

TECHNICAL PAPERS SERIES

Field study on the population status of three species of freshwater stingrays *Potamotrygon motoro*, *P. orbignyi*, *P. falkneri* (Elasmobranchii: Potamotrygonidae) in the Peruvian Amazon, taking into consideration the stakeholders' perceptions in relation to the value chain

Author: Alfredo Pérez Lozano, Biologist, e-mail: piracatinga@yahoo.com.br

Abstract: The Ministry of Production (PRODUCE) of the Republic of Peru, identified and entrusted the Bioamazon Project the conduction a field study, under Component 3, on the state of exploitation of three species of freshwater rays (*Potamotrygon motoro*, *P. orbignyi*, *P. falkneri*) in the Peruvian Amazon, used as ornamental fish. This paper is part of the field trip report in March 2022, to the city of Iquitos, Department of Loreto, through river crossings on the Nanay, Ucayali, and Amazon rivers. The trip aimed to collect data to support population studies of the species in its main capture areas, as well as to learn about the appreciation of various stakeholders in relation to the production chain of these stingray species.

Key words: Amazon, freshwater stingrays, ornamental fishery, Iquitos, Peru

BACKGROUND

The Regional Project for the management, monitoring, and control of species of wild fauna and flora threatened by trade (Bioamazon Project), managed by the Amazon Cooperation Treaty Organization (ACTO), with the financial support of the German Government through the German Development Bank (KfW) has the purpose to contribute to the conservation of the Amazonian biodiversity.

Some species of the wide ichthyological richness of the neotropical region are included in some category of risk of extinction. Among the threatened species are the freshwater rays of the Potamotrygonidae family, which are used as ornamental fish, and are included in Appendix II of the Convention on International Trade in

Endangered Species of Wild Fauna and Flora (CITES).

The Ministry of Production of Peru (PRODUCE) considered it was essential to study the population status of three species of freshwater rays from the Peruvian Amazon (*P. motoro*, *P. orbignyi* and *P. falkneri*), used as fish ornamental. The Bioamazon Project was requested to carry out the study within the framework of Component 3, in order to strengthen sustainable management initiatives and traceability mechanisms for species threatened by trade.

The current Peruvian legislation that regulates the capture, transport, commercialization, and export of freshwater stingrays for the ornamental market, is governed by the current legal framework, made up of Decree Law 25977-1992 of the General Fishing Law; the Regulation of the General Fishing Law (Supreme Decree No. 012-2001-

PE); and the Peruvian Amazon Fisheries Management Regulation (Ministerial Resolution No. 147-2001-PE). According to Araújo (1998), owing to the peculiarities of their reproductive cycle, the export quotas for freshwater stingrays of the Potamotrygonidae family must be reviewed every two years.

The data available from CITES (2020) and from the Ministry of Production of Peru (PRODUCE) show that, within a time horizon 2000 to 2021, the volumes of exports of the species (*P. motoro*, *P. orbignyi* and *P. falkneri*) with origin in the Department of Loreto have shown a continuous decline since 2010 (Figure 1), and until the most recent records (2017);

