REVISTA BIO CIENCIAS
http://revistabiociencias.uan.edu.mx
https://doi.org/10.15741/revbio.10.e1542
ISSN 2007-3380

Original article / Artículo original

Analysis of fishery landings of mota *Calophysus macropterus* in the Peruvian Amazon

Análisis de los desembarques de mota *Calophysus macropterus* en la Amazonia Peruana

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Please cite this article as/Como citar este artículo: Del Águila Chávez, J., Ríos Pérez, C., Ríos Ramírez, R. (2023). Analysis of fishery landings of mota *Calophysus macropterus* in the Peruvian Amazon. *Revista Bio Ciencias*, 10, e1542. https://doi.org/10.15741/revbio.10.e1542

Article Info/Información del artículo
Received/Recibido: June 27th 2023.
Accepted/Aceptado: October 11th 2023.
Available on line/Publicado: October 17th 2023.

ABSTRACT

Calophysus macropterus "Mota", has become a commercially important resource, because it has meat with a pleasant texture and good flavor, and is part of the daily consumption of the population; generating large economic income for the entire marketing chain. For the above-mentioned reasons, an analysis of the mota fishery in the Peruvian Amazon was carried out in the area to describe the fishing gear used, the type of bait used, landing volumes, and main markets. Fifty-five interviews were conducted between December 2019 and November 2020; 19 interviews were conducted from September to November 2020 with workers associated with its capture and commercialization in the departments of Loreto and Ucayali, Peru during the crescent and trough hydrological periods. The results showed that manual fishing is the most widespread with a fishing period that fluctuates between 5 to 7 days with an increase in catch volumes between 300 - 500 kg, as well as the use of fishing nets (trawlers) with a fishing period between 15 - 20 days and catch volumes of 500 to more kg. The use of river dolphins for mota fishing is reported in communities of Loreto and Ucayali (lower Amazon), so the case should be followed up; environmental problems are evident due to the use of bait from decomposing animals. We recommend the immediate presence of fishing authorities in the area to urgently regulate the fishing of the resource.

KEY WORDS: Fishery, Spotted Mota, Peruvian Amazon, *Calophysus*.

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ISSN 2007-3380

RESUMEN

Calophysus macropterus "Mota", se ha convertido en un recurso de importancia comercial, por presentar carne con textura agradable y buen sabor, siendo parte del consumo diario de la población; generando grandes ingresos económicos a toda la cadena de comercialización. Por lo antes mencionado se realizó en la Amazonia Peruana un análisis de la pesquería de la mota en la zona con la intención de describir las artes de pesca que usan en el área, tipo de carnadas usadas, volúmenes de desembarque y principales mercados. Se aplicaron 55 entrevistas entre diciembre 2019 y noviembre 2020; y 19 entrevistas de septiembre a noviembre de 2020 a trabajadores asociados con su captura y comercialización en los departamentos de Loreto y Ucayali, Perú durante los periodos hidrológicos de creciente y vaciante. Los resultados evidenciaron que la pesca manual es la más difundida con una faena que fluctúa entre 5 a 7 días con un aumento de los volúmenes de captura entre 300 – 500 kg, así como el uso de redes de pesca (arrastradoras) con una faena de pesca entre 15 – 20 días y volúmenes de captura de 500 a más kg. Se reporta el uso de delfines de río para la pesca de mota en comunidades de Loreto y Ucayali (bajo Amazonas) por lo que se debe hacer seguimiento al caso; se evidencia problemas ambientales por el uso de carnadas de animales en descomposición. Se recomienda la presencia inmediata en la zona de las autoridades pesqueras para generar un urgente ordenamiento pesquero del recurso.

PALABRAS CLAVE: Pesquería, Mota punteada, Amazonía Peruana, *Calophysus.*

Introduction

Peru is considered one of the most important countries in terms of fishery production by volume, observing over time that the diversity of small-scale fisheries has undergone profound changes with a substantial increase in their socioeconomic importance in Peru, becoming sources of employment and food security for coastal communities, however, despite this, little attention has been paid to artisanal fisheries (Gozzer-Wuest, *et al*., 2021). Initially, the fishery in the Peruvian Amazon showed various changes in the fishing gear applied to obtain food always focused on the subsistence of traditional populations, a situation that changed at present, from being a resource used only for consumption by nearby villagers to an important social, cultural and socioeconomic activity (Faria & Batista, 2019).

Recently, the mota fish (*C. macropterus*) has acquired commercial importance because it is a resource that enjoys a good appearance, meat with pleasant texture and good flavor becoming part of the daily consumption of the population; as a source of animal protein; generating in the same

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way economic income to anyone who is part of the direct marketing chain. The aforementioned characteristics make “mota” a species with aquaculture potential (Del Águila *et al*., 2019).

C. macropterus is the only species that is part of the genus *Calophysus*, part of the Pimelodidae family (Pérez & Fabre, 2009), which is widely distributed in South America, specifically in the Amazon and Orinoco basins, throughout Bolivia, Brazil, Peru, Colombia, and Venezuela (Salinas & Agudelo, 2000; Reis *et al*., 2003). Widely distributed in Peru along the Amazon, Ucayali, Marañón, Huallaga, Napo, Tigre, and Putumayo rivers; in other countries, it is known as piracatinga, water vulture or blanquillo with an approximate size of 30 cm in total length, with long spines and black spots on the dorsal area and below the lateral line; Its body color can vary from gray to dark brown, with the presence of some variants with the absence of spots, one of the most characteristic features being the presence of flat teeth stratified in one or two rows, unlike other fish of the family Pimelodidae.

Concerning its feeding type this is characterized by being necrophagous, although it can also feed on live fish, invertebrates, and plant material with a carnivorous and scavenger tendency, consuming fish remains and other dead vertebrates (Franco *et al*., 2016), it is considered a gregarious species that can be found at the bottom of the main riverbeds and in a smaller proportion in shallow lagoons being able to reach 4.4 kg in weight.

Thanks to its carnivorous tendency in countries such as Brazil, the presence of a *C. macropterus* fishery has been consolidated with the use of meat from dolphin species (*Inia geoffrensis*) and caiman (*Melanosuchus niger*) as bait for its capture, species that are found in the most threatened ecosystems in the world (Anderson *et al*., 2018), increasing pressure on their populations as human populations grow in lakes and rivers; likewise by the decline of commercially important species, undoubtedly generating negative impacts on these populations (Escobar *et al*., 2020).

According to Pereira *et al*. (2019), mota fish has a wide geographic distribution in the Amazon basin, with great abundance in the rivers and lakes of this basin, being a migratory fish that inhabits benthic environments and is most active at dusk, with omnivorous-opportunistic feeding habits, It feeds voraciously on animal and plant species, as well as fish carcasses, so it is considered necessary to know the new areas where this type of actions are used, which represent a threat to wild species that are used as bait and thus provide new data that help to act for their protection.

In the Peruvian Amazon, it has been observed that *C. macropterus* known in Peru as “mota” has been increasingly present in fishery landings, reflecting a significant increase in the catch of this resource, which has allowed it to be among the top 12 species caught in the Loreto Region and among the top 6 in the Ucayali Region (García *et al*. 2013). According to Escobar *et al*. (2020) in the last two decades in Peru and Colombia, there has been a considerable increase in landings of *C. macropterus* possibly due to the decrease in the abundance of the target species *Brachyplatystoma* Bleeker, 1862 known as “dorado” despite this, there are very few scientific

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studies conducted on this species, so for the area it is complicated the development of adequate strategies that allow having good monitoring and control of the fishery of this fishery resource (García *et al*., 2018).

Currently, the importance of the mota fishery in Peru has been increasing considerably, with an increase in "Mota" fishery landings observed in the main Peruvian Amazonian regions (Bonilla-Castillo *et al*. 2022), among these regions is Loreto, which is made up of the cities of Iquitos, Requena, Contamana, Nauta, Yurimaguas and Ucayali, with Pucallpa and localities of the Upper Ucayali River in the process of verification; however, this activity has generated a host of social and environmental problems with high impact repercussions and effects on the bodies of water of the Peruvian Amazon that are still in the process of review and specific localization.

