

Short Communication

First Record of the Ladder Gudgeon *Bostrychus scalaris* Larson, 2008 (Gobiiformes: Eleotridae: Butinae) from Mangrove Estuary of South Sumatra, Indonesia

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ABSTRACT

A single specimen of *Bostrychus scalaris* was collected from the mangrove estuary of Banyuasin Regency, South Sumatra, Indonesia. The species was originally described as a new species based on a single specimen collected from the disturbed mangrove site in Sementa River, Selangor State, Malaysia. Subsequently, the species was known to have been distributed in Singapore based on a watercolour painting by a French naturalist also in Mekong River in Soc Trang Province, Vietnam. The present specimen of *B. scalaris* represents the first record of the species from Indonesian water and southernmost record of the species.

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The genus *Bostrychus* characterised in having 7 dorsal spines; 9 dorsal soft rays; 1 anal spine; 8 anal soft rays; and 27 vertebrae (Larson 2008; Kottelat 2013) consists of eight valid species, viz., *Bostrychus sinensis* Lacepède, 1801, *Bostrychus africanus* (Steindachner, 1879), *Bostrychus zonatus* Weber, 1907, *Bostrychus aruensis* Weber, 1911, *Bostrychus expatria* (Herre, 1927), *Bostrychus strigogenys* Nichols, 1937, *Bostrychus microphthalmus* Hoese & Kottelat, 2005, and *Bostrychus scalaris* Larson, 2008 (Parenti 2021). The distribution of this genus covers Asia, Africa, Indo-West Pacific, and Oceania where three species have been recorded in Indonesian waters, namely *B. aruensis* (Aru Islands), *B. strigogenys* (Papua Province), and *B. microphthalmus* (South Sulawesi) (Miller & Wongrat 1990; Parenti 2021). Most of the genus *Bostrychus* are recorded inhabiting freshwater, brackish, and marine habitats. Most of this genus also inhabit estuaries and are mangrove ecosystem types.

The ladder gudgeon *B. scalaris* was previously reported with a limited geographical distribution in Malaysia (Larson 2008; Kottelat 2013; Huang et al. 2014; Parenti 2021), Singapore (Loneux 2006; Larson et al. 2016), and Vietnam (Tran et al. 2021; Taki et al. 2021). This species was originally described as a new species by Larson (2008) based on a single specimen collected from the Sementa River near Klang, Selangor State, Malaysia. Apart from being reported in Malaysia, this species' distribution in Singapore is suspected based on notes in a watercolour painting (number 607; genus unknown) by the French naturalist F. L. de

Castelnau. Other records also mention that *B. scalaris* is also found in mangrove habitats around Mekong River tributaries in Cu Lao Dung District, Soc Trang Province, Vietnam. The single specimen collection in this report represents the first record of this species in Indonesia, distributed in irrigated oil palm plantations in Banyuasin Regency, South Sumatra Province.

Counts and measurements of the body and its parts of a single specimen of *B. scalaris* follow Larson (2008). Measurements and meristic calculations were performed using Mitutoyo ABS digital caliper 500-151-30 0-150mm and a stereo microscope. Standard, total, and head lengths were abbreviated as SL, TL, and HL, respectively. Head length was measured from the base of the operculum to the tip of the mouth. Data of body proportion measurement is shown in both real scale and percentage of standard length, while head proportion data is shown in both real scale and percentage of head length. The character descriptions are based on a single specimen in Indonesia which was cataloged and deposited at the Museum Zoologicum Bogoriense (MZB) under the Directorate of Scientific Collections Management, Nasional Research and Innovation Agency, Indonesia.

Taxonomy

Gigaclass Actinopterygii

Superclass Actinopteri

Class Teleostei

Order Gobiiformes

Family Eleotridae Bonaparte, 1835

Subfamily Butinae Bleeker, 1874

Genus *Bostrychus* Lacepède, 1801

Bostrychus scalaris Larson, 2008

(Standard English name: Ladder gudgeon)

Figures 1–2

Material examined. MZB.26591, single specimen, 103.6 mm SL, brackish water flow in small plantation ditches, Sungsang IV Village, Banyuasin II District, Banyuasin Regency, South Sumatra Province, Sumatra Island, Indonesia, 2°21'00.5"S 104°51'49.4"E, throwing nets, Rusdianto, 31 May 2020.