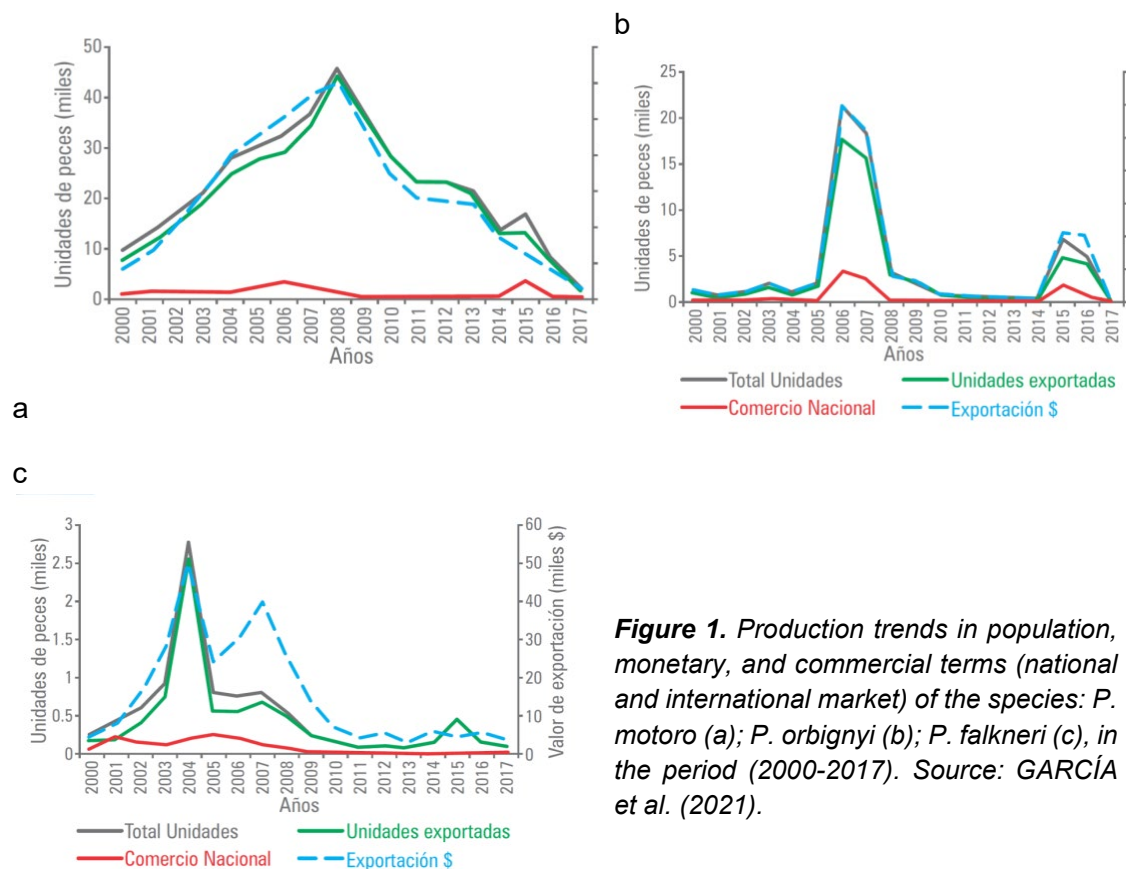


Figure 1. Production trends in population, monetary, and commercial terms (national and international market) of the species: *P. motoro* (a); *P. orbignyi* (b); *P. falkneri* (c), in the period (2000-2017). Source: GARCÍA et al. (2021).

and the trends until 2021 have maintained little variation with the reported volumes. In this sense, a field trip to the Peruvian Amazon (March 2022) had the objective of learning about the population status of these species and the causes of the decrease in catches, and about the current situation of the stingray trade in the region from

the opinion of the several stakeholders in the value chain of its commercialization. Accordingly, updated data was collected in the region, for which the main capture areas (Momón and Itaya rivers) were visited, along with the collection centers for export (aquariums), in Iquitos; research centers (IIAP and UNA) and government

agencies (DIREPRP-Loreto); and some fishing communities on the Nanay River (Santa Rosa) and on the Ucayali River (San Marcos).

THE AMAZON BASIN

Upon arrival in Iquitos, it was observed that the lowland forests are the dominant

landscape in the Department of Loreto, crossed by a hydrographic network formed basically by the Amazon basin, Ucayali, Nanay and Marañón (BRACK, 1997). The relief, in general, is plain, made up of terraces in the area near the city of Iquitos (Figure 2).



Figure 2. Satellite map of the Iquitos region and surrounding areas. (Source: Google earth)

THE RIVER CROSSING

Upon arrival in the city of Iquitos, three river trips were organized along the Nanay, Ucayali and Amazon rivers, to observe the capture of fish in their natural environment in several locations considered as capture areas, to observe the methods of capture, as well as to

interview the fishermen and the various actors involved in the commercialization chain of freshwater stingrays in the Peruvian Amazon.

