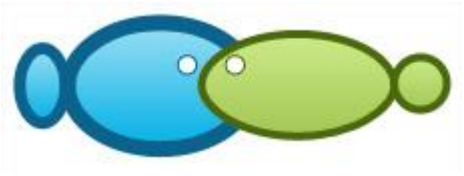

First record of Siamese fighting fish, *Betta splendens* (Regan, 1910) (Anabantiformes: Osphronemidae), in Bangka Island, Indonesia

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Abstract. Siamese fighting fish, *Betta splendens*, is a group of the *Betta* genus and Osphronemidae family, a freshwater fish that is native to the Mekong Basin. *B. splendens* has been introduced to several countries, largely as a result of escape from ornamental fish farms, with known feral populations established in Singapore, Malaysia, Brazil, Colombia, and the Dominican Republic. This research reports the first record of *B. splendens* in Bangka Island, Indonesia, as a nonnative species. The discovery of *B. splendens* in Air Itam Canals, Bangka Island, Indonesia, represents a new record for the country and expands the known distribution range of the species. A total of ten specimens collected in the Air Itam Canals, Bangka Island were successfully identified as *B. splendens*. The presence of non-native species in water communities could be a danger to the ecosystem, including the native and endemic species, through competition for resources, predation, hybridization, habitat modification, and disease transmission.

Key Words: freshwater species, geographical distribution, non-native species.

Introduction. The variety of freshwater fish in Indonesia is quite high: currently, there are 1,266 species of freshwater fish in Indonesian inland waters in 2022 and more than 8.500 fish species categorized based on habitat features (e.g. salty, brackish, and freshwater) (Gani et al 2021; Nurjirana et al 2022; Ndobe et al 2022; Valen et al 2020). The diversity of Indonesian freshwater fish consists of endemic, native, introduced, and reintroduced (Robin et al 2023a; Insani et al 2023; Valen et al 2022; Hasan et al 2023a; Widodo et al 2022; Hasan et al 2022a; Serdiati et al 2020). However, the diversity of freshwater species will be greatly influenced by human activities around the waters, directly and indirectly. Human activities like habitat modification, overfishing, and the introduction of alien species, as well as natural causes like sea level rise and global climate change, can all pose threats to an area's ichthyofauna diversity (Kusumah et al 2023; Hasan et al 2022b).

Siamese fighting fish (*Betta splendens*) is a species of freshwater fish in the family Osphronemidae, endemic to the Mekong River, Thailand (Tan & Ng 2005). *B. splendens* is known to be very territorial and attack each other (Lichak et al 2022). While this species is highly tolerant of low oxygen levels and poor water quality due to its special labyrinth organ (Mendez-Sanchez & Burggren). This situation is highly beneficial to *B. splendens*

introduction into other habitats, but the opposite is true for local endemic fish whose existence is threatened by the arrival of this species. Threats from fish increase when species become invasive and disrupt ecosystems (Serdiati et al 2021; Bariyyah et al 2021).

In this study, we report the occurrence of *B. splendens* in the natural freshwater bodies of the Air Itam Canals, Bangka Islands, Indonesia as a non-native species. This is the first evidence of the presence of *B. splendens* in natural freshwater in the Bangka Islands. A new record of *B. splendens* from Bangka Island helps us understand the distribution of an introduction species. In particular, understanding new distributions of alien species is necessary to support appropriate conservation decisions and environmental sustainability assessments, due to alien invasions. Also, the presence of exotic fish is very dangerous to the presence of native and endemic fish (Saptadjaja et al 2020). Direct impacts were competition for resources, predation, disease transmission (infection or parasitism), habitat change, and genetic influences.

Material and Method

Description of the study sites. The study was conducted from January to February 2023 in the Air Itam Canals, Bangka Island, Indonesia. A total of ten specimens were caught using a cast net and fish trap, during the fieldwork. Two specimens were fixed in 7% formalin and deposited at the Laboratory of Universitas Bangka Belitung, Indonesia. Two specimen was preserved in 96% ethanol (Lutfiatunnisa et al 2020) for further research.