To know the current status of *C. macropterus* mota landings in the Peruvian Amazon and the possible associated social and environmental problems, an analysis of the mota fishery in the Peruvian Amazon was carried out, to describe the fishing gear used in the area, types of bait used and their possible environmental impacts, landing volumes, main markets and thus generate recommendations to improve the potential coexistence of the activity without generating damage to the associated fauna present in the study area.

Material and Methods

To verify the environmental and social problems associated with landings of "mota" *C. macropterus* before the pandemic, we proceeded to conduct a reconnaissance inspection of the study area and confirm the current situation of the same, making contact with the main actors in the offices of the Regional Production Directorates (DIREPRO) of the Regional Governments of Loreto and Ucayali as well as all those belonging to the commercialization chain to give a subsequent formal start to the study.

Subsequently, the study was carried out in one of the three main basins of the Peruvian Amazon known as the Amazon or Atlantic Basin (lower Amazon) made up of the towns of Caballococha, Santa Rosa, and Leticia (Colombia); Ucayali from the city of Requena to the city of Pucallpa, Marañón the city of Nauta (Peru), including the communities of the influence and buffer zone of the Pacaya Samiria National Reserve (RNPS), which had a qualitative approach with a non-probabilistic sample, that is, its selection procedures responded to the judgment of the researchers.

The information on fishery landings was obtained through the random application of 74 semi-structured interviews distributed as follows: 55 interviews between December 2019 and November 2020; and 19 interviews from September to November 2020 applied to workers associated with the capture of the mota resource (*Calophysus macropterus*) from the departments of Loreto and Ucayali, Peru (Figure 1 and Figure 2), covering information two hydrological periods of rising and emptying present in Amazonian rivers.

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The interviews were specifically directed to *C. macropterus* mota fishermen, collectors, retailers present in nearby communities and wholesalers that distribute in the cities, and those responsible for meat packing plants (Leticia) to collect data on key actors, fishing methods and gear, marketing circuits and markets associated with mota, use of bait from wild animals, determination of the use of bait (fat, blood, and offal of cattle).

Due to the presence of the COVID-19 pandemic during the sampling period, it was necessary to work with key informants and experts in the mota fishery who had been contacted beforehand, so it was necessary to rely on the application of observation, telephone interviews, communication via social networks, including WhatsApp and text messages to develop an efficient proximity to the reality of the dimensions and perspectives on the social and environmental occurrence of the mota fishery in the Peruvian Amazon.

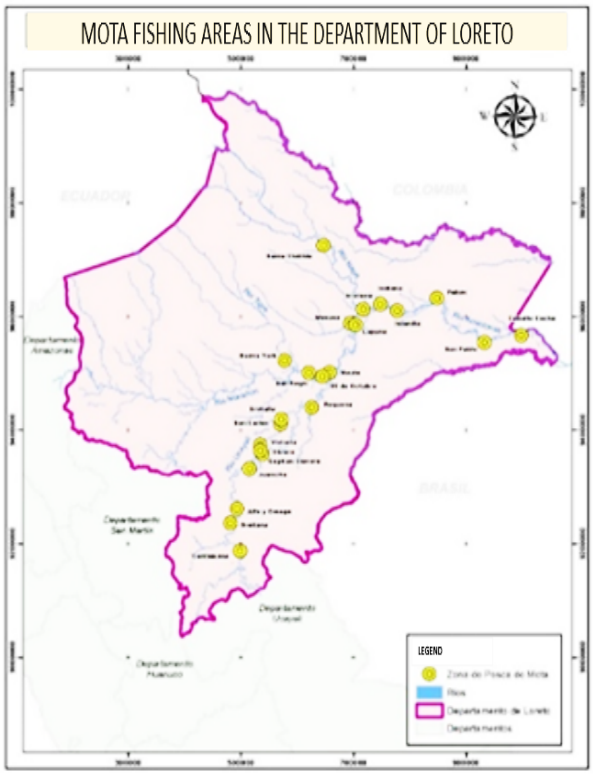

Figure 1. Fishing zones of the Mota *C. macropterus* resource in the department of Loreto.

Author's elaboration.

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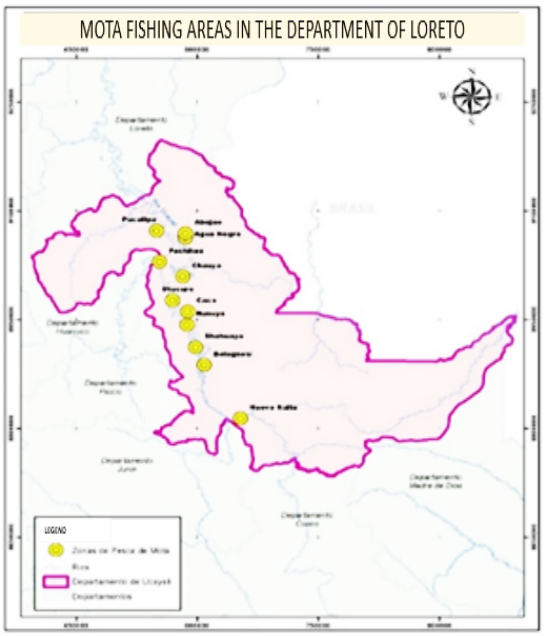

Figure 2. Fishing areas of the Mota resource *C. macropterus* in the department of Ucayali.

Author's elaboration

The results obtained were compared with the landing records of the Regional Production Directorates (DIREPRO) of the Regional Governments of Loreto and Ucayali.

The following instruments were developed:

a) Interviews with actors associated with the mota fishery, which served to collect information on the current reality in the study area, being part of the analysis of the mota fishery during the emptying season.

The surveys were applied to mota fishermen (as the main economic activity), to mota traders that operate in the Artisanal Fishing Landings (DPA), and to anyone who has their trade of buying and selling the mota resource in its different conservation modalities (fresh, salted or dried salted).

b) Open or unstructured interviews were applied to collect qualitative information on the resource under study through an investigative conversation, which covered a series of aspects of the mota fishery during the emptying season. Interviews were conducted with 09 key people, including officials from the Regional Production Directorates (DIREPRO) of Loreto and Ucayali

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(executive directors of Fisheries and those responsible for recording fishing information in the respective DIREPROs, traders, retired fishermen, specialists and park rangers from protected areas such as the RNPS and the Alto Purús National Park (PNAP), and finally the presidents of the Loreto and Ucayali Fishermen's Associations. The data were grouped according to the need to analyze the information obtained. Total, landings correspond only to fish landed fresh.

Once the results were obtained, they were presented to the executive directors of Fisheries, who are responsible for recording fishing information in the respective DIREPROs, and to the competent entities in the area of fisheries management.

Results and Discussion

Main mota catching areas

During the search for information, it was observed that the mota fishing zones are mainly distributed along the Ucayali and Amazon rivers. They are strategically located near the main collection centers and markets, as shown in Table 1. It was also observed that in the Ucayali River, the fishing areas are located between the town of Requena and the city of Pucallpa, with the main reference points being the section near the Tapiche River, Puinahua and the town of Bolognesi (upper Ucayali). The production generated in this section is stockpiled throughout the basin and its main stockpiling and trade centers are the towns of Requena and Pucallpa.

In the Amazon River, the most important fishing areas are near the city of Iquitos and the towns of Caballococha and Santa Rosa. In the case of Iquitos, because it is the largest market in the Loreto region, the mota usually comes from the Ucayali, Amazon, Napo, and Tigre rivers. The Ucayali River basin/Puinahua Channel is the area with the highest presence of mota fishermen, as it is where the "moteros" from the cities of Iquitos and Pucallpa converge. Another area with an active presence of mota fishermen is the Amazon River and, to a lesser extent, the Napo and Tigre River basins.

