

The First Record of *Atractosteus spatula* (Lacepède, 1803) (Actinopterygii: Lepisosteiformes: Lepisosteidae) in the Klawing River, Central Java, Indonesia

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Abstract: The Alligator gar, *Atractosteus spatula* (Lacepède, 1803), is a high-predatory fish native to North America. In 2020, two specimens were captured as a new species in the public waters of Klawing River, Central Java, Indonesia at 7°19'.27"S 109°20'10"E. Therefore, this study aims to describe the meristic and morphometric features of *Atractosteus spatula* based on an in-situ observation in the river.

Keywords: Alien fish; Alligator gar; Invasive species; Klawing river; Ornamental fish

Introduction

The Alligator gar, *Atractosteus spatula* (Lacepède, 1803), is a high-predatory fish native to North America, including the Mississippi River basin, South-Western Ohio, Southern Illinois, the Gulf of Mexico (Raz-Guzman & Grizzle, 2001; Keevin & Lopinot, 2019) and has recently been introduced to several countries worldwide due to aquarium trade (Salnikov 2010; Hasan et al., 2020). Aside from North America, *A. spatula* has also been found in open waters such as Zrebar Lake, Iran (Esmaeili, 2021), and the Malay Peninsula, Malaysia (Chang et al., 2008). In Indonesia, the presence of this fish has been reported in a coastal pond in Sumatra (Muchlisin, 2012), Nyanyi Estuary, south of Bali, and Brantas River Basin, East Java (Hasan et al., 2020).

Atractosteus spatula has the potential to become an invasive species because it is euryhaline, tolerant to new

habitats, highly predatory, has poisonous eggs, and maximum length of 305 cm (Mutlak et al., 2017). In addition, this species is very dangerous for Indonesia's native river environment because it is carnivorous and prey on other types of fish, as well as crustaceans, frogs, and birds (Robin et al., 2023; Fadjar et al., 2019). Therefore, it has the potential to reduce the biodiversity of local animals and fish.

Method

The Alligator gar sample was captured using a cast net on 17 December 2020 in Klawing River located in Karangnangka, Mrebet District, Purbalingga Regency, Central Java, Indonesia at -7°19'27"S 109°20'10"E. The fish was photographed and documented using a digital camera, while the voucher specimens were retained and stored in the laboratory of Aquaculture, Faculty of

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Fisheries and Marine Sciences, Jenderal Soedirman University. The meristic characteristics observed include the number of dorsal, pectoral, and anal, ventral fin rays, as well as the lateral line scales. Meanwhile, the morphometric features examined include total, standard, and head length, as well as body depth, eye diameter, and snout length. The methodology is consistent with Bigelow et al. (1963).

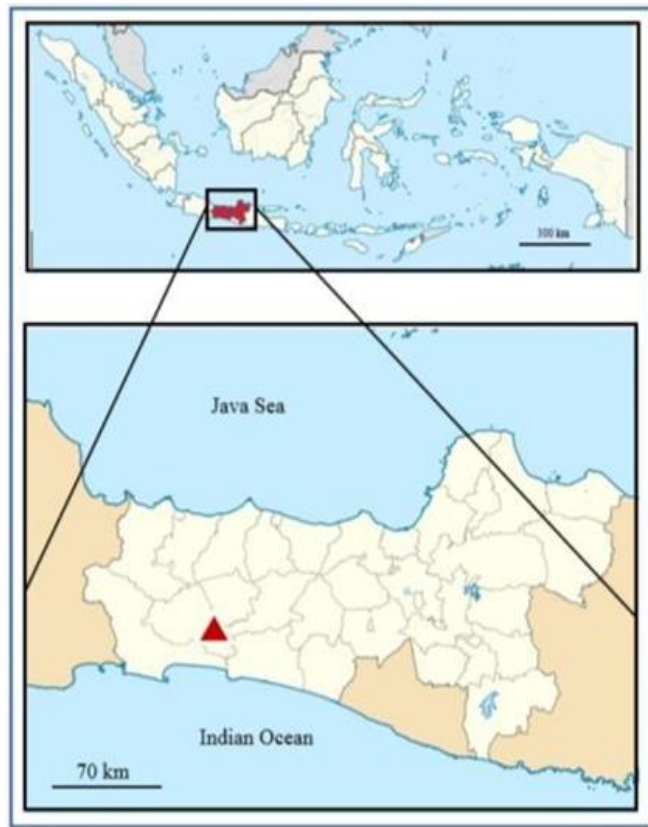


Figure 1. The location of a live specimen captured in Klawing River, Karangnangka, Mrebet District, Purbalingga Regency, Central Java, Indonesia ($7^{\circ}19'27''S$ $109^{\circ}20'10''E$)

Result and Discussion

The Record

Purbalingga Regency, Central Java, Indonesia at $-7^{\circ}19'27''S$ $109^{\circ}20'10''E$. The total length was 46.8 cm, hence, the specimens collected were identified as *A. spatula*. This species is easily distinguished from other Lepisosteidae family members due to its large size, with an elongated and triangular short snout. Furthermore, the specific morphological characters show cylindrical body with an obvious rounded tail, light dorsal stripe, dark olivaceous brown above and white to yellowish beneath, while dark brown blotches on all fins (Fig. 2). The meristic and morphometric characters of *A. spatula* are given in Table 1.



