

1 Running headline: Critically Endangered Ganges Shark Record

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

4 ***gangeticus***

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

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33 Key words: enforcement; euryhaline; conservation; protected species; river shark; threatened
34 species.

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50 River sharks of the genus *Glyphis* (Carcharhiniformes: Carcharhinidae) are a group of highly
51 threatened, rare, and elusive sharks. Their distribution and status has been difficult to
52 determine, globally and locally, due to a lack of specimens, taxonomic and nomenclatural
53 issues, and occurrence in often remote, inaccessible or poorly-studied locations. Outside of
54 northern Australia, where intensive research is ongoing (e.g. Kyne, 2012; Feutry *et al.*, 2014;
55 2017), these species are virtually unknown.

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

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70 River sharks are an evolutionarily unique group, specialized to inhabit large rivers and
71 estuaries. They are not however obligate freshwater species, but rather are euryhaline, relying
72 both on riverine and marine environments (Lucifora *et al.*, 2015). Available data from Australia
73 suggest that juvenile *Glyphis* spp. inhabit tidally-influenced rivers, from low to marine
74 salinities, while adults are generally thought to occur in coastal and marine waters (Pillans *et*

75 *al.*, 2010). However, adult specimens of river sharks are rarely encountered, especially in the
76 marine environment. The exception is *G. garricki* for which adults are regularly recorded in
77 riverine environments (Kyne, unpubl. data), while the first adult *G. glyphis* were only recorded
78 very recently, being taken from the coast of southern New Guinea (White *et al.*, 2015).

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81 Records of *G. gangeticus* are patchy, mostly historical, and are often based on jaw material
82 only (Compagno *et al.*, 2010; Li *et al.*, 2015). In the Arabian Sea, the western extent of the
83 species' range, there are records based on jaws prior to 2005, but the present status of the
84 species in this region is virtually unknown. The species' conservation status is of considerable
85 concern (Compagno, 2007; Jabado *et al.*, 2017). For example, recent targeted surveys in its
86 only known area of occurrence in Borneo, the Kinabatangan River, failed to locate any records
87 (Manjaji-Matsumoto *et al.*, 2017).

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90 As part of a study investigating shark landings along the northwestern coast of India (Gujarat
91 and Maharashtra states), data on shark landings were collected at the Sassoon Docks, a major
92 shark landing center located in Mumbai (Maharashtra) (Fig. 1). At this site, sampling was
93 carried out once a week from September 2014 to June 2016, between 6 and 8 am, to investigate
94 landings from gillnet boats, purse-seiners, and trawlers generally operating off the coast of
95 Maharashtra.

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98 On 7 February 2016, a female *G. gangeticus* specimen was recorded measuring 266 cm total
99 length (L_T) (stretched body). Identification was based on the following combination of

100 characters: broadly rounded short snout, small eyes, the absence of an interdorsal ridge, first
101 dorsal fin origin over rear third of pectoral base, second dorsal-fin height about half of first
102 dorsal-fin height, and an anal fin with deeply notched posterior margins, characteristic upper
103 teeth with high broad serrated triangular hooked cusps, and lower medials moderately large,
104 erect and hooked-cusped, narrowly symmetrical with arched roots with weakly serrated cutting
105 edges (Compagno *et al.*, 2010; Ebert *et al.*, 2013). While some photos were taken (Fig. 2),
106 additional information on the origin of the shark, detailed morphometric measurements, and
107 tissue samples for molecular analysis could not be collected due to rapid processing by fishers
108 and traders at the site. The specimen was most likely an adult, based on its large size.