The interviews and surveys conducted with the mota fishermen (moteros) determined that the capture zones are the same in both the crescent and trough seasons; only 4 % of the mota fishermen interviewed mentioned that they are not the same zones.

Characteristics of the area where the mota is fished

According to what has been reported, the mota fishery is characterized by being carried out on the shore, generally with turbid waters and suspended solids, which give it a light brown coloration, especially in ravine areas (eroded by the river waters), with a slight presence of aquatic vegetation, among which stand out the "gramalote de agua" (*Paspalum sp*.) and "huama" (*Pistia stratiotes*) on the dry land, an area is usually chosen that is ravaged and has scarce tree vegetation, preferably an area with shrubby vegetation, including "platanillo" (*Musa sp.).*

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Table 1. Fishing zones according to elements of the Mota value chain.

District	String element	Fishing area
Belén	Fisherman	River Amazonas, Lupuna community height
Iquitos	Official	River Amazonas, middle and low section
Punchana	Collector	Rivers Napo y Tigre
	Fisherman	River Ucayali, height of the Tapiche River
Requena	Collector	Puinahua Canal
	Fisherman, Official	River Ucayali, sectors near Pucallpa
Pucallpa	Fisherman	River Ucayali, Aguas Negras height
	Fisherman	River Ucayali, Abujao height
	Fisherman	River Ucayali, Chauya height
	Fisherman	River Ucayali, New Italy height
	Fisherman	River Ucayali, upper section -Bolognesi

Author's elaboration

According to the information handled by the DIREPRO offices, the average depth in which the use of the speck is carried out is between 0.57 - 1.00 meters, with a transparency of the water fluctuating between 17.05 cm and 11.75 cm, However, this value may vary if it is a river that has little sediment load, in the same way, areas with low current speed are preferred, which can range between 0.16 - 0.30 m/s, a value that is equally. This way can vary according to the basin where the fishing takes place, however, according to the surveys carried out to carry out the fishing of the speck, areas of a few centimeters deep are required, this is because the bait must be placed at a shallow depth to have the control, on the contrary, if it is placed in deep areas, control of it is lost, in the same way, an area with little flow or current is preferred (so that the pork fat that is part of the bait can be slowly dispersed).

Description of fishing gear used (fishing methods and gear)

It was determined that the same fishing gear and tackle are used during the low and high tide season (Table 2), the most common being the following:

Hand fishing, turned out to be the most used because it is used when the fish are consuming the bait (composed of cattle entrails and pork fat), so the fisherman very skillfully introduces his hands around the bait once the fish have concentrated around the bait. To carry out this type of fishing it is necessary to have some skill in using the hands and to be able to touch the fish to determine the size, being a type of selective capture aimed at larger fish. To remove an individual from the water, the fingers of the hand must act as hooks to hold the fish, preventing it from slipping if otherwise apprehended. Hand-fishing operations can last from 5 to 7 days. Most anglers who

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hand fish suffer from constant hand and arm lacerations, often caused by other fish with which the speck interacts on the bait.

This type of fishing is reported for the entire Loreto and Ucayali regions, including the districts of Belén, Nauta, Caballococha, Yavari (Santa Rosa), Maquía (Victoria), and Puinahua (Bretaña and San Carlos), Pucallpa.

Table 2. Fishing gear was used in the capture of Mota in the districts and provinces of the departments of Loreto and Ucayali.

Technique of Capture	Belén	Nauta	Caballococha.	Yavari (Santa Rosa)	Maqui Victoria	Pebas	Pucallpa (moteros)	Puinahua (Bret y SC)	Sarayacu	San Pablo	Tot.
Rig											
Fish hook								1		2	**3**
Fishing gear											
Trawl net 1,5”	1			1	1	15	4	1		11	**34**
Bowling alley					1			3			**4**
Trapnet of 1”									1		**1**
Trapnet of 1,5”									2		2
Trapnet of 2”		1									**1**
Other techniques											
Hand use	1	1	1	2	1			2			**8**
Total	**2**	**2**	**1**	**3**	**3**	**15**	**4**	**7**	**3**	**13**	**53**

Author’s elaboration

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Regarding the use of trawl nets, during the evaluation during the dry season, it was observed that some of the bikers consulted mentioned their use when fishing is abundant; however, they continue to rely on the use of bait. This type of net is used to capture a larger quantity of fish around the bait and is used quickly with only a few minutes (1 to 2 minutes) in the water since it is lifted immediately. Two (2) to three (3) people are needed to operate the net and it is used at a depth of two (2) to three (3) meters. A trawl fishing operation can last up to twelve days.

The study reports the use of trawl nets with a mesh size of 1.5" by fishermen in the districts of Belén, Yavari, Pebas, Puinahua, San Pablo, and Pucallpa, although it was determined that they are used temporarily and occasionally.

Use of the sling net, this type of net has the same function as the trawl net, but it is rarely used in the mota fishery. According to the last evaluation during the emptying season, 3 % of the moteros mentioned that they had used it at some time and that it is used to catch more fish. Still, its maneuverability requires several people, so in the long run, it is very costly to use, since profits decrease because many more people are participating in the fishing operations.

The use of the bolichera net is frequently used because of its easy maneuverability. This net is used to prepare the temporary pens to confine the fish caught, often extending below the bait and when the fish are crowded and abundant, the net is lifted, an action that is repeated continuously in a fishing operation that uses this type of net. They are reported to be used in the districts of Maquía (community of Victoria) and Puinahua (town of Bretaña and community of San Carlos, in the buffer zone of Pacaya Samiria National Reserve).

Use of 1", 1.5, and 2" trap nets. These types of nets are rarely used because they are waiting for nets and are used as trawls because there are no other trawls or trawl nets available. Their use is reported in the districts of Nauta (Loreto) and Sarayacu (Ucayali).

Use of Espinel, the use of this gear is aimed at fishing for other types of catfish, but it is also used to catch mota. In this case, three mota fishermen in the city of Requena (Loreto, Peru) reported using this gear, so its use is not very common for mota fishing.

The use of hooks was reported in the towns of Bretaña (district of Puinahua, Puinahua Channel) and San Pablo (district of San Pablo, Amazon River). This gear is used more by children, who fish for mota as a recreational activity and distraction.

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Bait is prepared using viscera, cattle blood, and pork fat in the mota fishery

The use of bait from the remains of butchered animals is a widely used alternative in this type of fishery, however, it produces serious problems affecting aquatic ecosystems, because its use implies that many times it is in decomposition, which causes problems by emanating foul odors that generate air pollution. Thus, it is necessary to pay attention to the use of this type of bait, in the case of Vera *et al*., (2018) they mention the use of viscera and remains of butchered animals as bait, as well as the discarding of refrigerators after fish processing.

The analysis determined the use of leather (skin) from cattle as bait preliminarily and temporarily; to use it, it is pierced with a knife through which a rope is passed to tie it, once the leather is tied with the rope, part of it is placed in the water and the other part out of the water, preferably tied to a railing or stick submerged a few centimeters deep. The bait (leather) is left submerged days in advance, to act as an attractant (as fishermen call it) for the specks and allow them to concentrate or agglomerate around this first bait.

Once the leather fulfills its function as an attractant, the fishing task is carried out, for this, cattle blood begins to be spread in the water, especially in the area where the fishing area will be. Next, the final bait is prepared, consisting of viscera, cattle blood, and pig fat, which is known as “guadal”, mixed and stored in polyethylene bags, decomposition occurring in a short time, emanating an exudate known as “ sanguaza”, in this condition the bait is already suitable for use in speck fishing. Likewise, it is highlighted that the “guadal” may contain chicken entrails and blood. The prepared bait is stored in buckets or drums where decomposition occurs and the more decomposed it is, the better it works and the better results are obtained, in the same way, the use of plastic garbage bags has been seen for its transport (mainly in Santa Rosa and Leticia).

