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Social media posts reveal the geographic range of the Critically Endangered clown wedgefish, *Rhynchobatus cooki*

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Published in:
Journal of Fish Biology

DOI:
[10.1111/jfb.14530](https://doi.org/10.1111/jfb.14530)

Published: 01/12/2020

Document Version
Peer reviewed version

[Link to publication](#)

Citation for published version (APA):

McDavitt, M. T., & Kyne, P. M. (2020). Social media posts reveal the geographic range of the Critically Endangered clown wedgefish, *Rhynchobatus cooki*. *Journal of Fish Biology*, 97(6), 1846-1851.
<https://doi.org/10.1111/jfb.14530>

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1 **Social media posts reveal the geographic range of the Critically Endangered**
2 **Clown Wedgefish *Rhynchobatus cooki***

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17 **Funding information**

18 PMK was supported by the Marine Biodiversity Hub, a collaborative partnership supported through funding from
19 the Australian Government's National Environmental Science Program.

20

21 **Ethics**

22 All research was undertaken online and did not involve the collection of, or the experimental use of, animals.

23

24 **Abstract**

25 The shark-like rays of the family Rhinidae (wedgefishes) are globally threatened with extinction. The poorly-known
26 Clown Wedgefish *Rhynchobatus cooki* has historically been recorded only from fish markets in Singapore and Jakarta,
27 Indonesia. Its natural geographic range has until now gone undocumented. Social media posts revealed the first wild
28 records of this Critically Endangered species; six records were located between 2015 and 2020 from small-scale
29 fisheries in Lingga and Singkep Islands, Indonesia. These results demonstrate the utility of social media searches to
30 identify biogeographic records of cryptic and data-poor species.

31 **KEYWORDS**

32 conservation; elasmobranchs; Indonesia; Rhinidae; rhino rays; threatened species

33

34 Sharks and rays (subclass Elasmobranchii) globally face an elevated risk of extinction due to their
35 limited biological productivity and fisheries-induced mortality as both targeted catch and bycatch
36 (Dulvy *et al.*, 2014). The wedgefishes (family Rhinidae) are one of the most threatened groups of
37 elasmobranchs, indeed of any fish family, with nine out of 10 species recently assessed as
38 Critically Endangered on the IUCN Red List of Threatened Species (Kyne *et al.*, 2020). Wedgefish
39 diversity is centered in the Indo-West Pacific Ocean region, with the highest species richness in
40 Southeast Asia (Kyne *et al.*, 2020). Wedgefishes inhabit shallow waters of the continental shelf,
41 which overlaps with intense demersal fisheries in tropical regions and available catch data shows
42 overexploitation and severe population depletion across much of their range (Kyne *et al.*, 2020).

43 The Clown Wedgefish, *Rhynchobatus cooki* Last, Kyne & Compagno, 2016 (subclass
44 Elasmobranchii; order Rhinopristiformes; family Rhinidae), is a recently described and largely
45 unknown wedgefish species (Last *et al.*, 2016a). The smallest of the wedgefishes, it has been
46 recorded from a limited number of specimens collected in the 1930s, 1975, and 1996 from fish
47 markets in Singapore and Jakarta, Indonesia (Last *et al.*, 2016a). More recently, a single specimen
48 was observed at a fish market in Singapore, the first record in 23 years (Clark-Shen *et al.*, 2019).
49 The merchant selling the recent Singapore specimen was unaware of its capture location, beyond
50 that it had been imported from Indonesia (Clark-Shen *et al.*, 2019). No known records have been
51 collected outside of fish markets and as such the actual geographic range of the species remains
52 unknown, particularly given that fishing vessels or traders supplying larger fish markets such as
53 those of Jakarta and Singapore can range widely throughout the Malay Archipelago and broader
54 Southeast Asian region (Last *et al.*, 2016a).

55 The passing of over two decades between records of *R. cooki* raised serious concerns for its
56 conservation status (Last *et al.*, 2016a), particularly given regular fish landing site and market
57 surveys throughout the region failed to record it (e.g. White & Dharmadi, 2007). Beyond an
58 estimated maximum size (<1 m total length) and male size-at-maturity (Last *et al.*, 2016a; Clark-
59 Shen *et al.*, 2019), all aspects of the life history, ecology, habitat, and geographic range of *R. cooki*
60 remained completely unknown. The species' Critically Endangered assessment on the IUCN Red
61 List was based on inference of population status considering the lack of records in a heavily
62 exploited region, and documented declines throughout the Indo-West Pacific of aggregated data
63 for rhinopristoid rays (Kyne *et al.*, 2019).

