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## Short Communication: Rare grouper *Epinephelus miliaris* from market surveys in South Sulawesi, Indonesia

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**Abstract.** Kadir NN, Husain AAA, Irmawati, Priosambodo D, Jamal M, Ilyas M, Malkab ANI, Fasirah E, Moore AM. 2022. Short Communication: Rare grouper *Epinephelus miliaris* from market surveys in South Sulawesi, Indonesia. *Biodiversitas* 23: 6070-6074. Groupers of the genus *Epinephelus* are tropical demersal fishes of both ecological and economic importance. However, knowledge is still limited regarding the diversity of fish caught and traded as well as the fine-scale distribution of many species. During a series of market surveys to photograph and identify groupers exploited in South Sulawesi, Indonesia, a small number of specimens of a widespread but rare grouper, *Epinephelus miliaris*, were found. The purpose of this study was to contribute to the body of knowledge on *E. miliaris* by analyzing and presenting spatial, morphological, and meristic data collected on these specimens and discussing the findings with respect to the current state of knowledge regarding this species. Our findings add Sulawesi, including the Makassar Strait and Gulf of Bone, to the recorded distribution of *E. miliaris*, to the south of the range according to the International Union for Conservation of Nature (IUCN) Red List. Both specimens were within the juvenile or sub-adult size range for this species. We conclude that there is a need to re-evaluate the range of this species, specifically within Indonesia, in fisheries and fish biodiversity databases.

**Keywords:** Distribution, Epinephelidae, market survey, morphology, netfin grouper, Serranidae

### INTRODUCTION

Groupers of the genus *Epinephelus* (Epinephelini: Serranidae) are tropical demersal fishes of both ecological and economic importance (Unsworth et al. 2007; Sadovy et al. 2013). Grouper fisheries are typically multi-species, and many are considered unsustainable (Sadovy et al. 2013; Khasanah et al. 2020; Nadiarti et al. 2021). However, knowledge is still limited regarding the diversity of fish caught and traded as well as the fine-scale distribution of many species. During a series of surveys to photograph and identify groupers at fish landing sites in South Sulawesi, Indonesia, a small number of specimens of the widespread but rare netfin grouper *Epinephelus miliaris*, were found. The Indonesian name for this species is kerapu minyak, literally oily grouper.

The known distribution of *E. miliaris* in the Indo-West Pacific ranges from East Africa (excluding the Red Sea and Persian Gulf) to the Gilbert Islands, Samoa, and the Ryukyu Islands, Japan (Allen and Erdmann 2012). Based

on reported occurrences, *E. miliaris* is considered native to American Samoa; Australia; British Indian Ocean Territory (Chagos Archipelago); Comoros; Fiji; French Southern Territories (Mozambique Channel Is.); India; Indonesia; Japan; Kenya; Madagascar; Malaysia; Maldives; Marshall Islands; Mauritius; Mayotte; Micronesia, Federated States of; Mozambique; Palau; Papua New Guinea; Philippines; Réunion; Samoa; Seychelles; Solomon Islands; Somalia; the Spratly Islands; Taiwan, Province of China; United Republic of Tanzania; Tonga; Tuvalu; Vanuatu; Wallis and Futuna (Sadovy 2018). While the range map in Sadovy (2018) includes a small part of northern Indonesia, around the Sangihe Islands and northern Moluccas, it does not include the Makassar Strait, Flores Sea or Bone Bay around South Sulawesi or any of the major islands of Indonesia.

Considered a minor fishery target species in the International Union for Conservation of Nature (IUCN) Red List assessment (Sadovy 2018), there are several records of *E. miliaris* exploitation. In Fiji, *E. miliaris* has been seen (and photographed) for sale on fish markets

(Thaman et al. 2008) and it is considered a commercial food fish in parts of India (Chatla and Pamulapati 2020) and is reported in studies on bottom longline (Mous et al. 2019a) and dropline (Mous et al. 2019b) catches and on grouper trading (Mous et al. 2021) in Indonesia. In the Maldives, *E. miliaris* appeared to have been relatively abundant and was considered an important grouper fisheries species in 1996 (Nickerson and Maniku 1997). In Pohnpei, Micronesia, indications of unsustainable grouper fisheries are reported, with *E. miliaris* as one of eight species recorded in 2006 fisheries catch but no longer present in 2015 (Rhodes et al. 2018). Furthermore, data on multispecies fisheries, including groupers, are not recorded at the species level in many countries, including India (Akhilesh et al. 2021) and Indonesia (Razi et al. 2021). However, *E. miliaris* is one of the groupers listed as a 26 ive fisheries species in the Decree of the Minister for Marine Affairs and Fisheries of the Republic of Indonesia No. 87/2021 on the National Fish Database (MMAF 2021).