Afterward, a compact ball is formed with the bait that is fastened or tied with a rope and it replaces the leather, which is fastened with a submerged stick at medium depth so that it is easy to handle; after a few minutes the bait is consumed by the mota and other catfish that have been attracted by the fat, and fishing begins with the hand, removing the fish that are concentrated around the bait.

The bait inside the water requires a continuous application of the mixture of blood and fat (it must be permanently baited), which is prepared using a small bucket mixed with the hands, this process is recurrent until the bait is exhausted or consumed by the fish to proceed to change it. If the concentration of fish on the bait is abundant, the bait is consumed quickly, so its change is constant; however, if the concentration of fish is scarce, the bait can last several hours during the fishing operations. An important detail in the process of catching the speck is the agitation (fluttering) of the water with the hands as a way of attracting the fish, considering that the agitation is produced very close to the bait.

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Bait and other animal remain require an investment of approximately S/. 250.00, considering that bait is made up of leather, blood, and viscera from cattle, pork fat, and sometimes chicken fat and blood. In the case of the city of Pucallpa, where the moteros (known as mota fishermen) are located, the investment in bait fluctuates between S/. 400.00. The bait is sold in 20-liter buckets (equivalent to 20 kg), which is considered the official measure. The “moteros” living in Pucallpa say that 10 20-liter buckets of bait are enough for them to fish for 20 days, which shows a large number of remains that can generate air pollution due to their strong odor during the decomposition process.

The bait ingredients are acquired from municipal canals in the cities of Iquitos and Pucallpa, or in any case from clandestine canals in these cities and in towns in the interior of these two regions.

Areas of mota fishing with the use of river dolphins

The present research study confirmed that the practice of using river dolphins for mota fishing persists in the communities of Loreto and Ucayali, being the border integration zone (lower Amazon) the one to continue paying attention to, there is a high interest in mota for the Colombian market (Leticia) because fishermen from Tabatinga (Brazil) and Santa Rosa (Peru) are supplied with the mota product. The information confirms that the dolphins are the product of bycatch and that they are used and sold for mota fishing, which indicates the lack of monitoring and control of the management of this resource and the need for regulation.

Due to the existence of the use of wild species as bait, the Corporación Autónoma Regional de la Orinoquia - Corporinoquia and Unión Temporal Aquabiósfera Omacha (2019) generated a protection measure for the pink dolphin (*Inia geoffrensis*) due to danger of extinction for the Colombian Amazon through a conservation plan for it and thus generate protection plans to reduce the different types of threats that could reduce their populations in the future.

In this way, the present investigation allowed us to determine that the mota fishery with the use of this type of bait is experiencing rapid growth in the riverside localities of the departments of Loreto and Ucayali, where an intense activity is reported around this fishing resource where its fishing is developed in almost all the rivers of these two departments, These include the Amazon River (near Iquitos and Nauta), Marañón River, Ucayali River, Puinahua Channel, which includes communities in the buffer zone of the Pacaya Samiria National Reserve (RNPS), and other rivers such as the Tigre (zone of influence of the Pucacuro National Reserve) and Tahuayo (zone of influence of the Tamshiyacu Tahuayo Communal Reserve - ACR CTT). The largest number of mota fishermen are concentrated in the city of Pucallpa along the Ucayali River (upper, middle, and lower sections), providing necessary information not only for mota management but also for a possible pink dolphin conservation plan in the Peruvian Amazon.

In these localities, fishermen dedicated exclusively to mota fishing were interviewed and it was possible to observe the presence of other fishermen dedicated to catching other species. When asked if they had had experience in catching river dolphins or if they had witnessed

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dolphin bycatch (*Inia. geoffrensis* and *Sotalia fluviatilis*), they were reluctant to answer, so only in the districts of Pebas and San Pablo in the lower Amazon did they provide answers to this question. In Pebas, 3 cases were reported during the flood season and 9 cases during the dry season, while in San Pablo, 3 cases were reported during the flood season and 1 during the dry season, respectively.

As mentioned above, this situation is observed throughout the Amazon, including other countries such as Bolivia and Colombia, where the capture of *C. macropterus* also involves fishing practices with methods that involve the use of the remains of domestic animals, as well as the use of meat, fat and viscera of aquatic species such as the freshwater dolphin (*Inia geoffrensis boliviensis*) and the lizard (*Caiman yacare*) (Escobar *et al*., 2020; Mosquera-Guerra *et al*., 2015). According to Campbell *et al*., (2022), riverine cetaceans are particularly vulnerable to anthropogenic impacts due to their limited ranges in the freshwater systems of China, South Asia, and South America.

The fishing gear reported during this type of bycatch was trawl nets with a mesh opening of 1” to 2”, 12 cases were reported in Pebas and 4 captures were reported in San Pablo respectively. The communities of Capironal and Las Palmeras belonging to the district of San Pablo (lower Amazon), report incidental fishing of dolphins in the spawning and crescent season and the district of Pebas reports three (03) in crescent and 09 (nine) in spawning respectively.

In the department of Loreto, the districts of Maquia (community of Victoria), Puinahua (localities of Bretaña and San Carlos) and Sarayacu (localities of Juancito, Alfa y Omega, Yahuarango, Berlín, Nuevo Dos de Mayo) and Pucallpa (Ucayali River) have reported using dolphins for fishing for mota.

Other types of bait used

The fishermen to whom the survey was applied stated that there are approximately six (06) types of bait (Table 3) using wildlife animals, among which we can name the use of fish pieces (heads of “tower fish”) *Practocephalus hemiolepterus* and “cahuara*” Pterodoras granulosus*, “black lizard” *Melanosuchus niger*, “pink dolphins” *Sotalia fluviatilis* and *Inia geoffrensis*, offal of “sea cow” or “manatee” *Trichechus inunguis*, ronsoco *Hydrochaeris hydrochaeris* and cooked fish.

In the district of Puinahua in the town of Bretaña and the community of San Carlos, they use pieces of fish (heads of zúngaros: “pez torre” and “cahuara”). It was also reported that the mota fishermen from the city of Pucallpa (department of Ucayali) use heads of zungaro, pez torre, and cahuara when they run out of bait (viscera, cattle blood, and pork fat) that they initially brought with them from their departure (Pucallpa). Also, fishermen interviewed stated that the moteros from Pucallpa use cooked fish.

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The moteros have a wide range of actions for their fishing operations. They are present in almost the entire Ucayali River, Puinahua Canal, and even fish in fishing zones near the city of Requena, which can take 20 to 30 days.

In the districts of Maquia (native community of Victoria) and Puinahua (community of San Carlos), they report using sea cows or manatee carcasses as bait. In the Sarayacu district (Juancito, Alfa y Omega, and Berlín), fishermen report using ronsoco as bait in the mota fishery, which is an environmental problem that puts these species at risk. The fishermen interviewed in the town of Santa Rosa (Yavari district) - lower Amazon, mentioned that they do not use wildlife animals as bait because of the restrictive measures and penalties imposed in both Brazil and Colombia. Also, much of the mota fishing activity is done at night and takes place in the Amazon on the Brazilian side.

Table 3. Reported areas (districts and communities) of mote fishing using wildlife bait.

	Typ. of Bait	Belén Iquito	Nauta	Caballococha	Yavari Santa Rosa	Maquia	Pebas	Pucallpa (moteros)	Puinahua	Sarayacu	San Pab.	Tot.
1	**Wild animals**											
1.1	pieces of fish (head of zúngaros: tower fish and cahuara)							1	2			**3**
1.2	Lizard Black					1			2	3		**6**
1.3	Dolphins (bufeos)					1		1	1	5		**8**
1.4	Sea cow (manatee) carcasses					1			1			**2**
1.5	Snoring									3		**3**
1.6	Fish Cooked (cooking)							1				**1**
	Total	0	0	0	0	3	0	3	6	11	0	**23**

Author's elaboration

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From the information obtained, it was observed that only 06 mota fishermen use other bait composed of barnyard animals such as chicken entrails and even domestic animals such as dead dogs and the fat of other animals. The dangerous use of dead dogs for bait was observed in the district of Sarayacu (town of Juancito) and the use of fat from other animals in the district of San Pablo (lower Amazon).

