RESEARCH
www.commprac.com
ISSN 1462 2815

CHECKLIST OF NON-NATIVE AQUARIUM PREDATOR FISH POLYPTERUS (POLYPTERIFORMES: POLYPTERIDAE) IN EAST JAVA, INDONESIA

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DOI: 10.5281/zenodo.11503258

Abstract

This study presents a comprehensive checklist of non-native aquarium predator fish species belonging to the family Polypteridae (Polypterus) in the East Java region, Indonesia. The research was conducted over a three-month period from January to December 2023, involving field surveys and primary data collection from various aquarium shops, including online stores. A taxonomic study was performed to identify and list the species accurately. The collected data were cross-checked with secondary sources such as journals, books, authentic online databases, and other published documents. The study identified and documented a total of 11 species of Polypterus present in the region. These included Endlicheri Bichir (Polypterus Endlicheri), Orna Bichir (P. ornatipinnis), Senegalus Bichir (P. Senegalus), Lapradei Bichir (P. Bichir), Ansorgii Bichir (P. Ansorgii), Congicus Bichir (P. congicus), Teugelsi Bichir (P. teugelsi), Mokelembembe Bichir (P. mokelembembe), Retropinnis Bichir (P. retropinnis), Polli Bichir (P. polli), and Delhezi Bichir (P. delhezi). This research contributes to the understanding of the presence and diversity of non-native predator fish species in the East Java area and provides valuable insights for aquatic resource management and conservation efforts.

Keywords: Aquarium, Checklist, Morphometric, Palmas, Polypteridae, Predator Fish.

INTRODUCTION

The aquarium industry has become one of the fastest growing sectors in Indonesia, with the number of ornamental fish lovers growing over time [1–4]. As part of this phenomenon, non-native predatory fishes, particularly Polypterid species, have become a major attraction for ornamental fish enthusiasts in the East Java region of Indonesia [5–7].

Polypterids are a unique and exotic group of fishes, known for their attractive lobed fins and characteristic slow movements [8,9]. Polypteridae, a family of fish, is being extensively traded in large quantities in Indonesia. Despite the high environmental risks and likelihood of establishing populations, there are no local or national regulations governing the ownership, cultivation, and release of this species. Existing central policies in Indonesia, such as PermenKP/19/2020 and PermenKP/41/2014, have never included Polypteridae in the list of banned aquatic species. Indonesian policymakers do not view Polypteridae as a dangerous predator and have no intentions of restricting its spread in the country. This situation is worsened by the growing domestic trade and export of Polypteridae. The climate in Indonesia is highly

suitable for Polypteridae, and the first potentially established populations were observed there [5].

Even though there is only one species in the Polypteridae family known as 'palmas' (*P. palmas*), all Polypterus spp. are traded in Indonesia under the name 'palmas'. This leads to confusion, making it difficult or even impossible to accurately identify the species in many cases. This misidentification likely occurred because the initial Polypteridae fish imports were labeled as *P. palmas*, leading to all Polypterus species being generalized as 'palmas' [5]. Consequently, previously published reports on the production and trade of 'palmas', including the Polypterus albino morph [5], are misleading.

However, the absence of a deep understanding of these species and their ecological impacts in local waters has been a serious concern. In this context, this study aims to compile a comprehensive checklist and conduct morphometric analysis of non-native Polypterid predatory fish species in the East Java region of Indonesia. As a geographical area with a high diversity of aquatic environments, East Java is an interesting location to understand the distribution, behavior, and potential impacts of these species on local ecosystems.

Morphometric analysis will help in identifying intraspecific variation among Polypterid individuals found in different locations in East Java [10–12]. This will provide a deeper understanding of the morphological adaptations of these species in various water conditions, which in turn can provide important insights into their ecology and biology.

This journal article will detail the methodology used, the results of the morphometric analysis, and the implications of these findings for aquatic resource conservation and ornamental fish management in East Java. As such, this article aims to make a valuable contribution to our understanding of non-native Polypterid predatory fishes in this region and provide the necessary information base for sustainable decision-making in ornamental fish management and freshwater ecosystem preservation in Indonesia, with the primary goal of preventing the spread and invasive potential of these species.

MATERIALS AND METHODS

Data Collection

The research was conducted over a three-month period from January to December 2023, involving field surveys and primary data collection from various aquarium shops, including online stores. Frequent field visits were made during the research period to the study area for primary data collection. Primary data was collected through a survey divided into several sub-divisions, namely direct observation, field visits, and interviews with questionnaires according to published methods [13].

Forty different aquarium shops and aquarium shop owner respondents, 20 aquarium hobbyist respondents, and 5 aquarium fish breeder respondents were interviewed during the survey, included online aquarium shop. Primary data and identification of fish species to create the checklist were cross-checked with secondary data such as authentic journals, books, online databases, online ornamental fish stores, and other published documents. Taxonomic studies were used to compile the aquarium fish list.

RESULTS AND DISCUSSION

Native Distribution

Polypterus, commonly known as bichirs or dinosaur eels, is a group of primitive fish species belonging to the family Polypteridae. In Indonesia, they known as ikan naga or ikan palmas. These unique fish are native to the freshwater habitats of Africa, primarily found in tropical and subtropical regions. They are widely distributed across the African continent [5,14], with their natural range spanning from North Africa to Central and West Africa [15–17]. Various species of Polypterus are known to inhabit diverse aquatic environments, including slow-moving rivers, swamps, lakes, and floodplains.