Nanay river

The hydrographic basin of the Nanay River is located in the Department of

Loreto, province of Maynas. It is a medium-sized basin in the Amazonian lowlands, and it is the only known river with blackwater-inundated habitats in Peru (Figure 3). It also houses the largest concentration of forests on white sand (varillales) in the country. It also contains terraced forests and low hills. In some lands, forestry, agriculture, and livestock are developed. The Nanay

River is a tributary of the Amazon, whose area is 1,750,737 ha, and its length is 529 km, with a maximum width of 545 m. The average speed during floods is from 0.58 to 0.62 m/s, the waters are acidic, poor in nutrients, with a sandy bottom and an average temperature of around 25°C (IIAP, 1996; MARENGO, 1998).



Figure 3. Hydrographic map of the region near Iquitos, Peru, showing some of the most visited areas for the capture of ornamental fish.

The trip along the Nanay River started from the Santa Clara de Nanay community. First, they passed through the mouth of the Momón River (Figure 4b) and entered Padre Concha (shell = horseshoe-shaped lakes), then they went up the Nanay River to the Ninarumi community (Figure 4a). In that community we were received by Mr. Pedro, a fisherman with considerable

experience in ornamental fish fishing. He introduced us to another group of fishermen of which half are called “rayeros” (named after stingray fishing). In the interview they explained in more detail the problem with the illegal gold mining dredgers that operate in the area of Santa María de Nanay, Libertad and Cerpera. They refused to take us to meet the community as they consider

the people from those places (the miners) are dangerous and many of the fishermen have already been threatened

by them. These circumstances forced us to return to Iquitos.



a



b

Figure 4. Landscape aspects of the Nanay (a) and Momón (b) rivers

Ucayali river

The hydrographic basin of the Ucayali is made up of 502 rivers and tributaries up to the fifth order. The Ucayali River is of vital importance since it constitutes the main communication route in the region. According to the National Inventory of Surface Waters (ONERN, 1980), the Ucayali River basin amounts to 351,549 km², its total length is 2,238 km and the

estimated average annual flow is 17,685.9 m³/s. The Ucayali River (Figure 5), together with the Marañón River, forms the Amazon River. It is an abundant river, long and winding, with numerous islands and horseshoe (shell) lakes. The dry season occurs from May to October, while the rainy season occurs from November to April (INEI, 2001).



Figure 5. Ucayali River, near the San Marcos shell

La Concha de San Marco is 48 hours upstream from Iquitos, on the Ucayali River. (Figure 6). We visited a community dedicated to fishing for stingrays, mainly *Potamotrygon motoro* and *Paratrygon aiereba*. The fishermen were kind and willing to answer all questions about the situation of the stingray fishery. Their general appreciation was similar to the opinion of people in Nanay River, that is, low prices

and low demand from exporters. Very few referred to the decrease of stingrays' stocks; however, many of them complained about the lack of basic needs (education, health, transportation), and technical assistance (fishing legislation, fishing technology and aquaculture) that should be provided by the government.

