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Article

First inland record of bull shark *Carcharhinus leucas* (Carcharhiniformes: Carcharhinidae) in Indonesian Borneo

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Abstract
An individual of bull shark *Carcharhinus leucas* (Müller & Henle, 1839) with c. 600-700 mm of total length was caught and photographed on 2019 in Barito River, South Kalimantan province, Indonesia. This finding is considered as a first inland record of *C. leucas* in Indonesian Borneo (Kalimantan). Collecting data using citizen science is needed to asses the occurence of *C. leucas* and evaluate the importance of riparian system in Kalimantan waters as nursery area or ranging habitat for this species.

Key words: elasmobranch, evidence, freshwater, Indonesia, Kalimantan.

Introduction

The requiem sharks or family Carcharhinidae are the dominant sharks (often in biodiversity, abundance and biomass) in tropical waters on continental shelves and offshores, but they also found in subtropical and warm temperate seas (Compagno & Niem 1998; Ebert *et al.* 2013). Most species of requiem sharks inhabit tropical continental coastal and offshore marine waters, with a few occuring in freshwater rivers and lakes (Ebert *et al.* 2013). A few requiem species (the little-known river shark *Glyphis* spp and the bull shark *Carcharhinus leucas*) appear to be the only living sharks that can live in freshwater for extended periods (Compagno *et* al. 2005).

At least 15 Indo-West Pacific species (6% of the total inshore-freshwater fauna) are possibly marginal freshwater elasmobranchs, and may occur in fresh water but may not travel up rivers to any great extent (Compagno 2002). *Carcharhinus leucas* (Müller & Henle, 1839) is a cosmopolitan elasmobranch in most Indo-West Pacific waters (including freshwater and brackish rivers and lakes) that occur in Indonesian and Bornean waters (Kottelat *et al.* 1993; Last *et al.* 2010). Unfortunately, there is no information if *C. leucas* has been recorded inland in Indonesian Borneo or Kalimantan. In this paper, we presented first inland record of *C. leucas* in Indonesian Borneo.

Materials and Methods

An individual of *C. leucas* (c. 600-700 mm of total length and 4 kg of weight) was caught and photographed on 28 September 2019 at Barito river, Ulu Benteng, Marabahan subdistrict, Barito Kuala district, South Kalimantan province, Indonesia (02°56'19"S, 114°45' 57"E) (Fig. 1). The site is in inland freshwater habitat located c. 70 km distance from mouth of river. The presence of *C. leucas* in inland freshwater habitat in Barito river was reported by local online media in Indonesia (Kurniawan 2019; Rendy 2019). The shark was identified by combination of morphological features. Unfortunately, due to the lack of preservation facility, neither tissue sample nor the body part was collected. Instead, the specimen was processed by villagers as dry salted fish for local consumption (Alkaf 2019).