Description. Head broad, compressed, flat, with a slightly protruding area in the centre of the nape extending parallel to the body axis towards the back, broadest area located in the area vertically aligned with preopercular margin. Total length (TL) 126.5 mm; head length (HL) 30.68 mm (29.61% of SL); head width at preopercular margin 23.99 mm (78.19% of HL). Mouth terminal, large and slightly oblique, forming an angle of about 30° with the body axis. The length of the upper and lower jaws are 18.45 mm (60.14% of HL) and 19.58 mm (63.82% of HL), respectively; posterior end of jaw just below eye. Upper lip free; lower lip joins with chin anteriorly; inner area of lip with fine fimbriae. Teeth in the upper and lower jaws are small, flat, arranged in a cone shape with slightly blunt tips. Teeth arranged in six to seven rows anteriorly and four to five rows posteriorly. Conical vomer teeth, six to eight-rows. Large tongue with rounded tip. Snout length 10.31 mm (33.60% of HL); broad, curved, and blunt in appearance when viewed dorsally, and curved and slightly pointed in ventral view. Eyes small, laterally arranged with a diameter of 2.93 mm (16.07% of HL). Interorbital broad, fleshy, with a width of 8.92 mm (8.61% of HL). Anterior naris small, with a long tube at the edge of upper lip; posterior naris oval, with short tube. Gill opening wide, ex-

tending forward to below the posterior preopercle. Preopercular pores five, with a single median anterior interorbital pore, posterior interorbital pores paired, anterior nasal pores small, located close to the edge of the upper lip. Six pores eye (oculoscular canal damaged). Sensory papillae in a transverse pattern, mandibular papillae *i* in several short transverse rows and mostly arranged in eight or nine irregular groups, a pair of papillae *i* groups on the chin.

Body slender, slightly rounded in anterior region, compressed posteriorly; body depth 19.04 mm (18.37% of SL); body width 15.70 mm (15.15% of HL); predorsal length 13.4 mm (12.93% of HL), preanal length 60.73 mm (58.61% of HL); preventral length 23.70 mm (22.87% of HL); dorsal fin base length 10.8 mm (I) (10.42% of SL), 19.70 (II) (19.01% of SL); first dorsal fin length 11.92 mm (11.50% of SL), second dorsal fin length 25.09 mm (24.21% of SL), ventral fin length 19.53 mm (18.85% of SL); anal fin base length 13.06 mm (12.60% of SL); anal fin length 17.68 mm (17.06% of SL); prepectoral fin length 19.90 mm (19.2% of HL); caudal peduncle height 11.56 mm (11.16% of SL); distance between base of dorsal fin (II) and caudal peduncle 20.30 mm (19.59% of SL). The body and head covered by small cycloid scales. Scales on the head embedded in the fleshy skin (difficult to see without dissection). Opercles covered with small cycloid scales. Preopercle covered with small cycloid scales covering most of the cheeks, especially in the area near the rows of papillae. Prepelvic region with small embedded cycloid scales extending forward. Base of pectoral fins covered with small cycloid scales. Predorsal scales small, cycloid-shaped, extending forward the operculum with embedded cycloid scales. First dorsal fin low and pointed (tips of third and fourth spines curved); the tip of the depressed fin reaching base of second dorsal fin; about 17 small scales between first and second dorsal fins. Height of second dorsal and anal fins are slightly greater than the first dorsal fin. The posterior fin is slightly longer than the anterior fin but not overly so. The posterior radius is much shorter than the base of the caudal fin. Pectoral fins broadly rounded, rays unbranched. Caudal fins oblong and rounded posteriorly; pelvic fins slender and pointed, extending less than half the distance to anus.

The characters of the single specimen of *Bostrychus scalaris* collected from South Sumatra, Indonesia, follow the characters of the holotype specimen first described by Larson (2008). This species is distinguished from all other species of the genus *Bostrychus* by the following combination of characters: 9 total dorsal soft rays; 8 total anal soft rays; 16 total pectoral rays; and 135 left-sided linea lateralis scales. Head is broad and flat, the body slender and compact; pectoral fin with distinct dark brown markings; throughout lateral surface of body with ca. 24–25 dark vertical bars; and a convoluted pattern along the body (Larson 2008; this study). Larson (2008) stated that the number of linea lateralis on the left side of the body is 135. Still, in this latest study, the number of linea lateralis scales could not be counted because the scales on the left side of the body had been damaged due to the removal of tissue for DNA analysis. The detailed comparisons between *B. scalaris* to each other species of the genus are given in Larson (2008).