Finally, concerning the use of wildlife animals for mota fishing, it was observed that it is more common in localities and communities far from the Amazon territory, where control measures are nonexistent and fishermen employ all possible alternatives for using different types of bait to obtain higher income from the commercialization of the mota fish product. It is very common to use other types of bait in the mota fishery when their initial bait supplies are depleted and they need to continue fishing.

Interaction of the fishery with other species

It was verified that the mota fishery deliberately affects the environment of the aquatic area where this resource is harvested, in such a way that it affects other fishermen to develop their activities in the areas that were previously used by mota fishermen where the use of viscera, cattle blood and pork fat was applied, because there are usually remnants or trails of fat in the water, which is slowly diluted or is dragged by the current until it is diluted.

In agreement with the aforementioned, Beltrão *et al*. (2017) mention that the species associated with the mote fishery are generally caught accidentally, among which are *Cetopsis candiru* (Spix and Agassiz, 1829); *Cetopsis coecutiens* (Lichtenstein, 1819) (Cetopsidae), *Pareiodon microps* (Kner, 1855) (Trichomycteridae), *Pimelodus blochi* (Valenciennes, 1840); *Pinirampus pirinampu* (Spix and Agassiz, 1829) (Pimelodidae) and *Centromochlus heckelii* (De Filippi,1853) (Auchenipteridae). This case was reflected in the present study since between 45 and 252 species of fish were reported to have been captured accidentally, 90 % of which were *C. candiru*; a proportion that reveals that the piracatinga (mota) forms a mixed school with *C. candiru*, known as blue whale catfish.

Similarly, from the interviews and surveys conducted, it was determined that the mota fishery interacts with other species, where the interaction with catfish (*Pimelodus blochii*), oil catfish (15 %), caneros (*Henonemus macrops*) (6 %), tower fish (*Phractocephalus hemioliopterus*) (4 %), all these species belong to the order Siluriformes, in order of importance. Similarly, to a lesser extent, interaction with sardines (*Triportheus* sp.), “pañas” (*Serrasalmus* sp.), and finally “mojarras” (*Astianax* sp.), “acharas” (*Leiarius* sp.) was reported. In the case of the Siluriformes, the most frequently reported stage in the interaction is juveniles and, to a lesser extent, adults. For the other species such as “Sardina,” their interaction is with juvenile and adult individuals, for mojarras the interaction is with adult individuals.

Of the species mention the silurids such as catfish *Pimelodus blochii* are of great commercial importance in the fishery, concerning that Garcia *et al*. (2018) mention that it is one of the most abundant species in the Ucayali region, being the species that currently occupies the second

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place of importance in fishery landings in that region. Similarly, the tower fish *Phractocephalus hemioliopterus*, according to Garcia *et al*., (2018), can reach an average of 26 tons with annual catches with a tendency to increase, starting its commercial capture in the late 1990s.

Of the species mentioned a Characiforme stands out in the interaction with the mote fishery, which is known as “sardine” *Triportheus* sp. Concerning this Garcia *et al*. (2018) report for the Peruvian Amazon two species of “sardine” *T. elongatus* and *T. angulatus*, reporting between the years 1995 to 2016 for Loreto a catch that could exceed 200 tons annually, except for the years 2006 to 2011 which was greater than 500 tons.

Actors in the mota fishing chain

According to studies conducted by Vera *et al*. (2018), fishing for mota is an easy and highly profitable activity, with immediate payment, a situation that has attracted the attention of many fishermen and fishing vessel owners involved in the activity, convinced by the promise of a high rate of return associated with minimal effort. However, the clandestine way of obtaining the bait, the risk involved in catching the fish by hand, and the inexperience in catching the fish can result in a much lower profitability than expected. This has discouraged many community members from trying to develop this activity in the middle Solimões region (Brazil).

The actors in the mota fishing chain are no strangers to the licensing system, considering the licensor to be an important actor since it stimulates the economy by inserting money into this activity, which is why the majority of fishermen dedicated to the exploitation of mota are part of the licensing circuit in the departments of Loreto and Ucayali.

In the triple frontier zone (lower Amazon), the enablers are not visible (many do not have a physical presence) and operate through contacts or telephone communication; they most frequently empower fish traders (buyers), the latter act in the landing ports, buying if possible, the entire production of mota or other fish products, which mostly arrive in isothermal crates. In this case (Figure 3) it was reported that Peruvian and Brazilian fishermen are the ones who supply refrigerated mota to the Leticia market and this is where the other actor appears, which is the owner of the cold storage facilities (locally known as the “cold room”).

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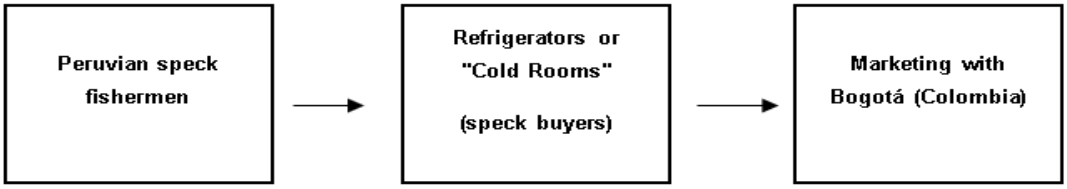

Figure 3. Actors in the mota fishing chain in the Border Integration Zone, Santa Rosa community (Yavari district, lower Amazon).

Author's elaboration

The interviews and surveys conducted revealed that those who make up the Mota commercialization chains are the same people who operate in both the emptying and crescent periods, both in Ucayali (Pucallpa) and Iquitos (Loreto) (Figure 4), buyers, collectors, and owners of fishing vessels (mainly wooden boats powered by stationary engines, including small boats) play an important role in this type of fishery.

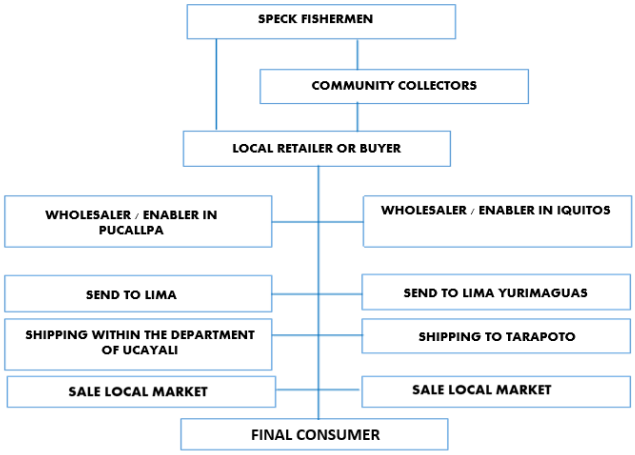

Figure 4. Flow chart of the commercialization chain of Mota with emphasis on Iquitos and Pucallpa.

Author's elaboration

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It was learned that there is a cold storage facility in the Belén Iquitos market that is considered one of the most important in this market center, which provides product storage and cold storage services. However, during the interview with the owner, he said that he does not provide services for the refrigerated storage of the mota fish product, which may be because he is aware of the prohibitions on this product in other countries and therefore does not want to be involved.

Some respondents openly stated that they work with Mota and every two or three days they receive shipments from the interior of the region, with their main markets being the cities of Lima and Tarapoto. At the time of the interview, they stated that the prices they offer per kilogram of mota are usually S/. 2.00 (small specks) and S/. 5.00 (large specks). The fish received is gutted and not shipped to the cities of Tabatinga and Leticia. Other respondents specialized in working with fresh salted mota (salpreso), owners of 10 boats equipped for mota fishing, reported paying between S/. 3.00 and S/. 6.00 (soles) per kilogram.