Figure 2. Shows a live specimen of *Atractosteus spatula* captured in Klawing River

Table 1. Meristic and Morphometric of Alligator Gar (*Atractosteus spatula*) from Klawing River, Purbalingga Regency, Central Java, Indonesia

Characters	Meristics (Counts)	Characters	Morphometrics (cm)
Dorsal fin rays	9	Standard length	51.2
Pectoral fin rays	12	Total length	46.8
Anal fin rays	7	Head length	31.7
Ventral fin rays	10	Body depth	11.2
Caudal fin rays	14	Eye diameter	1.7
Lateral line scales	58	South length	11



Figure 3. *Atractosteus spatula* captured in Klawing River, Karangnangka, Mrebet District, Purbalingga Regency, Central Java, Indonesia

Discussion

The spread of non-native species to new environments and habitats can occur through various intentional or unintentional means. In the modern era of global economic globalization and the trade of ornamental fish, there are significant opportunities for the introduction and invasion of species (Chan et al., 2019; Magalhães & Jacobi, 2013; Mendoza et al., 2015). The movement and entry of foreign species into different habitats have become widespread and rapid. This involves numerous species from diverse sources and for various purposes.

Most non-native species cannot survive in new environments either because they cannot adapt or

because their initial populations are too small to sustain successful growth (Hänfling, 2007; Sagoff, 2005; Manna et al., 2021). However, a few foreign species can thrive and spread widely beyond their native habitats, even becoming naturalized species. Fish species that can quickly adapt and are aggressive are often referred to as Alien invasive species (Liu et al., 2023).

Once established in new environments, some invasive species can cause significant economic losses in various sectors, including fisheries production and aquatic biodiversity (Saba et al., 2020; Dali et al., 2023; Cuthbert et al., 2021; Diagne et al., 2021; Giakoumi et al., 2018; Hatzenbuehler et al., 2017). Specifically, the invasion of fish into water bodies through the ornamental fish trade is a concerning and complex phenomenon. When exotic fish are imported to meet market demands, they are often inadvertently released into local waters. The transportation of these fish involves the use of various containers that may not be secure enough to prevent leakage or the release of fish into the surrounding environment. Once released, these fish can quickly adapt to the new environment, reproduce, compete with local fish for resources, and consume food that should belong to native species. This can drastically alter the ecosystem structure of water bodies and threaten the survival of local fish populations (Mousavi-Sabet, 2019; Atique & An, 2022).

Atractosteus spatula native to central and south-eastern states of the USA plus northern and central Mexico. No specific type locality was provided in the original description, and it has already disappeared from much of its northern range, with modern distribution comprising the lower Mississippi River basin plus Gulf Coast states of the southeastern U.S. and Mexico, as far south as the state of Veracruz (Hasan et al., 2020; Jawad et al., 2017). They are slow-moving fish except when attacking the prey, and is found in shallow, grassy areas of rivers, lakes, as well as tributaries often in small groups (Al-Janabi, 2018). These fish are glutton predators of smaller fish and invertebrates such as crabs, freshwater turtles, birds, as well as small mammals by holding and attacking with the teeth like needles (Aguilera et al., 2002; Bartnicki et al., 2021; Meitzen et al., 2023). Additionally, *A. spatula* causes biological pollution which potentially damages the fish and animal biodiversity throughout estuarine and freshwater habitats (O'Connell et al., 2007; Isroni et al., 2019; Islamy & Hasan, 2020).

In this study, it was assumed that *A. spatula* is released by a fish owner, that frequently disposes of unwanted predators into open water bodies. It is also likely that this fish was released due to its excessive size, and lack of maintenance (Chang et al., 2008). There are several cases in Java where the community deliberately

releases non-native fish into local waters because of the inability to provide feeding. Other examples of non-native fish that eventually invade freshwater in Java are Clariidae (Ihwan et al., 2020), and Cichlidae (Hasan et al., 2019a; Hasan et al., 2019b; Insani et al., 2020; Serdiati et al., 2020).

In the future, further introductions need to be prevented to reduce the impact of invasive predator fish on the open waters and generally on the native aquatic ecosystems in Java (Hasan & Tamam, 2019). Further repository and identification studies of native and non-native fish especially using a published identification model are needed (Pramono et al., 2020; Kang et al., 2022). Therefore, monitoring fish traffic and trade volume might be necessary as a means of population control (Octovianus et al., 2023).

The first record of *Atractosteus spatula* (Lacepède, 1803) in the Klawing River, Central Java, Indonesia, holds significant importance in both scientific and conservation contexts. This discovery makes a substantial contribution by expanding our understanding of the species' geographical distribution and ecology, previously unrecorded in this region. The presence of *Atractosteus spatula* in the Klawing River provides crucial evidence regarding the biodiversity and adaptation of this species to tropical freshwater environments, previously not thoroughly explored.

This finding also carries direct implications for the management of natural resources and environmental conservation in Indonesia. Understanding the presence of this species allows authorities and researchers to design more effective conservation strategies to protect its habitat and prevent overfishing, which could endanger the local population. Furthermore, this research offers an opportunity to comprehend the ecological interactions of *Atractosteus spatula* with other local species in the Klawing River, paving the way for further studies on freshwater ecosystem dynamics in this area.

Conclusion

Apart from its scientific and conservation benefits, this discovery holds high educational value. The local community and scientific community can learn more about the biodiversity of the Klawing River, raising awareness about the importance of environmental protection and stimulating interest in tropical aquatic ecology studies. Thus, the urgency of this research is immense, as it not only enriches our scientific knowledge of Indonesia's biodiversity but also provides a strong foundation for more effective and sustainable conservation actions to protect *Atractosteus spatula* and the Klawing River ecosystem as a whole.

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Author Contributions

T.B.P., S.M., J.J.P., S., and R.A.I. all contributed significantly to this work.

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Conflicts of Interest

The authors declare no conflict of interest.

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