64 The fact that the natural distribution of a Critically Endangered species is unknown is a major
65 impediment to its conservation and management. Here, we use social media to document wild
66 capture records of *R. cooki* and provide, for the first time, an understanding of its geographic
67 range.

68 Conservation science is often materially limited by lack of funding, scarcity of data, and regional
69 and taxonomic biases (Di Minin *et al.*, 2015). While field surveys and monitoring are a preferred
70 tool for mapping species' occurrence, cost can be prohibitive, particularly in remote locations.
71 An interesting and still underutilized resource to locate records of rare, cryptic, and threatened
72 taxa are reports on various social media platforms, wherein laypeople regularly post photographs

73 and information about species they encounter during a variety of activities (Di Minin *et al.*, 2015).
74 Such content can supply important and otherwise unavailable information, as some posts contain
75 textual descriptions, geotags (thus providing spatial data), as well as useful details concerning (1)
76 what activity the poster was engaged in when the species was encountered; (2) any resource,
77 trade, or use value; (3) any cultural or symbolic value; (4) the poster's attitude toward the taxon;
78 and/or, (5) conservation knowledge of the species.

79 As part of a broader study using wedgefish encounter records for Southeast Asia to assess species
80 composition, distribution, cultural information, and usage as a commercial and livelihood
81 resource, social media search data were examined for records of *R. cooki*. From July 2019 through
82 February 2020, a systematic search of social media posts on the Instagram, Twitter, and Facebook
83 platforms, as well as through Google image searches, was performed utilizing standard common
84 names and ad hoc local descriptions used for wedgefish in Indonesian, Malaysian, and Thai
85 languages (as well as major regional dialects utilized by fishers) to collect records of encounters.
86 The search terms utilized were sourced from various books and articles on fishes and fisheries in
87 the region, as well as common names encountered in online searches. These languages were
88 selected as the Malay Archipelago represents the centre of diversity for wedgefishes (Kyne *et al.*,
89 2020) as well as the centre of regional shark and ray fishing and trade. Additionally, because
90 accurate common names are not always utilized by fishers, general descriptors such as 'fishing',
91 'catch', 'shark', and 'ray' were also searched in the various local languages. Both standard and
92 #hashtag searching were employed (on platforms like Twitter and Instagram, keywords are often
93 indicated with an initial hash symbol, #, that links to other content containing that same term).

94 The online search was performed by entering each search term into each platform and recording
95 the resulting wedgefish records. For each record, photographs were saved and the following
96 details recorded where available: (1) poster or encounter location; (2) poster name; (3) post
97 and/or encounter date; (4) common name or search term appearing in the post; (5) context (e.g.,
98 what activity the poster was engaged in during the encounter); and, (6) any use made of the
99 animal. Research was undertaken online and did not involve the collection of, or the
100 experimental use of, animals.

101 The broad wedgefish encounter social media survey yielded 1,219 records, encompassing at least
102 four species: Bottlenose Wedgefish *Rhynchobatus australiae* Whitley, 1939, Broadnose
103 Wedgefish *R. springeri* Compagno & Last, 2010, Smoothnose Wedgefish *R. laevis* (Bloch &
104 Schneider, 1801), and *R. cooki*. The encounters included six records of *R. cooki* (totaling 0.49% of
105 the total wedgefish records), all located within the Lingga Archipelago, part of the Provinsi
106 Kepulauan Riau of Indonesia (Figure 1).

107 *Rhynchobatus cooki* records were identified through visual examination of animals appearing in
108 posted photographs using a combination of characters outlined in Last *et al.* (2016a; 2016b),
109 primarily: (a) a long, bottlenose rostrum with two rows of enlarged thorns on the dorsal surface;
110 (b) four large white spots between the eyes with a dark band in between, forming a cruciform

111 shape; (c) a conspicuous, continuous white margin around the body; and, (d) no distinct rows of
112 small white spots along the body or tail.

113 The first *R. cooki* record was encountered in a post by a local resident who had caught an
114 individual on 17 July 2015 while fishing (apparently subsistence fishing) near the village of Sungai
115 Pinang, southeast Lingga Island. The fisher expressed a negative attitude towards the animal,
116 lamenting the fact that only the small wedgefisk had been caught that day (Figure 2a).