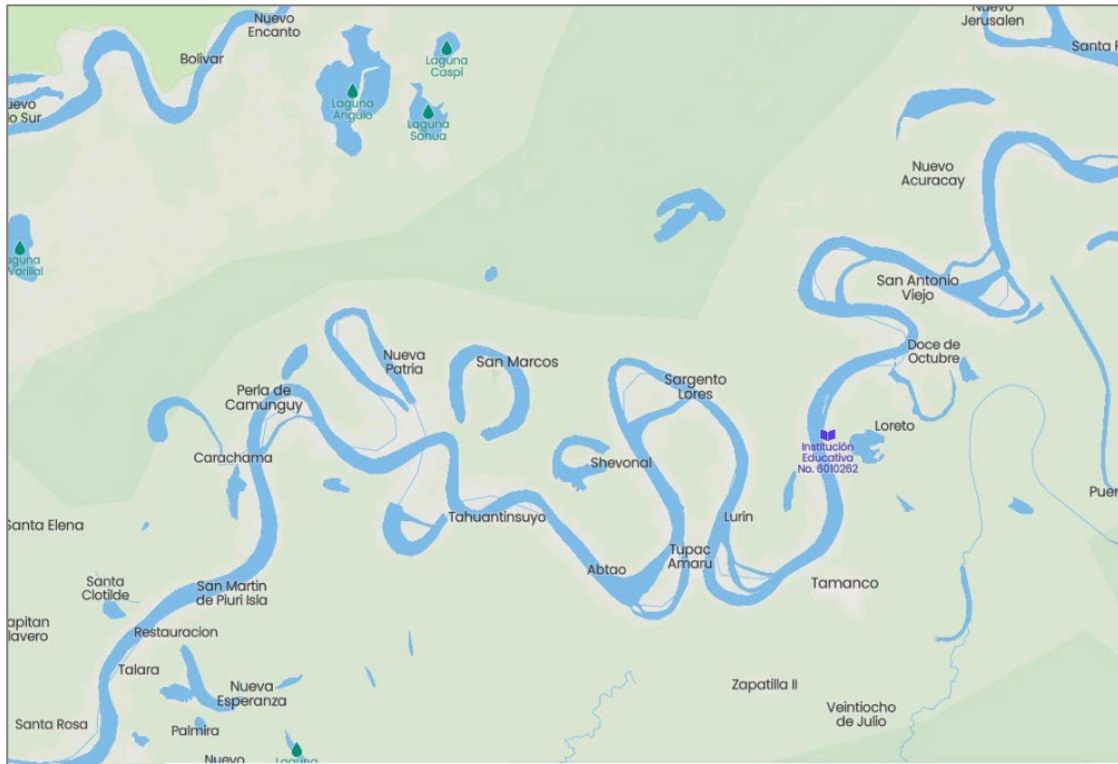


Figure 6. Location of the San Marcos shell, Ucayali River region, Peru.

Amazon River

We traveled up the Amazon River from Iquitos (Figure 7) to the Aucayo community. We observed several fishermen fishing for stingrays on the beaches recently flooded by the river,

using trawl nets called "bolicheras" that are dragged for 15 minutes by two motorboats. At the time of the recovery of the nets, the boats get together with the flow and without slowing down. The fishermen stated that the best time for fishing stingrays in the Amazon River is the empty and dry season.





Figure 7. Aspects in the capture of ornamental fish in the Amazon River (rays)

THE SPECIES

In the Peruvian Amazon there are 10 species of rays (*Potamotrygon motoro*; *P. orbignyi*; *P. falkneri*; *P. tigrina*; *P. constellata*; *Paratrygon aiereba*; *Plesiotrygon iwamae*; *P. nana*; *Heliotrygon gomesi*; *Heliotrygon rosai*), las especies más comunes son (*Potamotrygon motoro*; *P. orbignyi*; *P. constellata*; *Paratrygon aiereba*; *Plesiotrygon iwamae*) and those with the highest commercial value are (*Potamotrygon falkneri* y *Potamotrygon tigrina*). However, our work focused on three species (*Potamotrygon motoro*; *P. orbignyi*; *P. falkneri*), whose main characteristics are *Potamotrygon motoro* (motoro stingray) Figure 8a.

Diagnosis: The disk's dorsal surface is gray, brown, or beige. It has ocelli of variable sizes formed by three-colored rings (a yellow central spot, an orange intermediate ring and a black peripheral ring) distributed throughout the disc. The

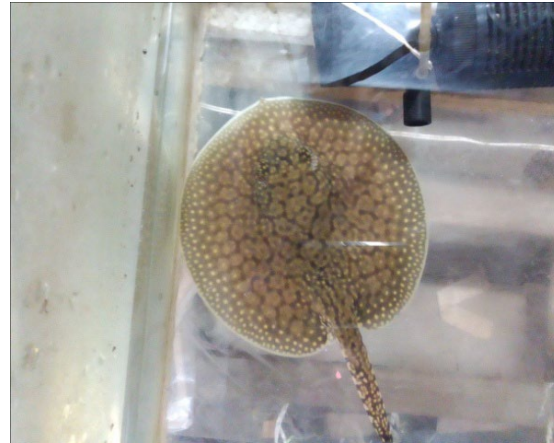
tail's length coincides with its body's length, and generally it has small circular spots and a series of short denticles that extend from the base to its middle part, from there a strong, long and saw-edged spine protrudes, which is replaced constantly.