Regarding the fishermen that work with riverboats, known locally as “moteros”, it can be said that they deserve special attention because they are concentrated in the city of Pucallpa and have the city’s fishing landing site as their landing point for the mota fish product, They explore and exploit the resource in all sections of the Ucayali River/Puinahua channel, and have total independence in their trips to carry out their fishing activities, including exploring and exploiting fishing zones near the cities of Contamana and Requena.

From interviews with some river vessels found in the Ucayali River, affiliated with the Association of Artisanal Fishermen (APA) - Single Union of Fishermen of the Ucayali Region (SINDU) and operating between the departments of Ucayali and Loreto, it was found that the main market chains and local trade zones for the mota fishery are the same during the dry and dry season.

It was also observed that in the case of the Department of Ucayali, the economic activity generated by the mota trade takes place at the artisanal fishing landing site (DPA) in the city of Pucallpa, where the mota buyers are concentrated, and it was determined that the state of conservation of the fish (mota) that is offered is freshly frozen, which is the condition that generates the most trade, Most of those who buy fresh frozen mota do all the packaging in the DPA itself and then ship it in trucks that take it out of Pucallpa to cities such as Tingo Maria, Huanuco, Cusco, and to oil palm and cacao plantations and even to coca fields that are used as “ranches” for the people who work in these plantations.

In the case of Iquitos, the largest commercialization chain is also found in the DPA La Punchana, where buyers generally arrive to bid for the mota, which also arrives in a fresh frozen state. All of those consulted who are involved in the mota trade say that the destination cities are Pucallpa, Yurimaguas, and Tarapoto (Tarapoto also sends mota to places where they grow oil palm, cacao, and even coca).

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Fishing volumes

Landing volumes in the Peruvian Amazon:

According to the Regional Directorates of Production (DIREPRO) of Loreto and Ucayali (Figure 5) the fishery landings of all species caught in the Peruvian Amazon between the years 2006 and 2016 was approximately 14592.05 t, with little significant variations thanks to the increase in landings for the years 2008 to 2011, in which its highest peak of production was observed equivalent to 24127.89 t, to then recover and obtain records that were found between 10446.91 t and 11778.30 t

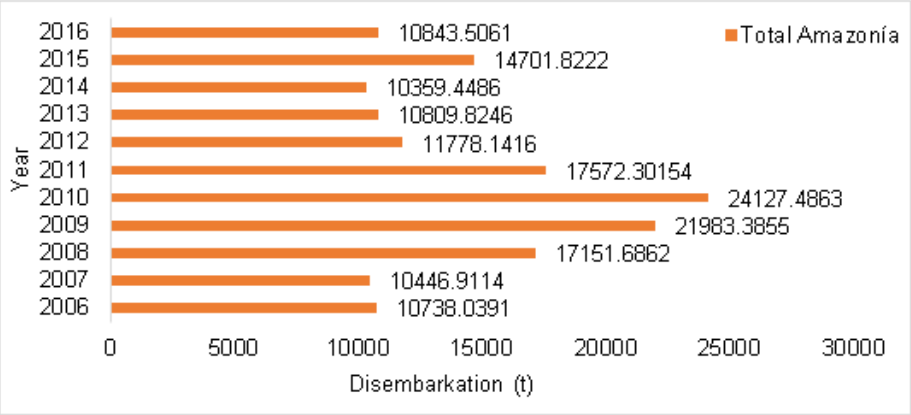

Figure 5. Total disembarkations in the Peruvian Amazon from 2006 to 2016 Landings volumes of Mota in Peruvian Amazon.

Source: DIREPRO

Landing volumes of mota in the Peruvian Amazon

The landing volumes of mota between 2006 - 2016 for the entire Peruvian Amazon; estimated from the landing records of the departments of Loreto and Ucayali according to DIREPRO (Figure 6) show that the landing of this resource presented its highest record in 2006 with 7392,961 t, subsequently, these records were lower and were found between 4246,755 t and 6090,832 t. As a whole, mota landings presented a slight tendency to decrease from 2006 to 2016 (r = -0.4581).

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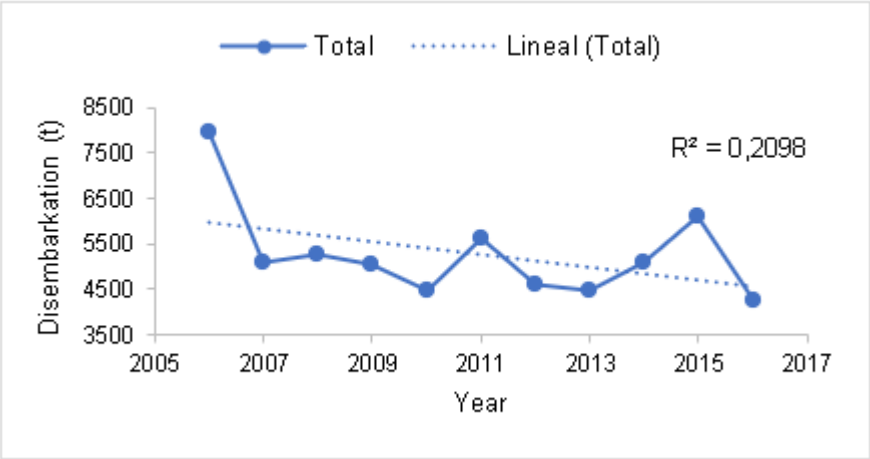

Figure 6. Total fishery landings (tons) of Mota throughout the Peruvian Amazon from 2006 to 2016.

Source: DIREPRO

As reported by DIREPRO offices, mota landings throughout the Peruvian Amazon remained relatively stable from 2006 to 2012, with figures that represented 1.40 % to 2.82 % of the total fishery. Subsequently, a significant increase is reported, because these doubled their importance until 2016, with a record equivalent to 5.20 % of total landings.

Landings in the departments of Loreto and Ucayali

When comparing the landing volumes of mota generated in the departments of Loreto and Ucayali (Figure 7), it can be seen that the average landing of mota in Loreto was 183.48 t, followed by 169.7 t reported for Ucayali. Likewise, the range of landings generated for Loreto and Ucayali was between 4.81 tons and 319.89 tons. Regarding the data reviewed from the DIREPRO database, there is a trend of mota landings between 2006 and 2016 to a decrease with a tendency to increase in the department of Loreto (r: 0.1535), unlike what happened in Ucayali, where the tendency to decrease was valued between low and medium (r: 0.4809).

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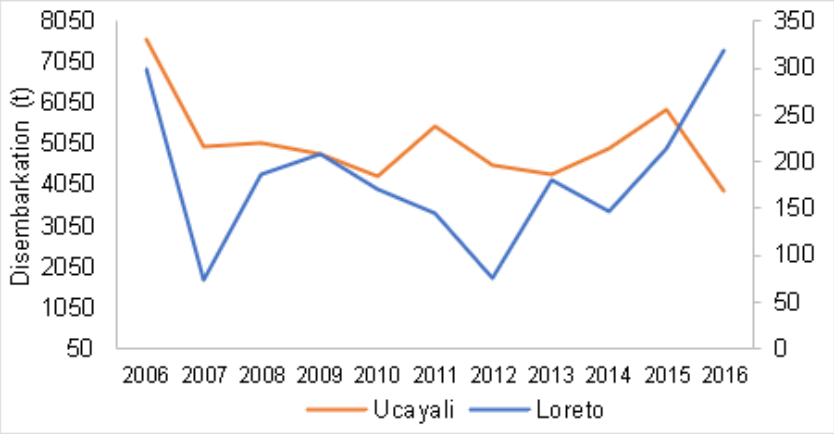

Figure 7. Landings of Mota in the departments of Loreto and Ucayali between 2006 and 2016. Own elaboration from DIREPRO.