117 The other five records came from an individual residing in the town of Dabo on Singkep Island;
118 this seller made posts on a social media account almost daily concerning food products available
119 for local sale from their residence. Such posts alerted followers to the availability of prepared
120 foods and freshly caught fish and other marine and freshwater fauna (i.e., crabs, slipper lobsters,
121 spiny lobsters, *Macrobrachium* prawns, and cephalopods) for local consumption. During the
122 study period, this seller posted five batches of fishes that included *R. cooki* (Figure 2b–g). Only
123 two of the five posts supplied the name of the wedgefisk offered for sale; the other posts merely
124 indicated that the pictured group of photographed fish and other seafood were available for sale,
125 without identifying the wedgefisk individually. Videos of some fish catches at the residence
126 clearly show live animals, strongly implying that the catches were local. The dates of the five fish
127 batches including a landed *R. cooki* were: 01 July 2019; 09 September 2019; 28 September 2019;
128 09 October 2019; and, 05 February 2020. Two of the posts by this seller listed the price for each
129 whole *R. cooki* as Rp 20,000 (= ±US\$1.42) per kilogram, with one animal expressly listed as
130 weighing 2 kg. None of the posted photos of *R. cooki* had been finned or had the rostrum
131 removed for use in high-value shark-fin or ‘shark-head’ dishes, respectively.

132 The five *R. cooki* advertised for sale from Dabo, Singkep Island were from an apparent home-
133 based business geared toward supplying the local community with food items. It is common in
134 Indonesia for women to sell a variety of prepared foods, freshly caught fish, and other products
135 through home businesses as a source of regular income for families (Melissa *et al.*, 2003; Renaldi
136 & Wijaya, 2018). These businesses employ social media to communicate to a pool of local and
137 non-local customers (Melissa *et al.*, 2003). This negates the necessity for a traditional store-front
138 or significant capital, and such sales may be made on a flexible schedule (Melissa *et al.*, 2003).
139 Many customers also prefer such home businesses, as products and foods may be obtained
140 locally and cheaply in less developed areas where such goods are not readily available (Melissa
141 *et al.*, 2003).

142 Searching the online posts of small-scale, local food sellers in Southeast Asia may yield important
143 data regarding the range, abundance, encounter frequency, and use of elasmobranch species in
144 the region. Machine learning could potentially enhance the utility of online searches and perform
145 species identification (Wäldchen & Mäder, 2018). Software could be programmed to identify a
146 target taxon (e.g. wedgefisk broadly or a specific species) and search across multiple social media
147 platforms.

148 Despite the multiple benefits presented through use of social media searches to locate species
149 encounters, there are also potential drawbacks. Social media posts, while abundant, are not
150 uniformly distributed throughout a species' range, most encounters are never recorded, and
151 there may be data quality issues (Di Minin *et al.*, 2015). Additionally, ethical issues must be
152 considered, such as the privacy of posters, and the avoidance of releasing any confidential,
153 proprietary, or sensitive information (Di Minin *et al.*, 2015).

154 Given that ecological details of *R. cooki* are unknown, identification of the other species captured
155 alongside the landed wedgefish in the present survey could provide important clues concerning
156 the habitat that it may occupy. Examination of the photographs of the individual fish batches
157 offered for sale from Dabo (Singkep Island), presumably representing fauna caught together in a
158 common net or fishing event, reveal a faunal assemblage that typically inhabits shallow inshore
159 waters over sandy and muddy substrates and reefs (Table 1). Examination of Google Earth (2019)
160 and a nautical chart for the island (U.S. Army, 1955) showed that the marine environment
161 surrounding Singkep Island is characterized by shallow waters with sandy-muddy substrates and
162 exposed tidal flats at low tides; variable sandy, muddy, or rocky shorelines; scattered mangroves;
163 and, extensive fringing reefs (with some offshore reefs) (see also Aryanto *et al.*, 2014).

