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A rare contemporary record of the critically endangered Ganges shark *Glyphis gangeticus*

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The first record of the Ganges shark *Glyphis gangeticus* from anywhere in its range in over a
decade is reported from the Arabian Sea. One female specimen was recorded at Sassoon
Docks in Mumbai, India in February 2016, measuring 266 cm total length. In light of the
critically endangered status of this species and its rarity, urgent management actions are
needed to determine population size and trends in abundance in combination with fisher
education and awareness campaigns.

Key words: enforcement; euryhaline; conservation; protected species; river shark; threatened
species.
River sharks of the genus *Glyphis* (Carcharhiniformes: Carcharhinidae) are a group of highly threatened, rare, and elusive sharks. Their distribution and status has been difficult to determine, globally and locally, due to a lack of specimens, taxonomic and nomenclatural issues, and occurrence in often remote, inaccessible or poorly-studied locations. Outside of northern Australia, where intensive research is ongoing (e.g. Kyne, 2012; Feutry *et al.*, 2014; 2017), these species are virtually unknown.

Prior to taxonomic resolution by Li *et al.* (2015), there were thought to be five species in the genus *Glyphis*. However, molecular data confirmed that the Borneo river shark *Glyphis fowlerae* Compagno, White & Cavanagh, 2010 from the Kinabatangan River, Sabah, Malaysian Borneo, and the Irrawaddy river shark *Glyphis siamensis* (Müller & Henle, 1839) from the Irrawaddy River, Myanmar, are junior synonyms of the Ganges shark *Glyphis gangeticus* (Müller & Henle, 1839). As such, *G. gangeticus* has a widespread but patchy distribution in the Indo-West Pacific. A further two species, the Speartooth shark *Glyphis glyphis* (Müller & Henle, 1839) and the Northern river shark *Glyphis garricki* Compagno, White & Last, 2008, occur across northern Australia (Pillans *et al.*, 2010) and both were recently rediscovered in Papua New Guinea (White *et al.*, 2015).

River sharks are an evolutionarily unique group, specialized to inhabit large rivers and estuaries. They are not however obligate freshwater species, but rather are euryhaline, relying both on riverine and marine environments (Lucifora *et al.*, 2015). Available data from Australia suggest that juvenile *Glyphis* spp. inhabit tidally-influenced rivers, from low to marine salinities, while adults are generally thought to occur in coastal and marine waters.
However, adult specimens of river sharks are rarely encountered, especially in the marine environment. The exception is *G. garricki* for which adults are regularly recorded in riverine environments (Kyne, unpubl. data), while the first adult *G. glyphis* were only recorded very recently, being taken from the coast of southern New Guinea (White *et al.*, 2015). Records of *G. gangeticus* are patchy, mostly historical, and are often based on jaw material only (Compagno *et al.*, 2010; Li *et al.*, 2015). In the Arabian Sea, the western extent of the species’ range, there are records based on jaws prior to 2005, but the present status of the species in this region is virtually unknown. The species’ conservation status is of considerable concern (Compagno, 2007; Jabado *et al.*, 2017). For example, recent targeted surveys in its only known area of occurrence in Borneo, the Kinabatangan River, failed to locate any records (Manjaji-Matsumoto *et al.*, 2017).

As part of a study investigating shark landings along the northwestern coast of India (Gujarat and Maharashtra states), data on shark landings were collected at the Sassoon Docks, a major shark landing center located in Mumbai (Maharashtra) (Fig. 1). At this site, sampling was carried out once a week from September 2014 to June 2016, between 6 and 8 am, to investigate landings from gillnet boats, purse-seiners, and trawlers generally operating off the coast of Maharashtra.
On 7 February 2016, a female *G. gangeticus* specimen was recorded measuring 266 cm total length (\(L_T\)) (stretched body). Identification was based on the following combination of characters: broadly rounded short snout, small eyes, the absence of an interdorsal ridge, first dorsal fin origin over rear third of pectoral base, second dorsal-fin height about half of first dorsal-fin height, and an anal fin with deeply notched posterior margins, characteristic upper teeth with high broad serrated triangular hooked cusps, and lower medials moderately large, erect and hooked-cusped, narrowly symmetrical with arched roots with weakly serrated cutting edges (Compagno *et al.*, 2010; Ebert *et al.*, 2013). While some photos were taken (Fig. 2), additional information on the origin of the shark, detailed morphometric measurements, and tissue samples for molecular analysis could not be collected due to rapid processing by fishers and traders at the site. The specimen was most likely an adult, based on its large size.