The purpose of this study was to contribute to the body of knowledge on *E. miliaris* by analyzing and presenting spatial, morphological, and meristic data collected on *E. miliaris* specimens from fish landing sites in South Sulawesi, together with a brief review on the current state of knowledge regarding this species.

## MATERIALS AND METHODS

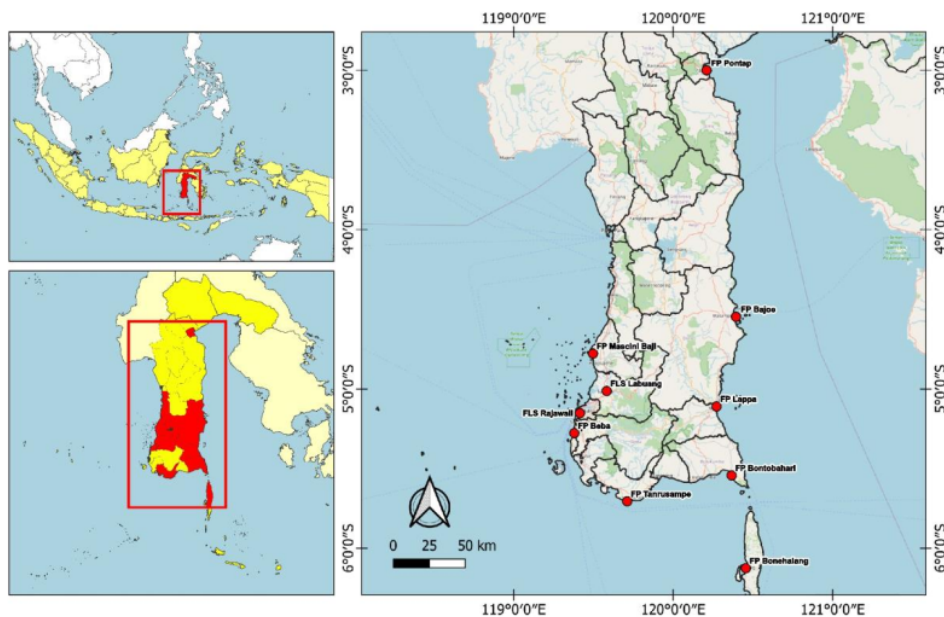
### Study area and species identification

The study area comprised 12 fish landing sites in South Sulawesi (Figure 1). The sites were selected because they

are the main landing and trading sites for snappers and groupers in South Sulawesi Province. Groupers being sold were identified using references (Heemstra and Randall 1993; Moore and Colas 2016; Mous et al. 2019c; Wu et al. 2020) and expert knowledge, either on-site or from photographs. Specimens of *Epinephelus miliaris* were observed at two of these markets during observations from June to August 2022. These were: Rajawali fish landing site in Makassar City facing the Makassar Strait (5.149966 S, 119.409533 E), and the Lappa Sinjai fish landing site in Sinjai District facing the Gulf of Bone which opens into the Flores Sea (5.106720 S, 120.271082 E).

### Procedures

All grouper specimens were photographed after requesting permission from the fish trader to buy or sell the fish. The fish were measured (total length in cm, precision 0.01 cm). As limitations on time and procedures were imposed by the fish traders, further details were obtained from the photographs using calipers (precision 0.01 cm) and through expert observation. For the specimens identified as *E. miliaris*, these included meristic characters (spine and ray counts); total length (TL); body depth (BD from the base of the dorsal fin to the base of the ventral fins; head length 1 (HL1) from the tip of the snout to the edge of the first operculum; head length 2 (HL2) from the tip of the snout to the edge of the second operculum; length of the dorsal fin (DFL); length of the pectoral fin (PFL); length of the ventral fin (VFL); length of the anal fin (AFL) and length of the caudal fin (CFL). Color patterns and other morphological traits were also noted.