General Characteristic of Polypterus

Polypterus species are characterized by several distinctive morphometric features. They have elongated, eel-like bodies covered in thick, ganoid scales that provide them with a prehistoric appearance and serve as protection against potential threats. Their dorsal fins are notably divided into two parts, with the anterior portion equipped with sharp spines, which can be raised for defense. These fish possess pectoral fins located close to the head, facilitating precise maneuvering, and a lobed caudal fin that aids in both stability and propulsion. The coloration of Polypterus varies among species but often includes shades of brown, green, or gray with mottled patterns or markings, contributing to their camouflage in their natural habitats. Polypterids stand apart from all other contemporary actinopterygians due to their distinctive features, including the presence of full ganoid scales that cover their whole body, a unique skeletal structure in their pectoral fin, the initial section of their dorsal fin divided into finlets composed of sharp spines supported by secondary rays and membranes, paired lungs with a ventral connection to the esophagus, a modified anal fin in males, adhesive eggs, and larval stages that possess external opercular gills [18].

The checklist

A checklist of aquatic orgamism is essential for various reasons within the realm of aquatic biodiversity management and conservation [19–21]. Firstly, it serves as a comprehensive inventory, cataloging the various species present in a particular aquatic ecosystem. This systematic documentation aids scientists, researchers, and conservationists in understanding the diversity of aquatic life forms, their distributions, and population dynamics. Additionally, a checklist is a valuable tool for monitoring changes in ecosystems over time, helping to identify shifts in species composition, potential threats, and the overall health of aquatic environments. Furthermore, a checklist is crucial for the establishment and implementation of conservation strategies. By identifying species at risk or those facing population declines, authorities can prioritize conservation efforts and allocate resources effectively. This is particularly significant given the numerous anthropogenic threats faced by aquatic ecosystems, including habitat destruction, pollution, and climate change. A well-maintained checklist also contributes to scientific research by providing a foundation for ecological studies, taxonomic research, and the identification of key indicator species that reflect the overall health of aquatic habitats.

The study identified and documented a total of 11 species of Polypterus present in the region (Table 1). These included Endlicheri Bichir (*Polypterus Endlicheri*), Orna Bichir (*P. ornatipinnis*), Senegalus Bichir (*P. Senegalus*), Lapradei Bichir (*P. Bichir*), Ansorgii Bichir (*P. Ansorgii*), Congicus Bichir (*P. congicus*), Teugelsi Bichir (*P. teugelsi*),

Mokelembembe Bichir (*P. mokelembembe*), Retropinnis Bichir (*P. retropinnis*), Polli Bichir (*P. polli*), and Delhezi Bichir (*P. delhezi*).

Table 1: Polypterus present in the regions in east java during the research on January to December 2023

Common name	Scientific Name	Number of Individuals Found in Aquarium Stock	Average Size (cm)	Locations Found in East Java
Endlicheri Bichir	*P. Endlicheri*	25	35	Surabaya, Malang, Probolinggo
Orna Bichir	*P. ornatipinnis*	18	28	Banyuwangi, Jember, Lumajang
Senegalus Bichir	*P. Senegalus*	30	22	Surabaya, Sidoarjo, Bangkalan
Lapradei Bichir	*P. Bichir*	12	40	Malang, Blitar, Kediri
Ansorgii Bichir	*P. Ansorgii*	22	33	Malang, Gresik, Surabaya
Congicus Bichir	*P. congicus*	15	26	Banyuwangi, Lumajang, Jember
Teugelsi Bichir	*P. teugelsi*	10	18	Sidoarjo, Surabaya, Jombang
Mokelembembe Bichir	*P. mokelembembe*	8	32	Probolinggo, Malang, Banyuwangi
Retropinnis Bichir	*P. retropinnis*	14	25	Jember, Lumajang, Surabaya
Polli Bichir	*P. polli*	20	30	Surabaya, Sidoarjo, Malang
Delhezi Bichir	*P. delhezi*	11	21	Probolinggo, Surabaya, Malang