Ecology and biology: Stingrays are carnivorous, fed mainly on molluscs, aquatic insects and small Characiformes, Siluriformes and Perciformes fish. It lives in clear and black water rivers, very occasionally in white waters, both in the bed of large rivers, lagoons, and pipes, as well as in flood zones.

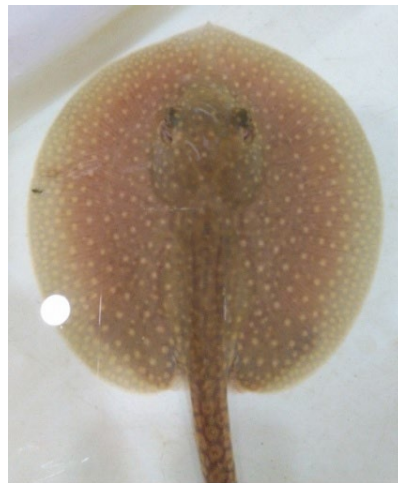
Commerce: Approximately 93% of the total specimens captured were exported and only 5% was commercialized in the country. The largest exports occurred between 2005 and 2010, with numbers greater than 27,000 individuals per year. The year 2008 registered the highest peak of export (44,217 individuals). (ROSA, 1985; PASIAN *et al.*, 2006; LASSO & SÁNCHEZ-DUARTE, 2012).



a



b



c

Figure 8. Picture of the three main species of stingrays commercialized in the Peruvian Amazon: *P. motoro* (a); *P. orbignyi* (b); *P. falkneri* (c).

Potamotrygon orbignyi (stingray motelo) Figure 8b

Diagnosis: The disk's dorsal surface is dark brown to black. It has a beige, brown, and/or black reticulate pattern that forms large round or hexagonal spots, which are sometimes arranged randomly as rosettes. The tail is smaller than the length of the body, and its back has dark or black transverse vertical bands and white bellies.

Ecology and biology: Stingrays are carnivorous, fed almost exclusively on crustaceans and small fish. It lives in all kinds of environments, both lotic and lentic, and in clear, black and white waters. Geographic record: Wide distribution in South America (Bolivia, Peru, Brazil, Venezuela, French Guiana, Guyana, Suriname). There are registries of stingray in Peru, in the Nanay and Ucayali rivers (San Marcos shell) from where the individuals are extracted for export purposes.

Commerce: The commercialization presents two export peaks. The highest peak encompasses more than 59% of the exported units (33,448 units) and was registered between 2005 and 2008; the second encompasses 16% (8,993 individuals) and was registered between 2014 and 2016. (REIS *et al.*, 2003; SHIBUYA; *et al.*, 2009; MORO *et al.*, 2011; LASSO *et al.*, 2013).

Potamotrygon falkneri (otorongo stingray) Figura 8c.

Diagnosis: The disk's color is dark brown on its dorsal area, with ocelli or light or orange spots of various shapes (circular, oval, vermicular and/or in rosettes), which are equal to or smaller in size than its ocular diameter.

Ecology and biology: Stingrays are fed mostly on molluscs, aquatic insects and fish. They inhabit blackwater riverbeds.

Commerce: Catches and exports of this species do not exceed 1,000 units, except for the numbers of 2004 (2,789 and 2,567 units, respectively), (REIS *et al.*, 2003; SILVA & CARVALHO, 2011).

ORNAMENTAL FISHING IN IQUITOS

According to Garcia *et al.* (2021), the export of ornamental fish dates to the 1950s and reached its peak between the 1960s and 1970s. At this time up to 5000 people became involved in the activity. The exporters transported their merchandise directly to Miami on charter flights. Controls and regulations were minimal, and thus thousands of fingerlings from Paiche and Arahua were shipped to the United States as ornamental fish (MONTREUIL, 1989; TELLO & CÁNEPA, 1991). At that time