This *G. gangeticus* specimen represents the first confirmed record from across the species’ range in over a decade, the first field observation of a whole large (and most certainly mature) specimen, and the only record from the Arabian Sea outside of Pakistan. The last available accounts of this species are from fishers and jaw traders in Pakistan (M. Harris and G. Naylor, pers. comm.). These include six jaws collected in Karachi in 2001–2002, from sharks estimated to be approximately 180–200 cm \(L_T\), as well as an additional set of jaws collected from commercial gillnet landings at the Manora Basin in 2005, likely caught in shallow coastal waters south of Karachi and around the Indus River mouth, and estimated to be from a 275 cm \(L_T\) shark (M. Harris, pers. comm.).
Information on the fishing location of this record is not available, and it is possible it could have been caught anywhere along the northeast coast of the Arabian Sea. However, even though records of this species are sparse, Glyphis species utilize rivers as nursery areas with female philopatry demonstrated in G. glyphis (Feutry et al., 2017). It could be assumed that the fishing vessel may have traversed north towards the Indus River (adjacent to Karachi, Pakistan), an important site for the species in the northwestern Indian Ocean. However, although the distribution and habitat preferences of adult river sharks remain a critical knowledge gap, studies from Australia and Papua New Guinea indicate that adults can occur outside of rivers in coastal marine environments (Pillans et al., 2010; White et al., 2015). In fact, it is possible that adults may travel long distances with recent molecular data indicating contemporary gene flow between the populations of G. gangeticus in Myanmar (= G. siamensis), Borneo (= G. fowlerae), and those of India and Pakistan, suggesting marine dispersal of several thousand kilometers (Li et al., 2015).

The historical population size of G. gangeticus within the region is unknown, but the population has likely been severely depleted due to a long history of fisheries and other threats in the northern Arabian Sea (Jabado et al., 2017). Over the past three decades, India has ranked as the second or third largest catcher of sharks and rays in the world, contributing up to nine percent of reported global landings (Bineesh et al., 2014; Dent & Clarke, 2015; Kizhakudan et al., 2015), while Pakistan has been considered in the top ten nations contributing to global shark and ray captures (Dent & Clarke, 2015). Landings data, as well as anecdotal information from Indian and Pakistani fishermen, suggest that shark catches, as well as the mean size of sharks landed, has noticeably diminished over the past 15 years with some stocks having already collapsed, especially in nearshore waters (Jabado et al., 2017;
Khan, 2012; Kizhakudan et al., 2015; Mohamed & Veena, 2016; Sutaria, unpubl. data). This raises concerns over the long-term sustainability of these fisheries and the status of *G. gangeticus* throughout its known range and its different life-stages. Fishing pressure is intense in India with over 13,400 gillnetters operating off Gujarat, as well as many other types of net gear also deployed in coastal areas (CMFRI, 2010). Furthermore, the reliance of *G. gangeticus* on riverine and estuarine habitat makes it particularly susceptible to many intensifying threats, including habitat modification and degradation, increased river use, and dams and barrages which alter flow, river productivity, and migration pathways. For example, there are four large dams and 22 barrages on the Indus River, Pakistan, which have fragmented the river habitat, with fragment size declining steadily as more barrages are built (Braulik et al., 2015). The construction of barrages has also led to the collapse of the commercial Hilsa shad *Tenualosa ilisha* (Hamilton, 1822) fishery due to the disruption of their migration (Braulik et al., 2015). Because of habitat overlap, it is possible that this fishery historically took juvenile *G. gangeticus* as bycatch, while net entanglement would be an ongoing threat in the river if juvenile sharks persist due to ongoing fishing pressure from other sources.

While *G. gangeticus* has been protected since 2001 under Schedule I, Part II A of the Indian Wildlife (Protection) Act, 1972, the effectiveness of this measure is likely limited, with ongoing issues in enforcement and compliance, as well as the accurate identification of protected species in catches. Recent extensive landing site surveys along the western coast of India have failed to record this species (Kizhakudan et al., 2015). Given the consistency of landing surveys, which are increasingly recording new species from Indian waters (Akhilesh et al., 2011; Kizhakudan et al., 2015), the lack of records of *G. gangeticus* has led to
questioning of the occurrence of this species in Indian waters, the possibility of its extinction, as well as its misidentification in recorded landings (Akhilesh et al., 2014). The lack of specimens suggests that this species might have a very low population size in this region or that it may have been extirpated in some portion of its range. The lack of records likely indicates overexploitation from fishing given the intensity of fishing in the northeastern Arabian Sea (Jabado et al., 2017).

Considering the potential rarity of this species, and its critically endangered status, even low-levels of illegal take likely have negative population-level effects (Kyne & Feutry, 2017). Landings such as this record represent a conservation issue and mitigation measures should be urgently considered in view of the suspected low population sizes. Since river sharks exhibit river-specific female reproductive behaviour, a depleted stock in a river is unlikely to be replenished by other populations (Feutry et al., 2014). Given the localized records of *G. gangeticus* in the Arabian Sea, and the habitat specificity of species, urgent management actions are needed. These should focus on increased surveys to determine the population size, trends in abundance, and spatial distribution of this species around the Indus River in Pakistan and possibly extending into northwestern India. Importantly, these efforts should be combined with education of fishers and training in protected species identification as well as increased monitoring and enforcement of regulations.

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