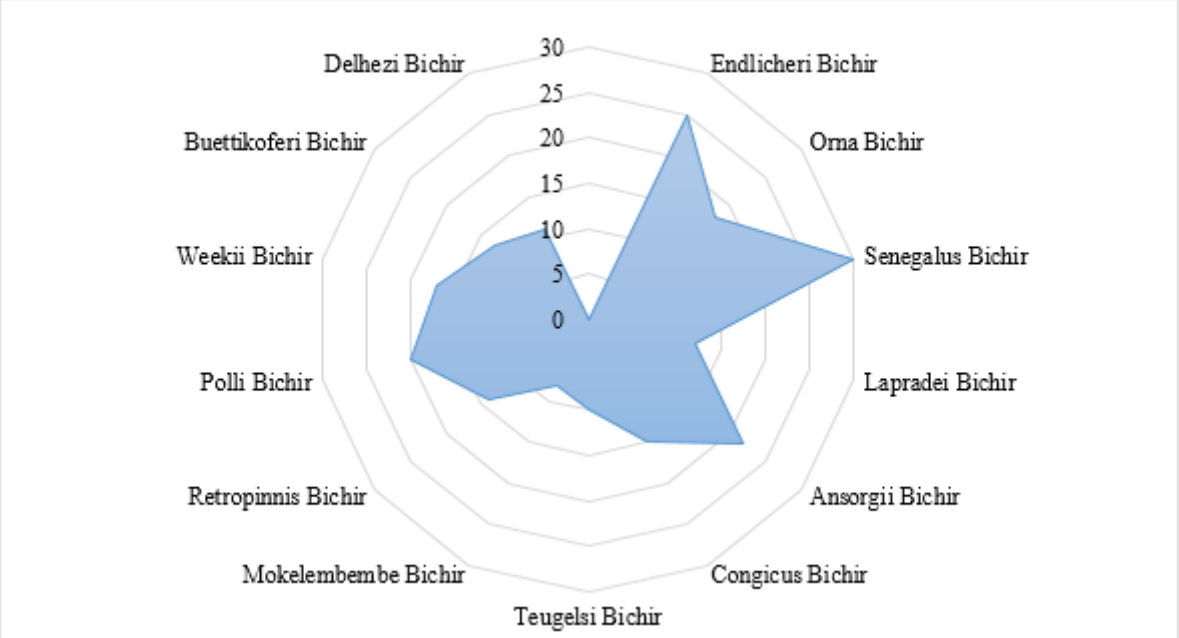

Figure 1: Number of Polypterus Individuals Found in Aquarium Stock during the research

Based on the provided data on the number of individuals found in aquarium stock (Figure 1), it appears that the Senegalus Bichir has the highest count with 30 individuals. This indicates that Senegalus Bichir is the most abundant species among the listed Bichir types in the aquarium stock. On the other hand, the Mokelembembe Bichir has the lowest count with only 8 individuals, making it relatively rarer in comparison to the other listed Bichir types. The rarity of a species in an aquarium stock can be influenced by factors such as availability in the wild, breeding difficulty, and demand among aquarium enthusiasts.

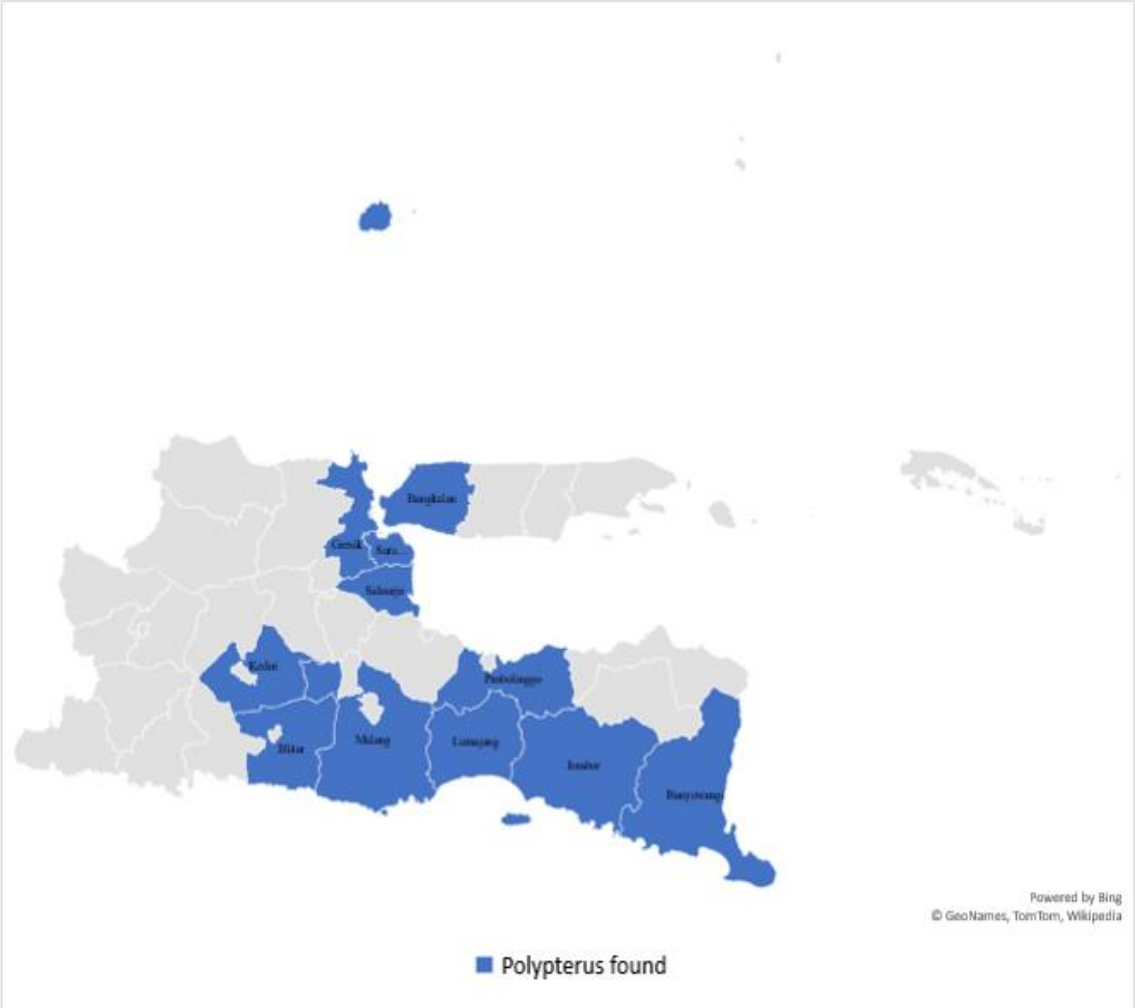

Figure 2: Polypterus found in East Java during the research on January to December 2023

During the research conducted on non-native Polypterid aquarium predator fish species in the East Java region, various locations across several cities were surveyed to assess the presence and diversity of these species in aquarium shops (figure 2). The study covered a range of urban and suburban areas, including Bangkalan, Banyuwangi, Blitar, Gresik, Jember, Kediri, Lumajang, Malang, Probolinggo, Sidoarjo, and Surabaya. Each location provided unique insights into the distribution and availability of Polypterus species within the aquarium trade. Bangkalan, being one of the surveyed areas, contributed to the understanding of the accessibility of these fish in the local market.