The Indonesian specimen of *B. scalaris* is larger than the holotype from Malaysia (103.6 mm vs. 93 mm SL). This size is followed by slightly larger or shorter in several morphometric proportions, e.g., head length (29.61% in the former vs. 25.7% of SL in the latter), head width (78.19% vs. 75.7% of SL), eye diameter (16.07% vs. 15.9% of HL), maxillary length (60.14% vs. 56.5% of HL), pectoral fin length (19.20% vs. 16.9% of SL), snout length (33.60% vs 32.2% of HL), and body depth (18.37% vs

15.5% of SL), caudal peduncle depth (11.16% vs 12.3% of SL). Several morphometrics (lengths of mandible, predorsal, preanal, second dorsal fin, and ventral fin) that previously not reported in its original description were examined in this study (see Description). Indonesian specimen could not be compared with the Vietnam specimen because the Vietnam specimen was not mentioned in detail regarding its morphometric measurements or meristic counts.

Preserved coloration. Based on a single specimen preserved in 70% alcohol, a dark brown dorsal head covers the entire surface of the scalp perfectly from the snout to the nape. Towards the ventral side, the dark brown fades and is incompletely distributed, resulting in an irregular pattern of spots around the eyes, cheeks, and operculum; the dark brown continues to fade ventrally, leaving small spots on the ventral 1/3 of the head. Dark brown centre upper lip then fades towards the lower side lip to leave small spots. The ventral head is perfectly white, and the chin is purplish (Figure 2a). Deep purple iris, outer edge of iris mottled purple-black, white pupil.

The dark brown dorsal body extends from the nape to the base of the tail. Ventrally, the dark brown is undistributed and does not completely cover the body, resulting in a pattern of light brown short vertical bars on the lateral body. The light brown short vertical bars number about 24 to 25, forming a ladder-like pattern, extending from the operculum to the base of the tail; some verticals are straight, crooked, and some are wavy. Some ends of the light brown short vertical bars are fused to each other in the centre of the bar, some ends are fused together in the ventral region, and some are separated from each other. At the ends of the vertical bars towards the abdomen and ventral region, the light brown colour fades, leaving small light brown spots along the sides of the body.



Figure 1. Preserved *Bostrychus scalaris* specimen, MZB.26591, 103.6 mm SL, collected from Banyuasin Regency, South Sumatra Province, Indonesia.

The base of pectoral fin light brown; near base of the fin, a short brown bar running parallel from the first to the last pectoral ray, producing 2 transverse, curved bands. Tip fin wide, blackish-brown band. The first dorsal fin mostly folded down, pale white base and with brownish tip. Second dorsal fin base white, purple-black patches alternating vertically with white; blackish dorsal fin tip. The first dorsal fin to the last dorsal soft ray purple-black produces a pattern of 4 horizontally aligned purple-black bands. Anal fin pale yellowish-white; two pale purple, thin, horizontally transverse bands; tip purplish with a narrow, pale white band just on the outer edge. Base of the upper lateral caudal fin, 2 mm diameter black spot, surrounded by a circular light brown; five dark brown bands, vertically curved and irregular. Tip of the outermost area black.

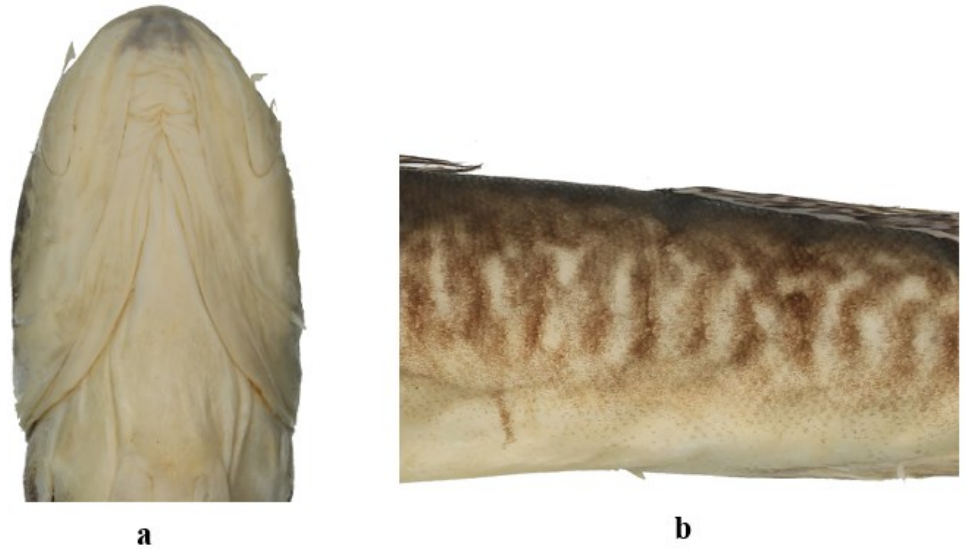


Figure 2. Enlargement of the body part of *B. scalaris* showing: **a)** pattern of folds on the ventral part of the head, **b)** a ladder-like pattern in the body, as one of the distinguishing characters.

