capture and export of stingrays, mainly *P. leopoldi*, *P. jabuti*, and *P. albimaculata*, occurred. *P. leopoldi* was export of parental stock.
2010	105	220	156	94	3	30	
2011	155	3287	88	8	0	1317	
2012	76	3547	306	2	0	1300	
2013	25	259	79	15	0	11	
2014	153	4069	79	46	0	1044	
2015	336	1626	418	38	0	225	
2016	6	172	31	0	0	0	
2017	-	-	-	-	-	-	
2018	-	-	-	6100	-	982	In 2018, the Administrative Authority of Brazil did not authorize export quotas of freshwater stingrays to aquarium trade due to the lack of fisheries monitoring and new studies on the population status of the main species exported to the trade. CITES data (2020) indicates the absence of P. leopoldi, P. henlei, and P. schroederi from

							Brazilian exports. I Instead, there are records of the critically endangered *Paratrygon aiereba, Potamotrygon* spp, and *Potamotrygon falkneri*. *Potamotrygon* spp can mean P. jabuti, P. albimaculata, P. leopoldi adults, a new color pattern of a nominal species, or even an undescribed species. Brazilian legislation does not allow the export of *Paratrygon aiereba* and *P. falkneri*. The most alarming data is the registration number of *Potamotrygon orbignyi*; according to the market trend, this species is in the group of brown stingrays and therefore does not have a significant export (see years 2003-2005 and 2009-2016). These data may refer to *Potamotrygon marquesi, Potamotrygon albimaculata, Potamotrygon jabuti,* and any freshwater stingray showing a reticulate rosette-like color pattern (Araújo et al., in preparation)

6.5 Actual or potential trade impacts

The growth of the ornamental market for freshwater stingrays is based on production of hybrid and albino specimens of freshwater stingrays. So, the pressure on new species or the search for new coloration patterns of already known species tends to increase. In this sense, the market for illegal species needs to be accounted for in South American countries such as Brazil. The decline in exports of black stingrays occurred when exports of *P. boesemani* (Suriname) and *P. marquesi* (Brazil) increased (Prang, 202c). Within the group of reticulate stingrays (*Potamotrygon humerosa, P. marque*si, and *P. orbignyi)*, *P. marque*si has the highest sales values by the unique patterns of individuals used to produce hybrids with *P. leopoldi* "black diamond" and *P. jabuti.* Currently, the highest sales values are for hybrids of *P. motoro* with *P. leopoldi* and *P. motoro* with *P. marquesi.* Like Brazil, the other South American countries (Peru, Colombia, Suriname) are just suppliers of matrices for the ornamental market, which increases the pressure on the wild populations, mainly of species such as *P. leopoldi (Prang, 2020b;2020c).*

See sections 6.3 and 6.4

7. Legal instruments

7.1 National

Potamotrygon leopoldi and *Paratrygon aiereba* are the only freshwater stingray species included in the National Plan for Threatened Amazonian fishes (PAN Peixes Ameaçados da Amazônia, ICMBIO, 2018). However, no conservation measures have been implemented. At least 25% of *P. leopodi* distribution area is in the Xingu River Extractive Reserve (ICMBIO, 2012) a protected area at Altamira Municipality, but there is no conservation measure for the species in the reserve management plan.

In the *Potamotrygon wallacei* distribution area, there is no protected area implemented with an established management plan. On the other hand, there are two fully protected conservation units in the low Rio Negro basin, but there is no registered *P. wallacei* occurrence.

The freshwater stingrays are subject to a single law in Brazil, the legislation IN 204/2008 that regulates the export quota of five stingray species occurring in the states of Amazon and Pará. The legislation also restricts the size of the capture for each species. However, there is no regulation for freshwater stingray species under fishing pressure for human consumption, such as *P. leopoldi, P. motoro* and *Paratrygon aiereba*.

7.2 International

There is no international legislation that protects freshwater stingrays from the Potamotrygoninae subfamily. Only CITES Appendix III inclusion (CITES, 2017), but there is a need to control the potamotrygonin trade better and including the species in Appendix II should be addressed by the international community (Charvet et al., 2022).

8. Species management

8.1 Management measures

Despite the vulnerability of *P. leopoldi* to different threats, the critical point is the total respect by the productive sector of the legislation to guarantee the sustainability of ornamental fishing to *P. leopoldi*. Based on demographic studies, the export quota revision should occur every two years.

The studies of population dynamics in the curse have shown that the exported quota must be evaluated at least every two years for *P. wallacei (*Araújo & Lessa, 2015). Suppose ornamental fishing occurs if there is no management, there is a decrease in population of 18,8% per year. The quota system regulates the fish effort. In a species with a strong relationship between the number of parental stock and the number of new recruits, limiting the maximum size to be exported protects the parental stock (Araújo, 2020a).

Besides the species' essential habitat conservation, better control of the international trade measure such as those established in Appendix II should be considered.

8.2 Population monitoring

Currently, there are no official fisheries monitoring programs in Brazil. The last bulletin published was in 2011, being unspecific for information about the fishery of freshwater stingrays for food and completely absent of information about the fishery of aquarium trade. The last official monitoring program happened in 2005. After this time, it just happened through the individual initiative of some researchers.

8.3 Control measures

8.3.1 International

Since 2019 Ibama (Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis), the CITES (Administrative Authority) and the federal environmental agency in the country, have not authorized the export of freshwater stingrays of the subfamily Potamotrygoninae for ornamental purposes. Even though a federal regulation (IN 204/2008) determines export quotas for five species of the *Potamotrygon* genus, there are no monitoring data and research about the potamotrygonin species' population status.

8.3.2 Domestic

There is no specific legislation for the harvest and domestic trade of Potamotrygon. Only general rules applied to the registration of fishers, vessels, and closed seasons in the hydrographic basins due to reproductive periods of migratory species.

8.4 Captive breeding and artificial propagation

Captive-bred hybrids are fertile hybrids used for sequential generation breeding (Y. Torres and P. Charvet pers. obs. 2021). There is a very high concern that these hybrids could be released in nature, especially in the Xingu Freshwater Stingray range area.

Compared to other markets the degree of hybridization of *P. leopoldi* in the Asian market is more significant than North America and the European Union. *P. leopoldi* is more targeted for crossbreeding than any other freshwater stingray species. The most valued patterns are “Black Diamond,” “White Diamond,” and “Super White.” The “Super White” and “White Diamond” patterns are distinct strains from different breeders in Asia. “White Diamond” patterns are just “Black Diamond” (BD), selectively bred over several generations that have very large white spots. “Super White” and “White Diamond” are hybrid strains (Prang, 2020b).

8.5 Habitat conservation

See section 7.1

8.6 Safeguards

9. Information on similar species

See section 3.4 and

10. Consultations

11. Additional remarks

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