Similarly, Banyuwangi, with its distinct aquatic environment, showcased the presence of Polypterids in aquarium shops, offering valuable information for resource management. In Blitar, Gresik, and Jember, the research shed light on the popularity and demand for these fish species among the local aquarium enthusiasts. The findings from these areas contribute to the broader understanding of the aquarium trade dynamics in East Java.

The inclusion of Kediri, Lumajang, and Malang in the research further enriched the dataset, providing insights into the regional variations in the availability of Polypterus species. These areas, each with its unique characteristics, played a crucial role in expanding our knowledge of the distribution patterns and market trends.

Probolinggo, Sidoarjo, and Surabaya, as major urban centers, demonstrated the significance of these locations as hubs for the aquarium trade. The research uncovered the prevalence of Polypterus species in aquarium shops within these densely populated areas, emphasizing the potential impact of urbanization on the trade and conservation aspects.

Species Descriptions

Endlicheri Bichir (*Polypterus Endlicheri*)

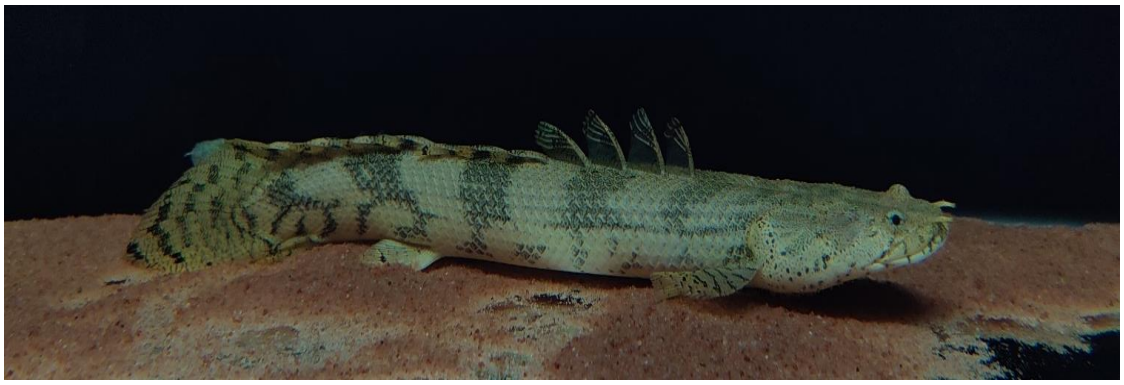

Figure 3: Surveyed Endlicheri Bichir (*Polypterus Endlicheri*) (Photo by: Admiral Amin Supit)

Native and Distribution: Endlicheri Bichir, commonly known as *Polypterus endlicheri*, is a species of polypterid fish native to the tropical waters of Cameroon, Nigeria, Burkina Faso, Ghana, Chad, the Ivory Coast, Mali, Sudan, Benin, and the Central African Republic [22]. Its natural habitat spans various river systems and freshwater lakes. The species exhibits a remarkable adaptability to different aquatic environments, allowing it to thrive in a wide range of water conditions.

Descriptions: *Polypterus Endlicheri* possesses distinctive morphometric characteristics that distinguish it within the Polypteridae family. This species can grow up to a maximum length of approximately 63 cm (24.8 inches) for unsexed males, with a recorded maximum weight of about 3.3 kg (7.3 lb) [23,24].

This species is known for its elongated body, flat head and prominent lower jaw, which is larger than its upper jaw, covered in bony plates known as ganoid scales, which provide it with a unique prehistoric appearance. The dorsal side of the fish is green and yellow, with black spots on its head and fins. They dorsal fin is notably divided into two parts, with the posterior section consisting of a series of lobes or "lobe-fins".

These lobe-fins are used for propulsion and stability in the water, contributing to its slow and deliberate movement. The coloration of *Polypterus Endlicheri* varies among individuals and can range from shades of brown to greenish or gray, often with darker markings or mottling, aiding in camouflage within its natural habitat. These morphometric characteristics not only make the species visually captivating for aquarium enthusiasts but also play a crucial role in its survival strategies and ecological niche within the African aquatic ecosystems. Reproduction occurs during the rainy season when there are changes in water chemistry and temperature. This species is known for scattering its eggs [18].