The Indonesian specimen was not documented when it was fresh or alive, however, the colour of preserved specimen apparently did not differ much from the colour when it was still alive. All dark markings in the fin rays, dark spot in the dorsal base of caudal fin, and ladder-like pattern of dark bars a long side of the body in the live individual are still retained in the preserved specimen (see Larson 2008: Figure 1-2). At that time, Indonesian specimen was immediately tissue harvested for DNA analysis and then preserved.

Habitat. A single specimen collected from a small ditch that irrigated the oil palm plantation area (Figure 3). Measuring width of the ditch about 1.5 m and less than 1 m in depth. The riparian vegetation is dominated by shrub vegetation with muddy bottom. The water source in this ditch flows from a mixture of fresh water at the estuary of the Musi River and salt water in the South China Sea which is directly adjacent to the Bangka Islands with a salinity level of 18.5 ppt (Hernawati et al. 2023).



Figure 3. Brackish waters in Banyuasin Regency, South Sumatra, which are the habitat of *Bostrychus scalaris*. Photograph: Rena Tri Hernawati (2020).

The single specimen from Indonesia was collected from brackish waters close to the mouth of the Musi River which borders the salty waters of the South China Sea. These waters flow inland through small ditches into plantations. These conditions are similar to the collection sites in Malaysia and Vietnam which are also brackish waters, but the salinity levels of the collection sites in Malaysia are slightly higher (20 ppt vs. 18.5 ppt in this study), while the collection sites in Vietnam have a lower salinity range than the collection sites in Indonesia and Malaysia (14 ppt - 16.8 ppt) (Larson 2008; Tran et al. 2021). This sampling area is dominated by *Derris* sp. and *Nypa* sp. (Dalimunthe et al. 2022; Hernawati et al. 2023), other species from the Fabacea family dominate in mangrove areas in Sungsang Subdistrict and around Payung Island, South Sumatra (Figure 3), while site collection in Malaysia and Vietnam are dominated by mangrove vegetation (Larson 2008; Tran et al. 2021). Site locations in Indonesia are slightly turbid, with slow currents and substrates of soil or mud. This data also emphasises the most suitable ecological niche conditions for *B. scalaris*, namely in brackish water habitats around estuary ecosystems with mangrove vegetation.

Distribution. *Bostrychus scalaris* was previously in Sementa River, near Klang, Selangor State, on the west coast of peninsular Malaysia (Larson 2008; Kottelat 2013; Huang et al. 2014; Parenti 2021); in Singapore based on scientific watercolour paintings illustrated by French naturalist F. L. de Castelnau in 1858–1862 (Loneux 2006; Larson et al. 2016); and in the mangrove habitat at the mouth of the Mekong River in Cu Lao Dung Province, Vietnam (Tran et al. 2021; Taki et al. 2021) (Figure 4). The present specimen from South Sumatra represent the first record of *B. scalaris* in Indonesian water and the southernmost record of this species.