Identification of species. The morphological features analysis of *B. splendens* was carried out based on Tan & Ng (2005), by measuring the meristic analysis, specific character, and body shape, complemented by photographs of the life specimen which were taken immediately after capture, aiming to document the coloration pattern in life.

Results

New records. In this research, we report the first record of *Betta splendens* from Air Itam Canals, Bangka Island, Indonesia (2°13’92”S, 106°15’33”E). We discovered ten specimens like the one in Figure 1. *B. splendens* is originated from the Mekong River, Thailand (Tan & Ng 2005) and it has been introduced into the natural water of the Bangka Island, as a non-native species.

Figure 1. Specimen of *Betta splendens*, from Air Itam Canals, Bangka Island, Indonesia.

Identification. The specimen collected in the Air Itam Canals, Bangka Island was successfully identified as *B. splendens* based on characters proposed by Tan & Ng (2005). The diagnostic features exhibited by the specimen include: the body is frequently brightly

colored, the iris of the eye has iridescent green or blue patches, bubble-nest brooders have bodies that are elongate or slender, the head has parallel opercles when viewed dorsally, red or brown anal and caudal fin rays contrast with iridescent interradial membranes (especially in males), unpaired fins lack fine iridescent margins, and the opercle of the male has red. In addition, the meristic characteristics of *B. splendens* (Table 1) are: the number of dorsal spines (1); the number of pectoral fin (11); number of anal-fin (29); the number of lateral line scales (29); number of sub dorsal scales (7); number of predorsal scale (24).

Table 1

Meristic measurement of *Betta splendens* from Bangka Island, Indonesia

Meristic data	*Present study, n=10*	*Tan & Ng (2005) n=7*
Dorsal fin	11	10-14
Pectoral fin	11	11-12
Subdorsal scales	7	7-10
Transverse scales	9	9
Anal fin	29	28-30
Lateral line scales	29	29-31
Predorsal scales	24	22-26
Postdorsal scales	8	8-11
Lateral scales below dorsal-fin	14	14-16
Lateral scales below anal-fin	6	5-7

Discussion. A popular ornamental fish from the Osphronemidae family that is native to Thailand, called *B. splendens*, has a long history of fighting and gambling that is akin to cockfighting. It's been more than a thousand years since this species was first domesticated. In the 19th century, it was then exported to other countries as a fighting and ornamental fish. This fish is classified as an alien fish species in Indonesia. The discovery of *B. splendens* in Canal Air Itam (Figure 2), Bangka District, is the first official record of this species on the island and an essential contribution to understanding the distribution (Robin et al 2023b; Hasan et al 2023b; Valen et al 2020), of this non-native species.