Orna Bichir (*P. ornatipinnis*)

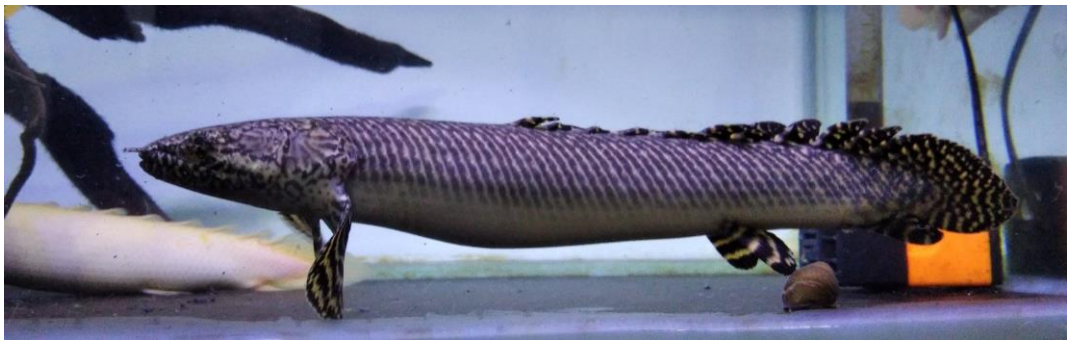

Figure 4: Surveyed Orna Bichir (*P. ornatipinnis*) (photo by: Lutfi Hadi P)

Native and Distribution: Orna Bichir, scientifically known as *P. ornatipinnis*, is a species of bichir fish indigenous to the freshwater systems of Central Africa, particularly the Congo River basin. Within its native range, this species inhabits various habitats, including slow-moving rivers, swamps, and floodplains. The Congo River basin serves as a primary stronghold for *P. ornatipinnis*, showcasing its adaptability to diverse aquatic environments [25].

Descriptions: *P. ornatipinnis* exhibits distinct morphometric characteristics that set it apart within the Polypteridae family [25]. This species is recognized for its elongated body covered in overlapping, thick ganoid scales that provide protection against potential. One of the most remarkable features of *P. ornatipinnis* is its striking coloration, characterized by a mottled pattern of vibrant orange, black, and white markings on its body and finnage. These striking colors contribute to its visual appeal and make it a sought-after species among aquarium enthusiasts.

The dorsal fin of *P. ornatipinnis* is divided into two distinct sections, with the anterior part having a series of sharp spines. These spines are primarily used for defense, as *P. ornatipinnis* can erect them when threatened, making it a challenging target for potential predators. Additionally, its pectoral fins are situated close to its head, allowing for precise maneuvering and stability in the water, while its lobed caudal fin aids in navigation and propulsion. According to published article [23], The fish has 9-11 dorsal spines and 14-15 anal spines. Its body is subcylindrical in shape, with upper and lower jaws of equal length. It has 9-11 dorsal finlets, and the dorsal fin starts well behind the pectoral fin. The fish has 58-65 ganoid scales along the lateral line, 38-44 scales around its body, and 22-27 predorsal scales. Its dorsal side is grey-brown with clear whitish spots, while the belly is white to yellowish. The head has a fine reticulated pattern, and its fins have alternating white and dark spots, forming a continuous bar.

Senegalus Bichir (*P. Senegalus*)

Figure 5: Surveyed Senegalus Bichir (*P. senegalus*) (photo by: Lutfi Hadi P)

Native and Distribution: Senegalus Bichir, scientifically known as *P. senegalus*, is a species of bichir fish native to the freshwater ecosystems of West Africa, particularly within the basins of the Senegal and Gambia Rivers. These rivers traverse several countries, including Senegal, Mauritania, Mali, and Guinea. *P. senegalus* has adapted to a range of habitats, from slow-moving rivers to seasonal floodplains, making it a prominent member of the local aquatic fauna.

Descriptions: *P. senegalus*, commonly known as Senegal bichir, possesses unique physical characteristics that differentiate it within the Polypteridae family. It has an elongated, cylindrical body covered in thick, protective ganoid scales. One of its distinctive features is the presence of paired dorsal fins, with sharp spines in the front that serve as a defense mechanism and help it stabilize in the water. The species exhibits a mottled pattern of earthy tones, such as brown, green, and black, with lighter spots, providing effective camouflage in its natural habitat. Its pectoral fins, located near its head, allow precise movement and hovering in the water, while the lobed caudal fin aids in propulsion and stability. *P. senegalus* is mainly insectivorous and is found in swampy waters and riverbanks, where it hides and feeds on various aquatic creatures, including insects, crustaceans, mollusks, frogs, and fishes. They also have the ability to breathe air and are known to come to the surface, especially during the hottest hours of the day, for respiration [26)].

Lapradei Bichir (*Polypterus lapradei*)

Figure 6: Surveyed Lapradei Bichir (*Polypterus lapradei*) (Photo by: Samytro)

Native and Distribution: Lapradei Bichir, commonly known as *P. lapradei* or the Lapradei bichir, is a species of bichir fish that originates from the African continent. This species is primarily native to the freshwater systems of Central Africa, specifically within the Congo River basin [14]. Within this basin, *P. lapradei* is found in a variety of habitats, including slow-moving rivers, swamps, and floodplain areas. Its native range extends across several countries in Central Africa, including the Democratic Republic of Congo and the Republic of Congo.

Descriptions: According to [23], Dorsal fin characteristics in *P. lapradei* include 13 - 18 dorsal spines and 0 dorsal soft rays, and its anal fin features 13 - 16 anal soft rays with no anal spines. It has a total of 61 - 62 vertebrae. This species is distinguished by its lower jaw being slightly longer than the upper jaw, and its pectoral fin extending to the first dorsal ray. In terms of scales, *P. lapradei* ranges from 63 to 70 in the lateral line, with 14 to 18 dorsal fin rays and 11 to 13 pelvic fin rays. The subspecies P. bichir lapradei has 58 to 68 scales in the lateral line, 13 to 15 dorsal fin rays, and 13 to 16 pelvic fin rays. This fish can facultatively breath air and often basks near the water's surface in shallow areas. It exhibits remarkable flexibility when swimming, resembling an eel in its ability to turn and twist. *P. lapradei* lays its eggs in aquatic vegetation, and the adult fish protects both the eggs and young. Its primary diet consists of bottom-feeding fish, making it primarily piscivorous.