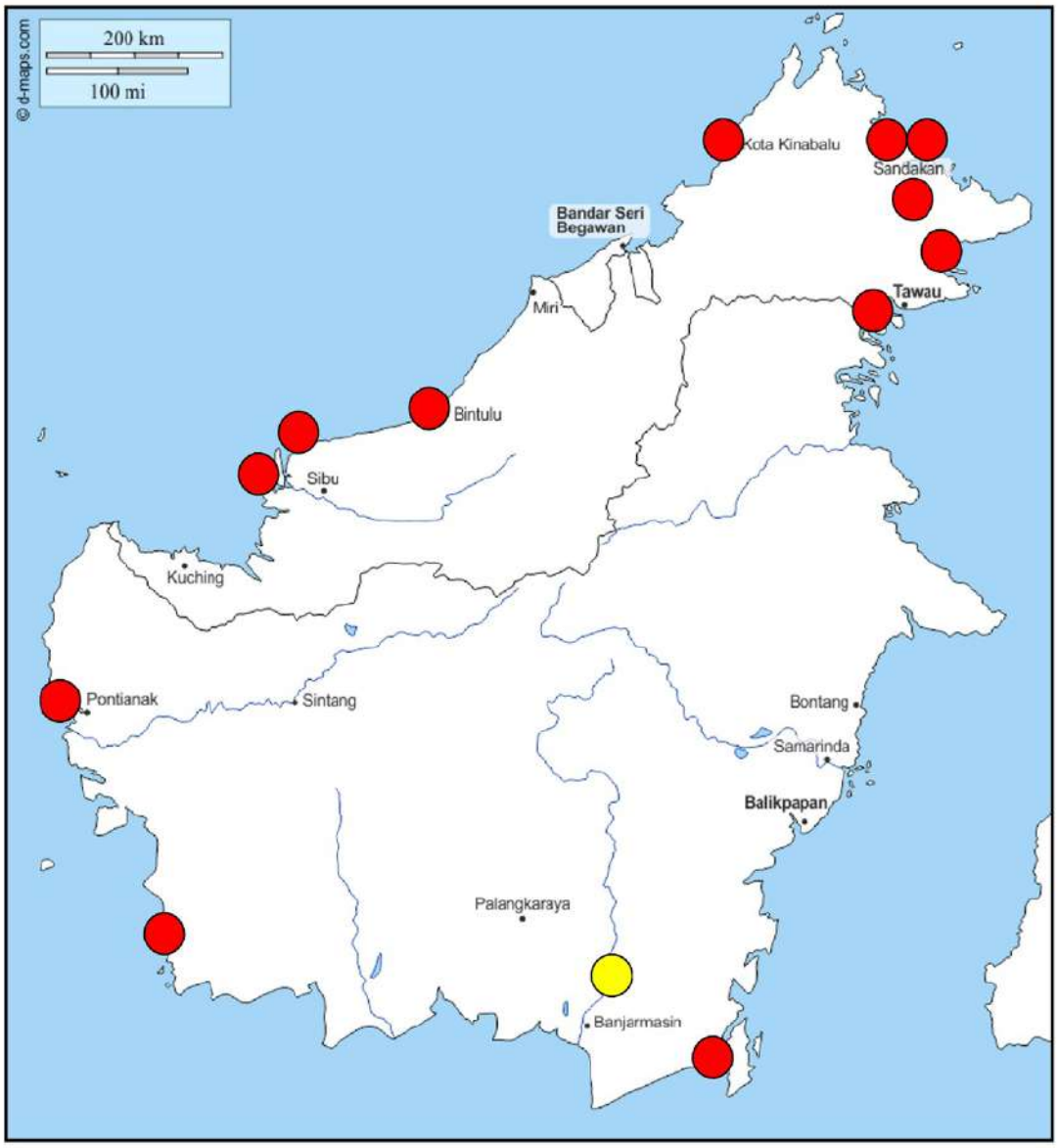

Figure 1. Location of known *C. leucas* in Borneo. Red circles are *C. leucas* recorded in Borneo after Last *et al.* (2010), and yellow circle is recent inland record from Barito river, Indonesia.

Results and Discussions

The *C. leucas* found in Barito River has features of requiem sharks family: eyes on side of head; mouth large, arched and elongated, and extending well behind eyes; two dorsal fins, the first dorsal fin moderately large, much shorter than the caudal fin, its base located over the interspace between pectoral and pelvic fin bases. This shark is identified as *C. leucas* by greyish back and white belly; snout short; small eyes; first dorsal fin high; pectoral fins broad, with narrow pointed; tip of second dorsal and caudal fins dark (indicate a young individual) (Fig. 2). The features above are fitted well to the characters of *C. leucas* (Compagno & Niem 1998; Compagno *et al.* 2005; Ebert *et al.* 2013). Based on freshwater habitat localities, both specimens could be a species of freshwater shark from genus *Glyphis*, which also occur in Indonesia waters (Last & Stevens 1994; Fahmi & Adrim 2009; Fahmi 2010). However, It was shortly recognized that these specimens differ from *Glyphis* by its small second dorsal fin, while *Glyphis* has large relative size of the second dorsal-fin (Last & Stevens 1994; Fahmi & Adrim 2009).

Figure 2. The *C. leucas* which caught by local fisherman in Barito river at Ulu Benteng, Barito Kuala district, South Kalimantan province (Photo: Rendy).