10 species of fish dominated exports. In 1978 Peru alone exported 19,581,539 specimens of ornamental fish. In 1988, export volumes decreased to 5,939,771 units. Exports were operated by 30 companies in Iquitos, which sent 88.5% of the shipments to the United States, and the remaining 13% was sent to Lima to cover the national market and supply Europe, Asia (SOREGUI & MONTREUIL, 198; TELLO & CANEPA, 1991). Until 1988, ornamental fish were extracted from nine basins Napo, Mazán, Tacshacuraray, Curaray, Tamboryacu, Tigre, Ucayali, Amazonas and Nanay (TELLO & CANÉPA, 1991). Later (year 2000), the number of basins used for the extraction of ornamental fish increased, but with very low contributions. Between 2000 – 2017, more than 120 million specimens were captured, of which more than 80% were destined for export.

Currently (2022), 24 companies operate in Iquitos, six of which are dedicated to the trade of stingrays and other species, one works exclusively with Osteoglosidos, three with Siluriformes, two with Chelonios and aquatic Macrophytes and eleven are generic exporters (they work with all the species in the region), and one went out of operation due to the death of the owner (covid-19).

DIFFERENT VIEWS ON THE STATUS OF STINGRAY POPULATIONS

Fishermen's view

In the conversations held with the fishermen in the community of Santa Rosa and Belén (Figure 9), few fishermen are dedicated to the ornamental fishing of stingrays

comparing to 10 years ago. At that time, the fishermen were specialized in some taxonomic groups (catfishers, arowaneros and rayeros). During the stingray boom (2004-2009), its demand was so great that a specimen of *P.*

falkneri (20 AD cm) cost 1,200 soles (USD 326.30), and today it hardly reaches 100 soles (USD 27.20); it was a bonanza that many fishermen were not aware of.



a



b

Figure 9. Typical house of a fishing family (a); A fisherwoman starting the fishing tasks (b).

According to the fishermen, the low commercialization of these species is due to the low prices of the stingrays, and to the extreme care in the selection of the specimens (they cannot have wounds, bites, scars, amputations, injuries, etc.); for this reason, it is no longer a sought-after species, and only today, they are occasionally transported and marketed when they are captured by fishing gear. The fishermen consider that there is no overexploitation of the stingrays since the fishing pressure has dropped considerably in the last 10 years due to their low demand in the international market. And even at the time of the stingray boom, they failed to see or notice a drop in catch rates. However, many expressed concerns about the recent illegal gold mining activity in the middle and upper part of the Nanay River (since 2015), which

could lead, in the near future, to a situation similar to the environmental problem of mining in the Madre de Dios River (DEZA, 1996). According to the fishermen, they are obliged to fish in the Momon, Tigre and Pintuyaculas rivers since mining companies forbid them to go to the middle and upper part of the river. Consequently, the fish (stingrays) they capture in the lower Nanay die within a few hours of being captured, and they attribute this phenomenon to the activity of illegal miners.

The stingray fishermen of the Ucayali River have another vision, and they have observed a decrease in the abundance of stingrays, mainly *P. motoro*. In their opinion, there are still many easy to catch stingrays, however, they are not as abundant as 15 years ago. The fishermen of the Amazon River admitted

not having observed any trend of decrease in stingrays, but they did observe a decrease in their economic income due to the reduction in international demand for the commercialization of freshwater stingrays.

Intermediaries' view

This group of actors, located in district Belén (Figure 10), who intervene in the

ornamental fish value chain, normally have a more “holistic” view of the situation, since they work with fishermen in the region in different hydrographic systems (Cashew, Ucayali, Nanay, Napo, Putumayo). These people consider that 15-20 years ago, there could have been overexploitation of this resource, but that is no longer the case owing to the low demand for stingrays in the international market, and few fishermen (rayeros) are still encouraged to exclusively fish stingrays.



Figure 10. Housing and facilities of an ornamental fish intermediary in District Belén, Iquitos.

Exporters' view

According to the opinion of exporters dedicated to the trade of stingrays who were interviewed (Figure 11), all have mentioned that the reduction in exports is a commercial concern rather than the availability of specimens in the natural environment. They admitted that over a decade ago, Asian importers began breeding stingrays, and by 2010 they were trading captive-produced stingrays on a commercial scale.