P. lapradei stands out within the Polypteridae family due to its unique morphometric characteristics. It possesses an elongated, cylindrical body covered in thick, overlapping ganoid scales, which provide a protective armor. The coloration of *P. lapradei* typically ranges from brown to greenish-brown and often features a mottled or speckled pattern that aids in camouflage in its natural habitat. A significant feature of *P. lapradei* is its dorsal fin, which is divided into two sections, with the front part equipped with sharp spines. These spines serve as a vital defensive adaptation and can be raised when the fish feels threatened, deterring potential predators. The positioning of its pectoral fins close to the head enables precise control and maneuverability in the water, and its lobed caudal fin assists in both propulsion and stability.

Ansorgii Bichir (*P. Ansorgii*)

Figure 7: Surveyed Ansorgii Bichir (*P. Ansorgii*) (Photo by: Dani Ramdani Pamungkas)

Native and Distribution: Ansorgii Bichir, scientifically known as *P. ansorgii*, is a captivating species of bichir fish originating from the freshwater habitats of West and Central Africa. This species is predominantly native to the Congo River basin, with its distribution extending through countries such as the Democratic Republic of Congo and the Republic of Congo. *P. ansorgii* thrives in a range of aquatic environments within this basin, including slow-moving rivers, swamps, and floodplains, where it has adapted to a variety of ecological niches.

Descriptions: According to [23], *Polypterus ansorgii*, a species found in Africa, has been identified in the Corubal River in Guinea Bissau, and more recently, in the Niger basin in Guinea, as well as in Lake Kainji and the Ogun River in Nigeria. It can be distinguished from other species in the same genus by its equally sized jaws and a forward-set dorsal fin, which is separated from the head by 11 to 13 scales.

P. ansorgii possesses unique morphological characteristics that set it apart within the Polypteridae family. Notably, it has a long, cylindrical body covered in tough ganoid scales, providing both protection and structural support. The coloration of *P. ansorgii* typically ranges from brown to greenish-brown, often with a mottled or speckled pattern that aids in blending with its natural surroundings. The dorsal fin of *P. ansorgii* is split into two sections, with the front part containing sharp spines that serve as a defense mechanism. Additionally, its pectoral fins are located close to the head, enabling precise control and maneuverability in the water. The lobed caudal fin enhances stability and propulsion.

Congicus Bichir (*P. Congicus*)

Figure 8: Surveyed Congicus Bichir (*P. Congicus*) (Photo by: Deni Trio Santoso)

Native and Distribution: Congicus Bichir, scientifically known as *P. congicus*, is a species of bichir fish native to the tropical freshwater systems of Central Africa. This species is predominantly found within the Congo River basin, which spans across several countries including the Democratic Republic of Congo and the Republic of Congo. Within this basin, *P. congicus* inhabits a variety of aquatic habitats, including slow-moving rivers, swamps, and flooded forest areas. Its native range showcases its adaptability to diverse environments within the Central African region, highlighting its significance in the local aquatic ecosystems.

Descriptions: *P. congicus* exhibits distinctive morphometric characteristics that characterize it within the Polypteridae family. These fish are characterized by their elongated, cylindrical bodies covered in overlapping, thick ganoid scales, providing them with a unique and ancient appearance. Like other Polypteridae species, P. congicus possesses a divided dorsal fin, with the anterior part having sharp spines that can be raised for defense.

The coloration of *P. congicus* varies, ranging from muted earthy tones to shades of brown, often with subtle mottled or speckled patterns for effective camouflage within their natural habitat. Their pectoral fins are strategically positioned near the head, enabling precise movement and navigation in the water, while the lobed caudal fin aids in stability and propulsion.

Teugelsi Bichir (*P. teugelsi*)