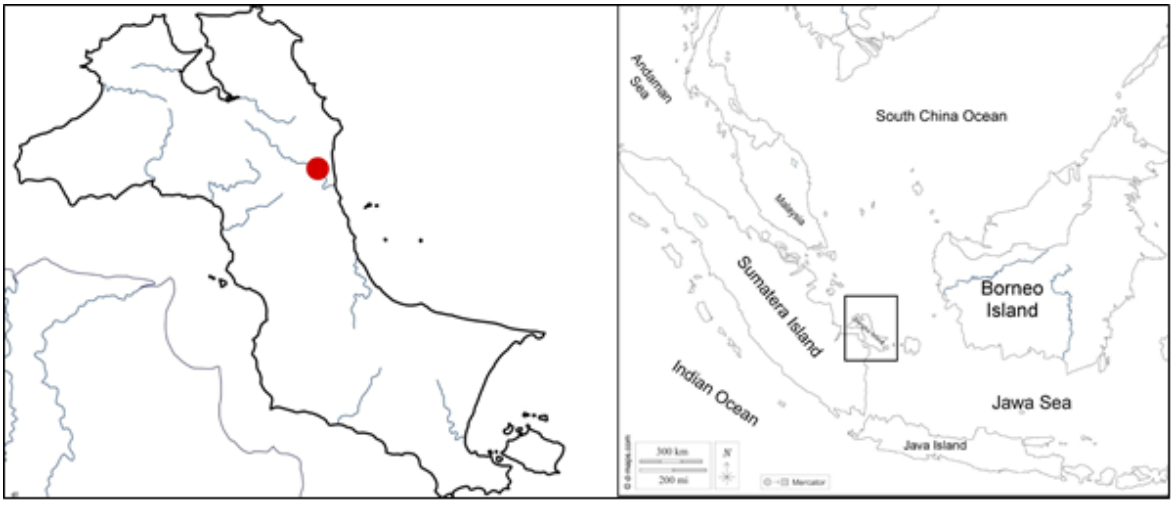

Figure 2. Presence of *Betta splendens* in Bangka Island, Indonesia.

B. splendens is currently being farmed and introduced to a number of nations, including Indonesia. Originally imported as an ornamental fish, this species has recently been shown to be thriving in inland water and behaving like a native fish by reproducing there. According to current reports, we discovered this species residing on Indonesia's Bangka Island's Air Itam Canals (Figure 3). Several native species, including *Rasbora einthoveni*, *Barbodes selifer*, *Osteochilus hasselti*, *Anabas testudineus*, *Trichogaster trichopterus*,

Betta edithae, *Channa striata*, *Hamirhampodon pogonatus*, *Macrobrachium* sp., and *Parathelphusa maculata*, were also present at the time of sampling.

Figure 3. Habitat of *Betta splendens* in Air Itam Canals, Bangka Island, Indonesia.

Local betta fish growers purposefully introduced *B. splendens* into the natural body of water in the Air Itam Canals on the Indonesian island of Bangka. Due to overproduction, breeders of this fish are forced to throw a portion of the harvest into natural body waters. The introduction of *B. splendens* to nature can harm the ecology and endanger the existence of local fish and endemic fish. The native fish that inhabit there will eventually be damaged directly and indirectly. The direct impact of the presence of non-native species is through resource competition, predation, hybridization, habitat alteration, disease transfer (infection or parasitism), and genetic repercussions (Jerikho et al 2023; Hasan et al 2023c; Foster et al 2021; Insani et al 2020; Ribeiro & Leunda 2012). Furthermore, non-native fish can breed quickly and grow to have large numbers. Native fish may become extinct as a result of high competition for food and space, as well as widespread predation (Robin et al 2023c; Mangitung et al 2021; Ihwan et al 2020; Rahim et al 2013). In fact, it is illegal to release non-native fish that have been raised. According to Law Number 31 of 2004 article 86, paragraph 2 concerning Fisheries, as amended by Law Number 45 of 2009 concerning Amendments to Law Number 31 of 2004 concerning Fisheries, people who cultivate fish that can endanger fish resources, the environment where fish resources are found, or human health, may be subject to a maximum prison sentence of 6 years and a maximum fine of 97,518.48 USD. The findings of this research will help the government and the community in working together, in the future, to protect natural aquatic ecosystems, prevent the introduction of invasive fish that could damage the balance of the environment, and impose sanctions in accordance with the law and regulations on those who violate and harm the environment.

Conclusions. The discovery of *B. splendens* in the Air Itam Canal, Bangka Island, Indonesia, represents a new record for the country and expands the known distribution range of the species. The identification of ten specimens in different sizes and their characteristic features confirms their classification as *B. splendens.* Co-existence of other fish species in the same habitat further contributes to understanding species diversity, expansion and biogeography in the region. This information is crucial for the classification and conservation of rivers, as well as for planning efforts to protect ecosystems, especially from non-native species that are potentially invasivepeci. *B. splendens* are

territorial, attack one each other and play a role in the ecosystem through resource competition, predation, hybridization, habitat alteration, disease transfer (infection or parasitism), and genetic repercussions. Also this species can breed quickly, reaching large populations and becoming more invasive.

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Conflict of interest. The authors declare no conflict of interest.

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