Landings in the main ports of Loreto

According to the reports generated by the DIREPRO office for the main ports of the department of Loreto, districts of Iquitos, Yurimaguas, Nauta, Requena, Contamana, Caballococha, and San Lorenzo between the years 2006 to 2018; it was observed that in Iquitos the landing of mota from 2007 to 2014 remained relatively constant, then, from 2015 to 2018 it increased significantly to remain stationary. Together, these records indicate that the landings of mota tend to increase with a low to medium value (r: 0.4621).

A second group of ports with an increasing trend in landings of mota is reported in the districts of Yurimaguas and Requena, where an increase could be observed from 2006 to 2014 and 2015, and then a progressive decrease until 2018.

The landings of mota in the districts of Nauta, Datem, Caballococha, and Contamana showed a tendency to decrease, with Caballococha and El Estrecho showing a tendency to decrease with a rating of high and medium-high, with correlation coefficients (r) of -0.8132 and -0.5542, respectively.

Landings of mota in Loreto 2015 – 2020

Concerning the total landing volumes of mota comparing the data obtained in this study with those reported by DIREPRO offices, it can be observed that it was higher in February, with 161.93 MT, while in the rest of the months, landings do not show significant fluctuations, varying between 73.19 and 105.93 MT. Likewise, when landings are grouped by water seasons, crescent

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and trough, it can be observed that in the crescent season, landings of mota total 613.36 MT, as opposed to the 503.20 MT recorded for the trough season, These data indicate that the greatest fishing activity for the species in question occurs in the months of the rising season when river levels increase and other species reduce their presence in the catches, a situation associated with the presence of an increase in the prices of all the species exploited in the different fisheries.

According to the average data of mota fishery landings reported for the years 2015 to 2020 by DIREPRO offices (Table 4) and the results of this study, it can be said that these are between 0.79 and 0.86 MT in the growing and emptying seasons, respectively. It is important to mention that the average landing during the crescent season is between 5.4 and 10.8 mt, while during the trough season, there is a smaller variation between 0.80 and 0.92 mt, which indicates that during the crescent season, there is usually greater exploitation of the resource, affected by lower landings, while during the trough season, the catches are smaller and relatively constant. This statement is corroborated by the range in which the landings occur, as an example, we have the landings that occurred in February (0.0095 to 6 MT).

Mota fishery landings in Ucayali

In this case, it was not possible to detail the fluctuation of mota fish landings for all the fishing zones distributed along the lower and middle Ucayali River, due to the reduced number of personnel responsible for landing records of the economically important species, associated with the limited financial capacity of DIREPRO (Loreto and Ucayali) to hire personnel, a situation that reached a critical point with the suspension of personnel activities in compliance with COVID 19 prevention measures. At this level of analysis, a greater number of records could be observed in the communities of Flor de Punga, Juancito, and Tamanco, in addition to the community of Las Palmas located in the Puinahua Canal. This corroborates once again that this fishery acquires greater importance in the main river channels.

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Table 4. Mota fishery disembarkations volume 2015 - 2020.

Month / Season	Total-Ton	Average Total-Ton	Máx. Total-Ton	Mín. Total-Ton
Creciente	613.36	0,79	10,8	0,0095
January	87,77	0,71	7,5	0,025
February	161,93	0,72	6	0,0095
March	105,39	0,82	10,8	0,02
April	73,19	0,80	3,6	0,02
October	100,77	0,92	8	0,02
November	84,32	0,83	5,4	0,01
Emptying	**503,20**	**0,86**	**9**	**0,005**
May	107,37	0,92	9	0,005
Jun	98,48	0,86	4,4	0,02
July	102,60	0,80	5,8	0,02
augusto	109,05	0,92	8,044	0,03
September	85,70	0,83	4,906	0,03
Total	**1,116,56**	**0,82**	**10,8**	**0,005**

Author's elaboration

A general analysis of the total landings of mota in the Ucayali River shows that the monthly records show less variation. Despite this, it is important to mention that in the months of flooding, landing volumes are lower than those reported in the months of emptying, with the lowest record at the beginning of the flood (September). In terms of landing volume, the largest record is equivalent to 27,813 kg, while the smallest record was 6,070 kg.

To reduce the variation and have a more reliable analysis of the mota fishery landings, the sample had to be reduced to total annual periods without the absence of monthly records. This allowed us to establish as a sample the landings that occurred in the Ucayali River during 2017 and 2019 by comparing the data reported by the DIREPRO office and those obtained in this study. This analysis allowed us to determine that the extraction of mota is higher during the months of the river's rise (January - March), and also shows important records during the emptying season (June) and the beginning of the rise (September).

Sources of the mota

According to the systematization process of DIREPRO's fish landing records (Figure 8), there are approximately 623 places of origin of the mota fish product, corresponding to 17 river basins/rivers registered in the fish landing. It was also observed that the Ucayali River basin has the most places of origin for mota shipments with 179, followed by the Marañón River with 142 places of origin, and the Amazon River with 133 places of origin for mota shipments.

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After observing the conditions in which the "mota" fishery is developed in the departments of Loreto and Ucayali, it can be said that this is not a sustainable activity, because during the capture process, those in charge of it do not protect the associated marine fauna despite using selective methods of capture, in the same way, they do not avoid waste concerning the use of the quantities of bait for its capture; Despite this, it is important to emphasize that this is done to generate food security, generate employment, however, unfortunately, a very important variable prevails as it is the environmental pollution due to the use of bait from animal remains.

Similarly, it can be said that the city of Pucallpa has the highest concentration of trade processes for the purchase and sale of fresh frozen fish compared to Iquitos, so it can be said that it is the population most committed to this type of fishing activity.

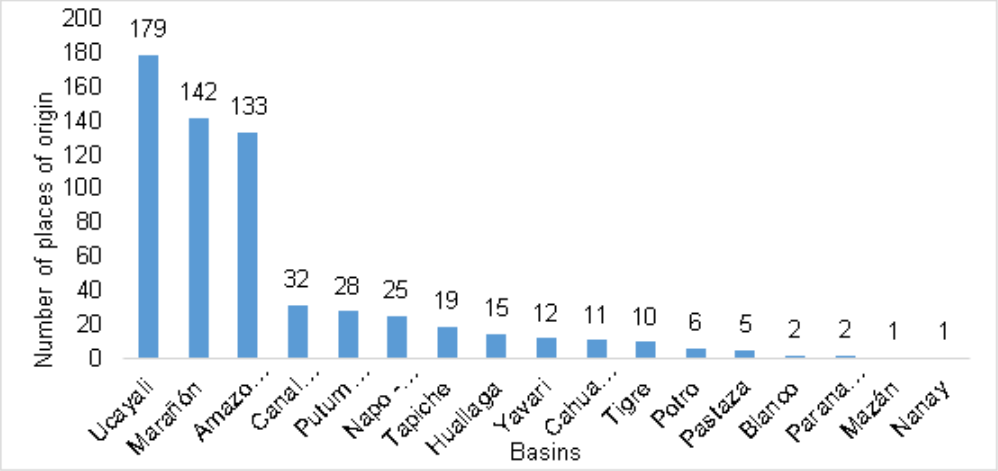

Figure 8. Places of origin of the mota in the main basins/rivers of the department of Loreto.

Source: DIREPRO

Conclusions

According to the results obtained, it was observed that mota fishing is mainly carried out in shore zones/areas, with scarce vegetation and a depth that fluctuates between one and three meters, with hand fishing being the most common technique, which is used when fishing fluctuates between 5 to 7 days and catch volumes are around 300 - 500 kg. Regarding the use of fishing nets, it was observed that the most commonly used is the trawl net, which is used when fishing fluctuates between 15 - 20 days and catch volumes are between 500 and more kg.

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After observing the conditions in which the “mota” fishery develops in the departments of Loreto and Ucayali, it can be said that this is not a sustainable activity; the largest trade processes for the purchase and sale of fresh frozen mota are concentrated in the city of Pucallpa compared to Iquitos.

From an economic point of view, the mota fishery generates an important economic dynamic in the departments of Loreto and Ucayali, with similar economic yields in both emptying and growing seasons. Since the Mota catch is an emerging fishery, it requires immediate attention from the authorities linked to artisanal fishing, so it is proposed that the competent entities in the fishing sector carry out an ordinance and a fishery management plan, and this study is a necessary basis to start the process.