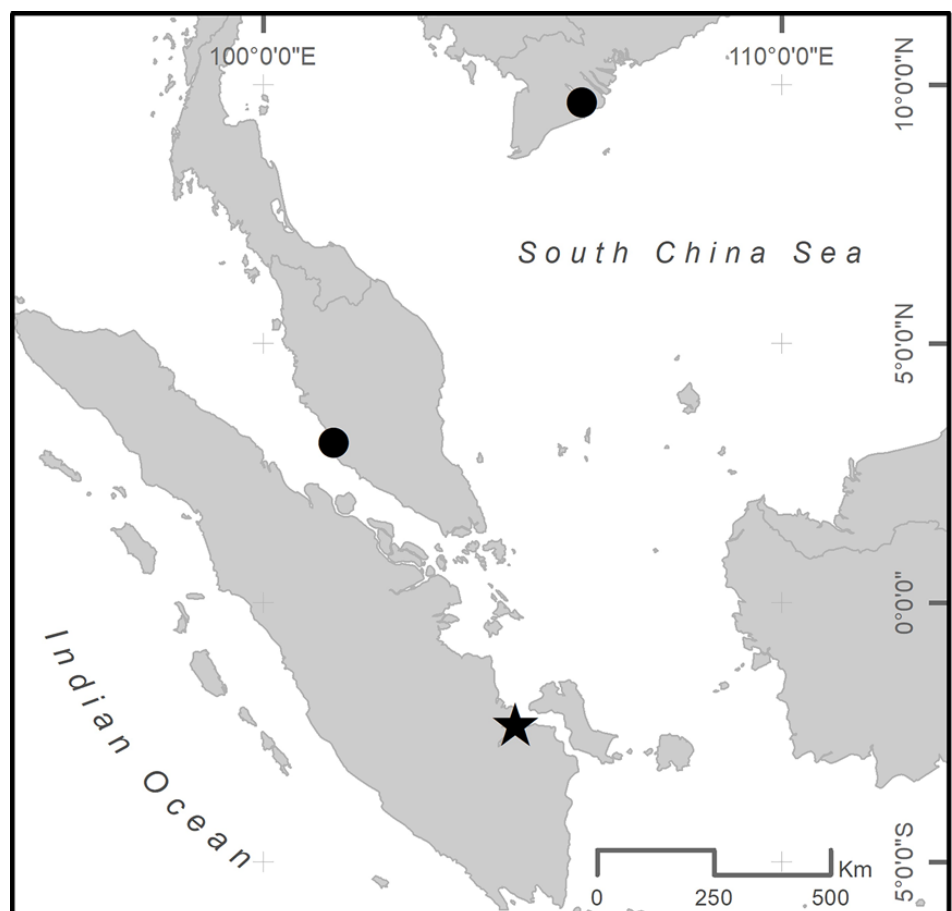


Figure 4. *Bostrychus scalaris* distribution records based on previous studies (circles) and new records based on recent studies (star).

This species almost found in a relatively small number of individuals at each site, especially scientific reports from Malaysia and Indonesia which indicate a solitary species in its distribution. Another assumption leads to a low reproductive rate which causes its distribution to be less abundant, especially in its juvenile phase. Therefore, further research is essential to prove these assumptions. It is also important to develop an on-site conservation strategy to prevent potential damage to natural habitats, considering that the reported distribution of this species in Indonesia is only in brackish waters in plantations which are very vulnerable to degradation and damage due to land use change. This is also to prevent habitat destruction as happened in Malaysia, where it was reported that the holotype's natural habitat had been reclaimed (Larson 2008)

The present record of *Bostrychus scalaris* in Indonesian waters confirms the geographic distribution of this species in the Indo-West Pacific, especially in the South China Sea. In addition, this record of *B. scalaris* in South Sumatra also completes the distribution records of four species of *Bostrychus* in the Indonesian water after i.e., of *B. aruensis* in the Aru Islands, *B. strigogenys* in Papua, *B. microphthalmos*, and most recently, *B. scalaris* in South Sumatra (Nichols 1937; Allen 1991; Hoese & Kottelat 2005).

Bostrychus scalaris does not yet have a protection status from either the IUCN Red List or CITES. The small number of individuals and its limited natural distribution means that data and information on the species is still lacking. Further assessment is really important to determine its protection status immediately and to evaluate its population trends in nature, followed by the preparation of further management strategies. In terms of potential utilisation, the unique body colour of with a brownish staircase pattern along its body give an attractive value of this species as an ornamental aquarium fish.

A partial mitochondrial DNA sequence of the Cytochrome C Oxidase Subunit I (COI) gene of approximately 686 bp was obtained from this sample. Currently, the reference sequence of *B. scalaris* is not available in several GenBanks such as NCBI or BOLD SYSTEM. Uploading the COI sequence of *B. scalaris* from the results of this study in GenBank will be the first time so that it can be used as a reference for future research. The nucleotide BLAST results showed that the sequence of *B. scalaris* was different from the sequences of *B. sinensis* and *B. zonatus*, but it was more similar to *Oxyeleotris marmorata*. This is due to the limited reference sequences of *B. scalaris*, both its partial mtDNA and full genome mtDNA. Details of BLAST similarity values with *O. marmorata* results are maximum score 662, total score 662, query coverage 93%, E value 0, and percent identity 85.78%. Further research using molecular approaches is important, including to determine the phylogenetic position of *B. scalaris* with other species of the genus *Bostrychus*.

AUTHORS CONTRIBUTION

R. designed the study, collected the specimens, and wrote the original draft. G.W. collected and analysed the morphometric and meristic data, KW documented the specimens, reviewed, and edited the manuscript. All authors have read and approved the final version of the manuscript.

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CONFLICT OF INTEREST

The authors declare they have no conflict of interest relating to the study.

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