28 **Figure 1.** Map of South Sulawesi showing the sites of the fish markets where *Epinephelus miliaris* were found

### Data analysis

The morphometric and meristic data were tabulated, and morphometric character ratios, including the aspect ratio (TL/BD), head-to-body ratios (HL1/TL, HL2/TL), and ratios of fin lengths to head and body lengths, were calculated in Microsoft Excel 2010. The weight of each specimen was estimated using the length-weight formula  $W: aL^b$  (Froese 2006) with the values of  $a$  and  $b$  for *E. miliaris* ( $a: 0.0255$ ;  $b: 3.00$ ) given in FishBase (Froese and Pauly 2021). Quantitative and qualitative data were analyzed descriptively.

## RESULTS AND DISCUSSION

### *Epinephelus miliaris* at Rajawali Fish Landing Site, Makassar City

One *E. miliaris* specimen was found at the Rajawali fish landing site on 15 August 2022 (Figure 2). This specimen was in poor condition, with some of the scales apparently scraped off. Nonetheless, it was recognizable by key traits, including the fin coloration.

The body had an off-white base color, decorated with light to reddish brown circular spots on the head from the snout to the operculum. Although the pattern was no longer clearly visible from the second operculum to the middle of the body, irregular polygonal spots were clearly visible on the rear end of the body to the caudal peduncle. All fins were off-white with dark (brown to black) circular spots. The spots on the fins were larger than those on the body, with pale fin margins. This specimen measured 26.82 cm TL with body depth (BD) 7.32 cm; head length 1 (HL1) 5.71 cm; head length 2 (HL2) 9.08 cm; dorsal fin length (DFL) 12.31 cm; pectoral fin length (PFL) 4.80 cm; ventral fin length (VFL) 4.33 cm; anal fin length (AFL) 3.30 cm; and caudal fin length (CFL) 4.24 cm. The estimated weight was 491.9 g.

### *Epinephelus miliaris* at Lappa Sinjai Fish Landing Site, Sinjai District

One *E. miliaris* specimen was found at the Lappa Sinjai fish landing site on 21 July 2022 (Figure 3). This specimen was in good (fresh) condition, with both scale and fin patterns clearly visible.

The base color of the body was off-white or pale, with mostly round light brown spots on the head, becoming more irregular in shape (polygonal) from the operculum to the caudal peduncle. The fins have a distinctive pattern differing from that of the body with larger, darker, and more widely spaced roughly circular spots on an off-white base and mostly cream-colored fin margins. This specimen measured 24.50 cm TL with body depth (BD) 6.24 cm; head length 1 (HL1) 4.35 cm; head length 2 (HL2) 7.51 cm; dorsal fin length (DFL) 10.87 cm; pectoral fin length (PFL) 4.85 cm; ventral fin length (VFL) 4.16 cm; anal fin length (AFL) 4.09 cm; and caudal fin length (CFL) 3.55 cm. The estimated weight was 374.9 g.

### Comparison of morphological traits

The morphological traits of the *E. miliaris* specimens identified in this study are compared with data on this species from the FAO grouper species catalog (Heemstra and Randall 1993). The traits compared include ratios (Table 1) and meristic characters (Table 2).

**Table 1.** Comparison of *Epinephelus miliaris* morphometric ratios from this study and in the FAO grouper species catalog

Character/ratio	Present study (Makassar)	Present study (Sinjai)	Heemstra and Randall (1993)
SL (cm)	23.20	20.53	15-43
SL/BD	3.17	3.29	2.8-3.2
SL/HL1	4.06	4.72	
SL/HL2	2.56	2.73	2.4-2.6
HL1/PFL	1.19	0.90	
HL2/PFL	1.89	1.55	1.6-1.9
HL1/VFL	1.32	1.05	
HL2/VFL	2.10	1.81	1.7-2.1
HL1/CFL	1.35	1.23	
HL2/CFL	2.14	2.12	No data