A specimen of *C. leucas* found in Barito River show specific features of early young individual. Another recent finding of early young juveniles of *C. leucas* in Sumatra (Iqbal *et al.* 2019) indicate freshwater habitat as a nursery area for this species in Western Indonesia. Young individuals of *C. leucas* readily tolerate low salinities, and some of them born in freshwater (Compagno & Niem 1998). Early young individual of *C. leucas* in Barito River are meet to other records of the juveniles of this species from around the world, including presence of early young *C. leucas* in Brisbane River, Australia, and a number of 14 small specimens of *C. leucas* in brackish Indian River lagoon system on the central east coast of Florida, USA (Snelson *et al.* 1984; Pillans 2006). The early youngs of *C. leucas* have the osmoregulatory plasticity to acclimate to salt water; and their preference for the freshwater inland of rivers where salinity is low therefore likely to be for avoiding predator and increased of prey abundance rather than because of a physiological constraint (Pillans *et al.* 2004).

Carcharhinus leucas is most wide ranging requiem shark inhabiting marine, shallow waters, estuarine and up to upstream of large river (Compagno & Niem, 1998; Compagno *et al.* 2005; Ebert *et al.* 2013). Inland record of *C. leucas* has been reported in Malaysian Borneo, when a species has been reported as a dried fin provided by a villager in Sukau (Sabah) in 1996 and a juvenile (identification was made based on photographs) was caught in 2010 in main Kinabatangan River close to the Malbumi estate (freshwater habitat approximately 40 km upriver from the estuary) (Manjaji 2002; Min 2013). Recent finding of *C. leucas* in Barito River could be represent a first known inland record for Indonesian Borneo. The record of *C. leucas* c. 70 km in Barito River also represent further inland of this species in Bornean waters. A worlwide of global freshwater records of the *C. leucas* was compiled by Gausmann (2018). Previous known incidences presence of the *C. leucas* in freshwater area of this species of sharks from around the world are: a freshwater record of 120 km inland in Zambesi River, Zimbabwe; recorded up to 420 km inland in Karun River, Iran; recorded of up to the distance of 130 km far inland in Lake Jamur, West Papua, Indonesia; a confirmed as far as 115 km inland at Wyrallah, Richmond River, Australia; a female *C. leucas* was reported in the Mearim River, 80 km far from the river's mouth, Maranhão State, Brazil; 67 juveniles *C. leucas* were monitored in Caloosahatchee River between 2003 and 2006 using 25 acoustic receivers, ranged 0 to 14 km with most more 5 km from the river's mouth, southwest Gulf Coast of Florida, United States; and recently a record of up to 75 km inland in Musi River, South Sumatra, Indonesia (Martin 2005; Heupel *et al.* 2010; Feitosa *et al.* 2016; Gausmann 2018; Iqbal *et al.* 2019).

The invasion of and adaptation to freshwater environments has occurred independently many times in elasmobranch evolution (Lucifora *et al.* 2015). However, the factors affecting the poor penetration of elasmobranchs into freshwater environments are currently unknown, however, an important consideration may be the high urea requirement of many proteins in marine elasmobranchs (Ballantyne & Robinson 2010). It is more likely that *C. leucas* had not been reported because elasmobranch of Indonesian and Bornean waters had not been explored enough than species recently colonized in this area. Recent works suggest that few species of elasmobranch had been known occur locally but lacking for publication, such as *Carcharhinus melanopterus*, *C. leucas*, *Fluvitrygon oxyrhynchus* and *Urogymnus polylepis* (Iqbal & Yustian 2016; Iqbal *et al.* 2017; Iqbal *et al.* 2019a, b).

An individual of *C. leucas* found in Barito River has black tip of fins and size around c. 600-700 mm of total length, show specific characters of young individual (Compagno & Niem 1998). The young individual of *C. leucas* in Barito River is meet to other records of the young individual of this species from Indoensia, including presence of two species of *C. leucas* in Musi River, South Sumatra province (Iqbal *et al.* 2019a). The young *C. leucas* readily tolerate low salinities, and some are born in freshwater (Compagno & Niem 1998). In the future, collecting data using citizen science is needed to assess asses the occurence of *C. leucas* and evaluate the importance of riparian systems in Kalimantan waters as nursery area or ranging habitat for this species.

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