Therefore, it can be said that the objectives proposed during the research were met, as well as a deeper recognition of the current problems, to generate possible solutions in the short or medium term.

Authors’ contribution

Conceptualization of the work, author 1, author 2; methodology development, author 1, author 2; software management, author 1, author 2; experimental validation, author 2, author 3; analysis of results, author 2, author 3; data management, author 1, author 3; manuscript writing and preparation, author 2; writing, revising and editing, author 2; project management, author 1, author 3; fund acquisition, author 3.

All authors of this manuscript have read and accepted the published version of the manuscript.

Financing

This research was financed with own funds and supported by the consultancy developed by WWF Peru, on the Mota Fishery in the Peruvian Amazon.

Statement of Informed Consent

Informed consent was obtained from all subjects involved in the study.

Conflict of interest

The authors declare that they have no conflicts of interest.

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ISSN 2007-3380

Referencias

Anderson, E. P., Jenkins, C. N., Heilpern, S., Maldonado-Ocampo, J. A., Carvajal-Vallejos, F. M., Encalada, A. C., Rivadeneira, J. F., Hidalgo, M., Cañas, C., Ortega, H., Salcedo, N., Maldonado, M., & Tedesco, P. A. (2018). Fragmentación de la conectividad Andes-Amazonía por represas hidroeléctricas. *Science Advances,* 4(1), eaao1642. https://doi:10.1126/sciadv.aao1642

Beltrão, H., Porto-Braga, T. M., & Schwartz-Benzaken, Z. (2017). Uso alternativo de carnada durante la pesquería de piracatinga (*Calophysus macropterus)* en la región de Manacapuru, localizada en el bajo río Solimões-Amazonas, cuenca del Amazonas, Brasil. *Revista Panamericana de Ciencias Acuáticas,* 12(3), 194-205. https://www.researchgate.net/publication/320553121

Bonilla-Castillo, C. A., Vásquez, A. G., Córdoba, E. A., Hurtado, G. G., Vargas, G., & Duponchelle, F. (2022). Variaciones en los rasgos de historia de vida y dinámica poblacional de *Calophysus macropterus* (Siluriformes: Pimelodidae) en dos sistemas fluviales de la Amazonia colombiana y peruana. *Ictiología Neotropical,* 20(1), e210082. https://doi.org/10.1590/1982-0224-2021-0082

Campbell, E., Alfaro-Shigueto, J., Aliaga-Rossel, E., Beasley, I., Briceño, Y., Caballero, S., Vera, M. F., Gilleman, C., Gravena, W., Hines, E., Khan, M., Khan, U., Kreb, D., Mangel, G., Marmontel, M., Mei, Z. J., Mintzer, V., Mosquera-Guerra, F., Oliveira-da-Costa, M., … Godley, B. (2022). Retos y prioridades para la conservación de los cetáceos fluviales. *Endang Species Res*, 49, 13-42. https://doi.org/10.3354/esr01201

Corporación Autónoma Regional de la Orinoquia - Corporinoquia y Unión Temporal Aquabiósfera Omacha. (2019, april 16). Plan de conservación del delfín de río o delfín rosado (*Inia geoffrensis*) para la jurisdicción de Corporinoquia. Bogotá D.C. 92.

Del Águila, E. A., Zuta, L., & Nakagawa, N. (2019). Conociendo a la „Mota“ *Calophysus macropterus* L.; aspectos básicos para su reproducción en cautiverio: manual técnico. ISBN: 978-612-4372-15-5

Escobar, M., Rey, G., Coca, C., Córdova, L., Sainz, L., Moreno, A., Rojas, C., & Van Damme, P. (2020). La pesquería de una especie carroñera (*Calophysus macropterus*) y su posible impacto en las poblaciones del bufeo boliviano (*Inia geoffrensis boliviensis*) en la Amazonía boliviana. *Hidrobiología Neotropical y Conservación Acuática*, 1(1), 26-4. https://editorial-inia.com/wp-content/uploads/2020/09/Escobar_2020_pesca-Calophysus-macropterus-Amazonia-boliviana_NHAC_1_1.pdf

Faria, J., & da Silva, B. (2019). Frota pesqueira comercial na Amazônia Central: composição, origem, espécies exploradas e mercado. *Agro ecosistemas,* 11(1), 146 - 168. https://doi.10.18542/ragros.v11i1.5248

Franco, D., Sobrane-Filho, S., Martins, A., Marmontel, M., & Botero-Arias, R. (2016). The piracatinga, *Calophysus macropterus*, production chain in the middle Solimões River, Amazonas, Brazil. *Fisheries Management and Ecology*, 23(2), 109-118. https://doi:10.1111/fme.12160

García, A., Ruíz, L., Vargas, G., Sánchez, H., Tello, S., & Duponchelle, F. (2018). Alimentación natural de la “mota” *Calophysus macropterus* (Lichtenstein, 1819), en ambientes de la

Revista Bio ciencias
ISSN 2007-3380

Amazonía peruana. *Folia Amazónica,* 26(1), 29-36. https://doi.org/10.24841/fa.v26i1.416

García, A., Vargas, G., Tello, S., & Duponchelle, F. (2013). Desembarque de pescado fresco en la ciudad de Iquitos, Región Loreto, Amazonia Peruana. *Folia Amazónica,* 20(1-2), 45 - 52. https://doi.10.24841/fa.v21i1-2.31

Gozzer-Wuest, R., Alonso-Población, E., & Tingley, G. A. (2021). Identificación de áreas prioritarias de mejora en la pesca peruana. *Marine Policy,* 129, 104545. https://doi.org/10.1016/j.marpol.2021.104545

Mosquera-Guerra, F., Trujillo, F., Caicedo-Herrera, D., Zoque-Cancelado, J., & Mantilla-Meluk, H. (2015). Impactos de las pesquerías de *Calophysus macropterus* Un riesgo para salud pública y la conservación de los delfines de río en Colombia. *Mom. Cien*, 12, 76-87. https://core.ac.uk/download/pdf/288215049.pdf

Pereira, L., Bisaggio, F., & Tavares-Dias, M. (2019) Metazoan parasites of *Calophysus macropterus* (Siluriformes: Pimelodidae) in the Acre and Iaco rivers in the western Amazon region of Brazil: diversity, similarity and seasonal variation. *Journal of Natural History*, 53:23-24, 1465-1479. https://doi:10.1080/00222933.2019.1657195

Pérez, A., & Fabre, N.N. (2009). Crecimiento estacional e historia de vida del bagre *Calophysus macropterus* (Lichtenstein,1819) (Siluriformes: Pimelodidae) de la llanura aluvial amazónica. *Revista de Ictiología Aplicada*, 25, 343-349. https://doi.10.1111/j.1439-0426.2008.01104.x

Reis, E.R., Kullander, S., & Ferraris, C. (2003). Checklist of the freshwater fishes of South and Central America. EDIPUCRS

Salinas, C., Cubillos, JC., Gómez, R., Trujillo, F., & Caballero, S. (2014). ‘’Pig in a poke (gato por liebre)’’: The ‘’mota’’ (*Calophysus macropterus*) fishery, molecular evidence of commercialization in Colombia and Toxicological Analyses. *EcoHealth*, 11, 197-206. https://doi.10.1007/s10393-013-0893-8

Vera, S., Nunes, A., Araújo, D., Batista, J., Cunha, H., & Martin, A. (2018). The use of Amazonian dolphins (*Inia* and *Sotalia*) as bait for the piracatinga fishery. Conference: Workshop on Poorly Documented Takes of Small Cetaceans: South AmericaAt: Santos, Brazil https://www.researchgate.net/publication/323884400_The_use_of_Amazonian_dolphins_Inia_and_Sotalia_as_bait_for_the_piracatinga_fishery