29: TL/BD: aspect ratio; TL: total length; 17: body depth; HL1: head length 1; HL2: head length 2; PFL: pectoral fin length; VFL: ventral fin length; AFL: length of 2<sup>nd</sup> anal fin spine; and CFL: caudal fin length



**Figure 2.** *Epinephelus miliaris* from Rajawali fish landing site, Makassar City, South Sulawesi, Indonesia



**Figure 3.** *Epinephelus miliaris* from Lappa Sinjai fish landing site, Sinjai District, South Sulawesi, Indonesia

**Table 2.** Comparison of *Epinephelus miliaris* meristic characters from this study and other sources

Fin (spines and rays)	Present study (Makassar)	Present study (Sinjai)	Heemstra and Randall (1993)	Rajan (2019)*
Dorsal fin	X 19	X 15	XI 16-17	X-XI 14-18
Anal fin	V not visible	Not visible	III 8	III 7-10
Pectoral fin	18	17	17-18	No data

Note: Spines are given in Roman numerals and rays in Arabic numerals; \* Genus *Epinephelus*

## Discussion

As mentioned in the Food and Agriculture Organization of the United Nations (FAO) species catalog (Heemstra and Randall 1993), the color patterns on the body of the two specimens were somewhat similar to those of some other groupers, in particular, the white-streaked or specklefin grouper *E. ongus* and the highfin or spotted grouper *E. maculatus*, while the tail is similar to that of the areolate or squaretail grouper *E. areolatus*. However, specific diagnostic characteristics noted included smaller dark spots on the body compared to *E. maculatus* and dark spots on the soft dorsal, caudal, and anal fins considerably larger and darker than those on the body, with interspinous dorsal-fin membranes, noticeably incised and a rounded caudal fin. As the meristic counts were based on photographs of specimens with poorly presented fins due to the limitations imposed by fish traders, these can only be used as an indication, and there may have been confusion between some spines and rays. However, the high number of dorsal fin spines/rays in one specimen is also indicative of *E. miliaris*, while the pectoral fin rays are consonant with this species.

The maximum reported length (TL) in the Maldives is 54 cm, with a reported size at maturity of 35 cm TL (Nickerson and Maniku 1997), larger than the size at first maturity of around 21 cm SL/25 cm TL given in the FAO species catalog of groupers (Heemstra and Randall 1993). Based on these data, the specimens in this study were close to the reported minimum size at first maturity and may have been large juveniles or young/small adults.

The netfin grouper *E. miliaris* is classified as Least Concern under IUCN Red List criteria due mainly to its widespread distribution (Sadovy 2018). The assessment notes that *E. miliaris* is “only a minor component of fisheries at this time” and states that “there are no known major threats”. However, the assessment also notes that little is known about this species, that it appears to be naturally scarce within its range, and that more research is needed on the distribution as well as population size, life history, ecology, and trends. This grouper is thought to have a depth range of around 1-200 m (Randall et al. 2005), with a wide range of habitats including lagoons, seagrass beds, offshore reefs as well as mangroves and muddy-bottomed waters including harbors (Mundy 2005). While the fishing grounds where our two *E. miliaris* specimens were caught cannot be identified with certainty, the likely areas are the coastal and small island coast of

Bone Bay and the Spermonde Archipelago, with extensive habitats likely suitable for this species.

This is not the first report of *E. miliaris* in Indonesia outside the range shown in the IUCN Red List assessment (Sadovy 2018). Locations where *E. miliaris* has been recorded include reef flats in Padang, off the coast of Sumatra; densities at this site, albeit relatively low, are similar to those of several other groupers from the genera *Epinephelus*, *Plectropomus* and *Cephalopholis* (Bulanin 2010). This fish has also been found in Australia (Rome and Newman 2010), indicating a much greater extension southwards in the Indo-pacific compared to the range described in existing databases (Heemstra and Randall 1993; Sadovy 2018; Froese and Pauly 2021). Our data add South Sulawesi to the distribution of *E. miliaris* and reinforce the need for a re-evaluation of the native range of this species in databases such as the IUCN Red List, FishBase and FAO species catalog.

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