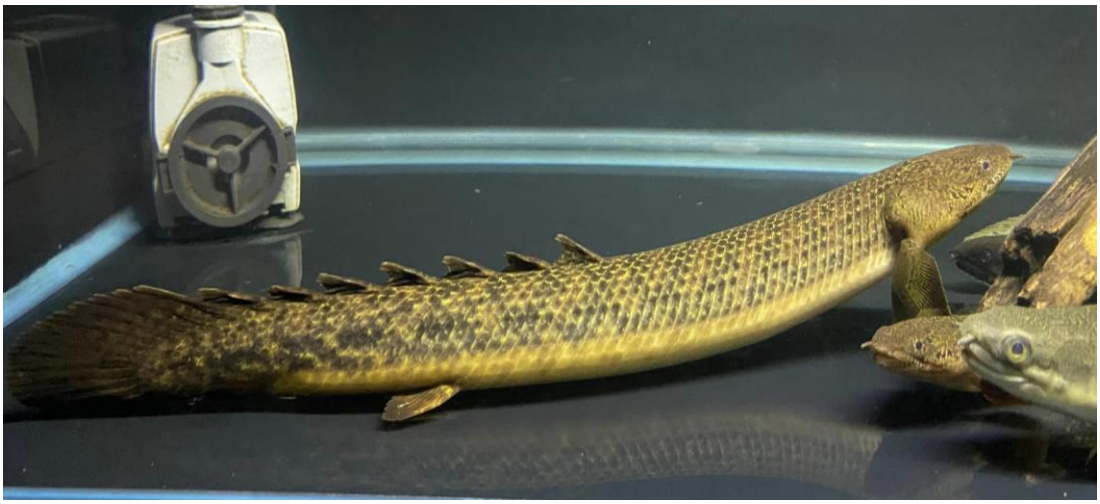

Figure 9: Teugelsi Bichir (P. teugelsi) Photo by: Firman Saputra

Native and Distribution: Teugelsi Bichir, scientifically known as *P. teugelsi*, is an intriguing species of bichir fish native to the freshwater ecosystems of Central Africa. Specifically, it is predominantly found in the Congo River basin, a region spanning several countries including the Democratic Republic of Congo and the Republic of Congo.

Within this basin, *P. teugelsi* inhabits various aquatic environments such as slow-moving rivers, swamps, and flooded forest areas. This species' adaptability to different water conditions showcases its significance in the intricate aquatic ecosystems of Central Africa, emphasizing its role in the region's biodiversity.

Descriptions: *P. teugelsi* exhibits distinct morphometric characteristics that define it within the Polypteridae family. These fish are characterized by their elongated, eel-like bodies covered in thick ganoid scales, providing them with a unique and ancient appearance. One of the notable features of *P. teugelsi* is its divided dorsal fin, with the anterior part containing sharp spines that can be raised as a defensive mechanism [18].

Additionally, their pectoral fins, located close to the head, enable precise maneuverability and control, while the lobed caudal fin assists in stability and propulsion. The coloration of *P. teugelsi* varies, often featuring subdued earthy tones, including shades of brown and green, with intricate patterns that aid in their camouflage within their natural habitat.

Mokelembembe Bichir (*P. mokelembembe*)

Figure 10: Surveyed Mokelembe bichir (*P. mokelembe*) (Photo by: Elvan Agung Harimulyo)

Native and Distribution: Mokelembembe Bichir, scientifically known as *P. mokelembembe*, is a captivating species of bichir fish native to the lush freshwater ecosystems of Central Africa. This unique species is predominantly found in the Congo River basin, which spans across various countries, including the Democratic Republic of Congo and the Republic of Congo. Within this basin, *P. mokelembembe* thrives in a diverse range of aquatic habitats, encompassing slow-moving rivers, swamps, and flooded forest areas. Its native distribution showcases its adaptability to the intricacies of Central Africa's aquatic environments, highlighting its ecological importance in the region's biodiversity.

Descriptions: According to published article [27], *P. mokelembembe* is characterized by having 6-8 dorsal spines and no dorsal soft rays, with a body shape that starts as subcylindrical and elongate, then becomes laterally compressed towards the tail. The head is slightly flattened, with a terminal mouth, fleshy lips, and an acute snout. The distance between internostrils is 11.6-13.7% of the head length. It has 6-8 dorsal finlets and a wide first dorsal-fin spine, comprising 6.4-8.1% of the head length. The pectoral fins are rounded and do not reach the level of the first dorsal spine. The fish has 57-60 lateral-line scales, 32-38 scales around the body, 32-37 predorsal scales, and 42-47 prepelvic scales. The body scales are square on the flanks and rhomboid on the caudal peduncle. The lateral-line pores are elongated and located on the anterior portion of each scale in the first half and in the central part of the second half of the lateral line. Preserved specimens of *P. mokelembembe* have a dark grey dorsal body color with ill-defined dark grey to black bands and blotches. These markings may converge on the dorsal third of the body to form broad saddles in front of the first finlet.

There is no distinct boundary between the dark dorso-lateral coloration and the light beige ventral coloration. Additionally, there is a single large black blotch on the base of the pectoral fin.

P. mokelembembe possesses unique morphometric features that set it apart within the Polypteridae family. These fish have a long, cylindrical body covered in thick ganoid scales, giving them an ancient and fascinating appearance. One distinctive characteristic is their dorsal fin, which is split into two parts. The front section is armed with sharp spines, serving as a defense mechanism. Their pectoral fins, located near the head, enable precise movement and navigation, while the lobed caudal fin provides stability and assists in propulsion. In terms of coloration, *P. mokelembembe* displays a range of subtle earthy hues like browns and greens, adorned with intricate patterns that aid in effective camouflage within their natural environment.

Retropinnis Bichir (*P. retropinnis*)

Native and Distribution: Retropinnis Bichir, scientifically known as *P. retropinnis*, is a captivating species of bichir fish native to the rich aquatic habitats of Central Africa. This species is predominantly found in the Congo River basin, a region encompassing countries such as the Democratic Republic of Congo and the Republic of Congo. Within this basin, P. retropinnis inhabits a diverse array of aquatic environments, including slow-moving rivers, swamps, and flooded forest areas. Its native distribution highlights its adaptability to the dynamic and complex ecosystems of Central Africa, underscoring its ecological significance in the region's aquatic biodiversity.

Descriptions: *P. retropinnis* possesses distinctive morphometric characteristics that define it within the Polypteridae family. These fish exhibit an elongated, cylindrical body encased in thick ganoid scales, giving them a unique and prehistoric appearance. One of the notable features of P. retropinnis is its dorsal fin, which is divided into two parts. The anterior section of the dorsal fin is equipped with sharp spines, offering both a defensive mechanism and stability in the water. Their pectoral fins, positioned near the head, enable precise movement and navigation, while the lobed caudal fin contributes to stability and assists in propulsion. The coloration of P. retropinnis varies, often displaying muted tones of brown and green, with intricate patterns that aid in effective camouflage within their natural habitat.