164 The full extent of the species' range remains unknown as records identified here are from a small
165 area of Indonesia (two islands of the southwest Riau Islands). The historic records from large fish
166 markets (i.e. Jakarta and Singapore) allow only speculation on the natural range of the species
167 since these ports act as hubs of landings and trade from the wider region (Last *et al.*, 2016a). The
168 Malay Archipelago consists of >25,000 islands including many remote locations, which may not
169 have been surveyed scientifically for their marine fauna. Larger efforts to survey the
170 elasmobranch fauna of eastern Indonesia (White and Dharmadi, 2007), Borneo (Last *et al.*, 2010),
171 and the Philippines (Compagno *et al.*, 2005), amongst other ongoing surveys in the region, have
172 not recorded *R. cooki*, supporting the notion that the species may have a small distribution.
173 Whether that small range reflects a range contraction due to the high levels of exploitation and
174 major population reductions of rays (including wedgefishes) (Blaber *et al.*, 2009; Kyne *et al.*,
175 2020) is unknown. In any case, its risk of extinction may be elevated compared to wider-ranging
176 Indo-West Pacific wedgefishes (Kyne *et al.*, 2020); conversely, a restricted range could allow
177 spatial management to be an appropriate conservation tool (with effective implementation and
178 enforcement).

179 Despite its small size, there are indications that *R. cooki* enters the international shark-fin trade.
180 The recent Singapore specimen reportedly originated in Indonesia and had both of its dorsal fins
181 and caudal fin removed (Clark-Shen *et al.*, 2019). Singapore is a major supplier of shark-fin to
182 Hong Kong (the global hub of shark-fin trade) (Shea & To, 2017). Wedgefish fins are amongst the
183 highest value elasmobranch fin products (Kyne *et al.*, 2020), although small elasmobranch fins
184 are a lower value component of the international shark-fin trade (Cardeñosa *et al.*, 2019). In
185 contrast to the Singapore specimen, photos of *R. cooki* on sale on Singkep Island all showed fins
186 attached, suggesting only local consumption of the meat. It is also possible that this species

187 appears in the ‘shark-head’ trade where the interstitial jelly of rhinid rostra is consumed as an
188 expensive delicacy (M.T. McDavitt, unpubl. data).

189 The area where *R. cooki* records were located faces considerable international development
190 interest (Anon., 2019). Such projects have the potential to deleteriously impact *R. cooki* habitat.
191 However, despite this development interest, unregulated fishing remains the immediate threat
192 to the *R. cooki* population. All wedgefishes, including *R. cooki*, were listed on Appendix II of the
193 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in
194 November 2019. This means that Indonesia will have obligations to ensure any international trade
195 is not to the detriment of the population. There are currently no national or regional laws in
196 Indonesia specifically regulating the take of wedgefish (Rusandi *et al.*, 2019).

197 While managing both international trade and localized exploitation for a rare and poorly-known
198 species such as *R. cooki* in Indonesia will be challenging, its Critically Endangered status requires
199 urgent conservation intervention. Understanding the species’ natural geographic range is the
200 first step, allowing for a focus of conservation and management efforts. Delineating the species’
201 full geographic range, its habitat preferences, and bathymetric range are the next steps.

202 **ACKNOWLEDGEMENTS**

203 We thank the fishers, traders, and communities of the Riau Islands for informative postings on
204 social media. We extend our gratitude to Barry Russell for assistance with bony fish identification,
205 Rima Jabado for producing the map of record locations, and Natasha Stacey and Ria Fitriana for
206 assistance with the literature.

207 **AUTHOR CONTRIBUTIONS**

208 M.T.M. and P.M.K. conceived the idea for the manuscript. M.T.M. undertook social media
209 searches. M.T.M. led the writing of the manuscript, with contribution from P.M.K. Both authors
210 approved the final version of the manuscript.