In the final report of the South American Freshwater Ray Workshop (2009) (CITES, AC24 Doc. 14.2) it was already clear that the species were being reproduced and bred in captivity, in Asian countries, to be marketed both for domestic markets and for export to other parts of the world.

Possibly, the costs of international transport for its commercialization are lower from major Asian centers than from remote areas of South America, and captive breeding now offers a wider range of color patterns. The report also notes that freshwater stingray farming

operations were underway in Asia prior to the adoption of a moratorium on the export of stingrays from Brazil and have continued to expand significantly. Wingerter (2012) notes that as breeders

continue to increase production, they could flood the market with captive-bred products and neutralize the export of river stingrays from their areas of origin in the very near future.



Figure 11. Interviews with managers and owners of ornamental fish exporting companies (aquariums) in Iquitos, Peru.

Resource managers' view

Government officials in the fishing sector (Figure 12) consider that all stingray species are overexploited, as well as the rest of the fish resources that are commercialized (for human consumption or ornamental interest). Likewise, they think that this situation is

generated by the lack of access to basic public services (health, education, transportation, security) and the absence of formal jobs in the region that would allow them to improve their quality of life. This causes riverside communities to sustain their daily way of life through fishing.



Figure 12. Public servant of the fisheries statistics section of DIREPRO-L, in Iquitos, Peru.

Researchers' view

Apparently, there is no consensus among researchers on the status of stingray populations in the Peruvian Amazon (Figure 13). Some consider that there is an overexploitation of the resource in general, because the fishing pressure is real, and the trend is that it will continue to increase due to the natural growth of the human population in the region, and to the lack of employment opportunities other than fishing; However, they recognize that

there is a high natural variability in the interannual fluctuations in the abundance of stingrays, so that, without a population monitoring study, it is very difficult to establish reliable projections on the state of exploitation. In addition, this resource is not always accessible or available for fishing owing to the region's hydroclimatic conditions along with the flood pulse (JUNK, 1997) and the high spatial heterogeneity of the different Amazonian biotopes, not to mention the high operational and logistical costs of the fishing campaigns.



Figure 13. Researchers and facilities of the Research Institute of the Peruvian Amazon (IIAP).

Other researchers consider it audacious to think that there is overexploitation of the resource, without having periodic, continuous and reliable fishing statistics. On the other hand, they consider that it is unlikely that the resource is currently under overexploitation. Firstly, due to the drastic decrease in the demand for stingrays in the international market, in the last 10 years, owing to the development of techniques for their reproduction in captive conditions, in the countries of Southeast Asia. Secondly, because the fishing of stingrays is a very selective activity (the rays must be without deformations, without injuries, without mistreatment, without bites on the edges of the fins, without amputation of the caudal spines, etc.) so most stingrays are returned to the water alive, and this activity also requires care in the maintenance and transport of the specimens to minimize mortality, and therefore economic losses.

CONCLUSIONS

Based on the analysis of the different views on the state of exploitation of stingrays in the Peruvian Amazon by the

different actors involved in the commercialization chain of freshwater stingrays, the following conclusions were reached.

- The lack of basic information on the stingray fisheries in the region is overwhelming, considering their economic importance to the region.
- Gold mining in the Nanay River, oil exploitation in the Napo River, and contamination by sewage in the Amazon River are threats that increase progressively, daily, and without the application of mitigating measures.
- Despite the existence of different versions among the actors involved in the ornamental fish marketing chain about the state of exploitation of stingrays in the Peruvian Amazon, the annotations indicate that, apparently, the stingrays are not in a state of overexploitation.
- Most fishermen live in very deplorable conditions below the minimum desirable conditions for

a citizen, so this must be considered primarily for any fisheries management initiative based on this resource.

- DIREPRO-L needs to update its information technology infrastructure to generate reliable information for decision-making for the management of fishery resources.
- Exporters need clear rules for the sustainable use of ornamental fish, including stingrays.
- Scientific research centers in the region need to do less science to promote the academic excellence of researchers and more applied science in solving biological, ecological and environmental problems in the region.

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Published in the Bioamazon Newsletter, issue n. 14, March-April 2022.

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