Polli Bichir (*P. polli*)

Figure 11: Surveyed Polli Bichir (*P. polli*) (Photo by: Vin Estewe)

Native and Distribution: Polli Bichir, scientifically referred to as *P. polli*, is an intriguing species of bichir fish native to the freshwater ecosystems of Central Africa. This species predominantly inhabits the Congo River basin, spanning across countries such as the Democratic Republic of Congo and the Republic of Congo. Within this basin, *P. polli* is primarily found in slow-moving rivers, swamps, and flooded forest areas. Its native distribution exemplifies its adaptation to the dynamic and diverse aquatic habitats of Central Africa, emphasizing its ecological significance in the region's aquatic biodiversity.

Descriptions: *P. polli* displays unique morphometric characteristics that distinguish it within the Polypteridae family. These fish are characterized by their elongated, cylindrical bodies covered in thick ganoid scales, imparting them with a distinctive and ancient appearance. Notably, *P. polli* features a divided dorsal fin, with the anterior section equipped with sharp spines that serve as both a defensive mechanism and aids in stability during swimming. Their pectoral fins, located close to the head, facilitate precise movement and navigation, while the lobed caudal fin provides stability and assists in propulsion.

The coloration of *P. polli* typically consists of subdued earthy tones, such as browns and greens, with intricate patterns that allow for effective camouflage within their natural habitat.

Delhezi Bichir (*P. delhezi*)

Figure 12: Surveyed Delhezi bichir (*P. delhezi*) (Photo by: Admiral Amin Supit)

Native and Distribution: Delhezi Bichir, scientifically known as *P. delhezi*, is a fascinating species of bichir fish endemic to the freshwater ecosystems of Central Africa. This species primarily inhabits the Congo River basin, spanning across countries such as the Democratic Republic of Congo and the Republic of Congo. Within this basin, *P. delhezi* is commonly found in slow-moving rivers, swamps, and flooded forest areas. Its native habitat showcases its adaptability to various aquatic environments, underscoring its ecological importance in the intricate ecosystems of Central Africa.

Descriptions: *P. delhezi* exhibits distinctive morphometric characteristics within the Polypteridae family. These fish are recognized for their elongated, cylindrical bodies enveloped in robust ganoid scales, lending them a unique and ancient appearance. One of the key features of *P. delhezi* is its divided dorsal fin, with the anterior section armed with sharp spines that serve both as a defensive mechanism and for stability during swimming. Their pectoral fins, positioned near the head, allow precise movement and navigation, while the lobed caudal fin contributes to stability and assists

in propulsion. The coloration of *P. delhezi* often includes subdued earthy tones, such as shades of brown and green, adorned with intricate patterns that enable effective camouflage within their natural habitat.

Feeding Habit

Polypterus are carnivorous predators with diverse feeding habits. Polypterus fishes are all carnivorous and capable of terrestrial locomotion with predominantly nocturnal activity [28]. They are opportunistic feeders and primarily prey on a variety of aquatic organisms, including fish, crustaceans, insects, and small amphibians. Their diet may vary depending on their size, age, and the availability of prey in their habitat. Polypterus are well-adapted ambush predators and use their cryptic coloration and slow, deliberate movements to stalk and capture prey.

Potential Invasive Species

Polypterus are not typically considered invasive species in their native range, they have gained popularity in the global aquarium trade due to their unique appearance and hardiness. The concern with the potential invasiveness of Polypterus arises when they are introduced into non-native ecosystems. In regions where these fish are not native, they could potentially establish populations and compete with or prey upon native species, disrupting the local aquatic ecosystems. This has happened to several non-native fish families in Indonesia. Several types of non-native fish have been found in public waters in Indonesia, such as from the Cichlidae family [29–31], predatory fish from the Osteoglossidae family [32] and Lepisosteidae [33] have also been found, although there have been no reports of finding their juveniles in the wild. They were initially traded as ornamental fish, then cultivated locally and finally released into public waters, whether intentionally or unintentionally.

The culture of Polypterus is unregulated in Indonesia, and the potential risk of establishment of this predatory fish and its potential spread in this Southeast Asian country is alarming for wildlife managers [5]. In general, fish invasion in aquatic areas through the ornamental fish trade is a worrying and complex phenomenon. When foreign ornamental fish are imported to meet market demand, they are often accidentally released into local waters. Transportation of these fish involves the use of various types of containers and containers which may not be secure enough to prevent leakage or release of fish into the surrounding environment. Once the fish are released, they can quickly adapt to the new environment and reproduce, competing with local fish species for resources and eating food that would otherwise be native to the species. This can result in drastic changes in the structure of aquatic ecosystems and threaten the sustainability of local fish populations. Recording fish traffic and trading volume may be needed as a form of population control [34]. Therefore, responsible ownership and management of Polypterus in the aquarium trade is crucial to prevent accidental releases and the potential invasive impact on local ecosystems. Legislation and regulations may also be in place in some regions to control the import and possession of non-native species such as Polypterus to mitigate the risks associated with their introduction into new environments.

Acknowledgements

Authors thanks to the Faculty of Fisheries and Marine Science, PSDKU Brawijaya University Kediri, and Integrated Research Laboratory for all support and facilities.

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