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111 This *G. gangeticus* specimen represents the first confirmed record from across the species'
112 range in over a decade, the first field observation of a whole large (and most certainly mature)
113 specimen, and the only record from the Arabian Sea outside of Pakistan. The last available
114 accounts of this species are from fishers and jaw traders in Pakistan (M. Harris and G. Naylor,
115 pers. comm.). These include six jaws collected in Karachi in 2001–2002, from sharks estimated
116 to be approximately 180–200 cm L_T , as well as an additional set of jaws collected from
117 commercial gillnet landings at the Manora Basin in 2005, likely caught in shallow coastal
118 waters south of Karachi and around the Indus River mouth, and estimated to be from a 275 cm
119 L_T shark (M. Harris, pers. comm.).

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122 Information on the fishing location of this record is not available, and it is possible it could
123 have been caught anywhere along the northeast coast of the Arabian Sea. However, even
124 though records of this species are sparse, *Glyphis* species utilize rivers as nursery areas with

125 female philopatry demonstrated in *G. glyphis* (Feutry *et al.*, 2017). It could be assumed that the
126 fishing vessel may have traversed north towards the Indus River (adjacent to Karachi,
127 Pakistan), an important site for the species in the northwestern Indian Ocean. However,
128 although the distribution and habitat preferences of adult river sharks remain a critical
129 knowledge gap, studies from Australia and Papua New Guinea indicate that adults can occur
130 outside of rivers in coastal marine environments (Pillans *et al.*, 2010; White *et al.*, 2015). In
131 fact, it is possible that adults may travel long distances with recent molecular data indicating
132 contemporary gene flow between the populations of *G. gangeticus* in Myanmar (= *G.*
133 *siamensis*), Borneo (= *G. fowlerae*), and those of India and Pakistan, suggesting marine
134 dispersal of several thousand kilometers (Li *et al.*, 2015).

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137 The historical population size of *G. gangeticus* within the region is unknown, but the
138 population has likely been severely depleted due to a long history of fisheries and other threats
139 in the northern Arabian Sea (Jabado *et al.*, 2017). Over the past three decades, India has ranked
140 as the second or third largest catcher of sharks and rays in the world, contributing up to nine
141 percent of reported global landings (Bineesh *et al.*, 2014; Dent & Clarke, 2015; Kizhakudan *et*
142 *al.*, 2015), while Pakistan has been considered in the top ten nations contributing to global
143 shark and ray captures (Dent & Clarke, 2015). Landings data, as well as anecdotal information
144 from Indian and Pakistani fishermen, suggest that shark catches, as well as the mean size of
145 sharks landed, has noticeably diminished over the past 15 years with some stocks having
146 already collapsed, especially in nearshore waters (Jabado *et al.*, 2017; Khan, 2012; Kizhakudan
147 *et al.*, 2015; Mohamed & Veena, 2016; Sutaria, unpubl. data). This raises concerns over the
148 long-term sustainability of these fisheries and the status of *G. gangeticus* throughout its known
149 range and its different life-stages. Fishing pressure is intense in India with over 13,400

150 gillnetters operating off Gujarat, as well as many other types of net gear also deployed in coastal
151 areas (CMFRI, 2010). Furthermore, the reliance of *G. gangeticus* on riverine and estuarine
152 habitat makes it particularly susceptible to many intensifying threats, including habitat
153 modification and degradation, increased river use, and dams and barrages which alter flow,
154 river productivity, and migration pathways. For example, there are four large dams and 22
155 barrages on the Indus River, Pakistan, which have fragmented the river habitat, with fragment
156 size declining steadily as more barrages are built (Braulik *et al.*, 2015). The construction of
157 barrages has also led to the collapse of the commercial Hilsa shad *Tenualosa ilisha* (Hamilton,
158 1822) fishery due to the disruption of their migration (Braulik *et al.*, 2015). Because of habitat
159 overlap, it is possible that this fishery historically took juvenile *G. gangeticus* as bycatch, while
160 net entanglement would be an ongoing threat in the river if juvenile sharks persist due to
161 ongoing fishing pressure from other sources.

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

175 indicates overexploitation from fishing given the intensity of fishing in the northeastern
176 Arabian Sea (Jabado *et al.*, 2017).

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

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