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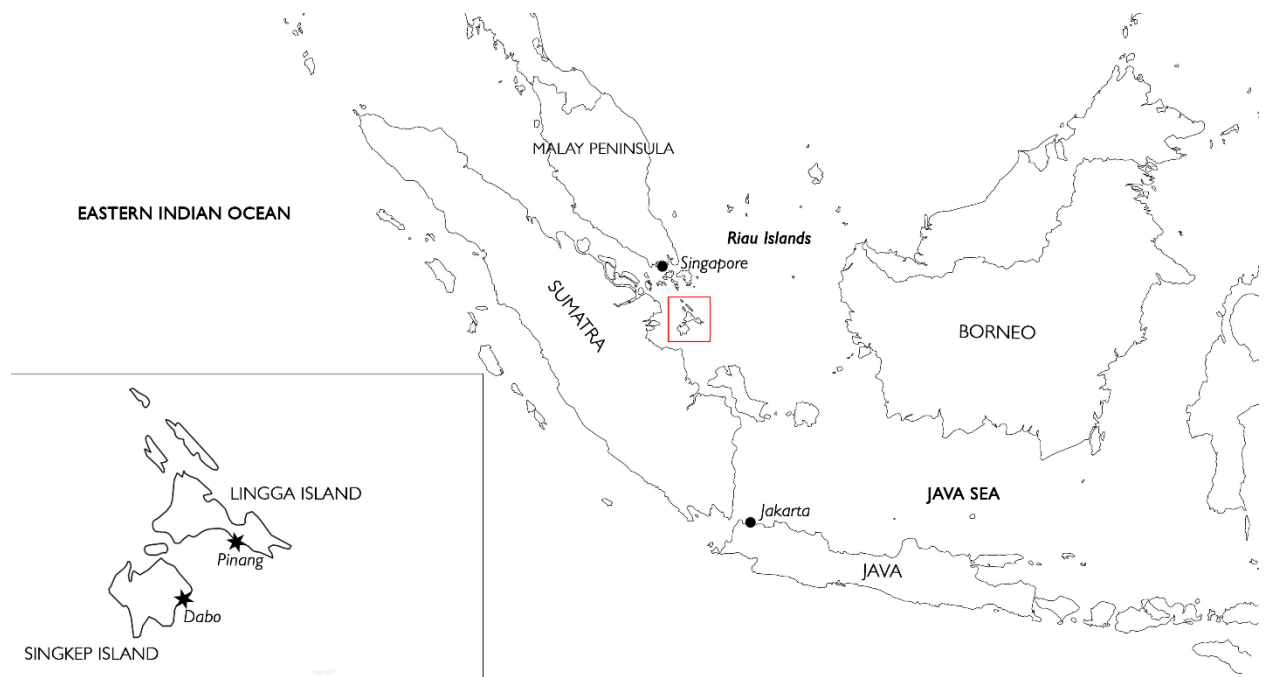
275 **TABLE 1** Fish and invertebrate species identified from photographs of *Rhynchobatus cooki*
 276 landings in the Lingga Islands, Indonesia (Figure 2 and additional photographs). Habitat
 277 information from Carpenter & Niem (1999; 2001a; 2001b) and Last *et al.* (2016b).

Taxon	Common name	Habitat
<i>Abalistes stellaris</i> (Bloch & Schneider, 1801)	Starry Triggerfish	Demersal; mud & sand; reefs
<i>Anodontostoma chacunda</i> (Hamilton, 1822)	Chacunda Gizzard Shad	Neritic; 0–50 m
<i>Chirocentrus dorab</i> (Fabricius, 1775)	Dorab Wolf Herring	Inshore
Coleoidae	Squids/cuttlefishes	Neritic
<i>Maculabatis gerrardi</i> (Gray, 1851)	Whitespotted Whipray	Demersal; 0–60 m
<i>Nemipterus</i> sp.	Threadfin breams	Demersal; mud & sand; 0–80 m
<i>Neotrygon orientalis</i> Last, White & Serét, 2016	Oriental Bluespotted Maskray	Demersal; inshore
Palinuridae	Spiny lobsters	Demersal; reef
<i>Portunus armatus</i> (L., 1758)	Blue Swimming Crab	Demersal; sand & sandy-mud; 10–50 m
<i>Psettodes erumei</i> (Bloch & Schneider, 1801)	Indian Halibut	Demersal; mud & sand; 0–100 m
Scyllaridae	Slipper lobsters	Demersal
<i>Telatrygon biasa</i> Last, White & Naylor, 2016	Indonesian Sharpnose Ray	Demersal; 0–40 m

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279

280 **FIGURE 1** Location of historic (closed circles) and recent landings of *Rhynchobatus cooki* (stars) in
281 Indonesia and Singapore. Inset box (red in main map) shows the site of recent landings on Singkep
282 and Lingga Islands.



283

284

285 **FIGURE 2** *Rhynchobatus cooki* landings in the Lingga Islands, Indonesia (a) near Sungai Pinang,
286 Lingga Island, 17 July 2015; and Dabo, Singkep Island: (b) 01 July 2019; (c) and (d) 09 September
287 2019; (e) 29 September 2019; (f) 09 October 2019; and (g) 05 February 2020.



288