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

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Funding information

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

Ethics

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

Abstract

The shark-like rays of the family Rhinidae (wedgefishes) are one of the most threatened group of marine fishes globally. The poorly-known Clown Wedgefish *Rhynchobatus cooki* has historically only been recorded from fish markets in Singapore and Jakarta, Indonesia. Its natural geographic range has until now gone undocumented. Intentional searches of social media posts describing wedgefish catches in Indonesia and Malaysia revealed the first wild records of this Critically Endangered species. A total of six catch records from small-scale fisheries were located from Lingga and Singkep Islands in Indonesia (1 from 2015, 4 from 2019, 1 from 2020). It remains unknown if the species is a micro-endemic to this small area of the Malay Archipelago, or if it is wider ranging. These results demonstrate the utility of social media searches to identify biogeographic records of cryptic and data-poor species.

KEYWORDS

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

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

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

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

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

Conservation science is often materially limited by lack of funding, scarcity of data, and regional and taxonomic biases (Di Minin *et al.*, 2015). While field surveys and monitoring are a preferred tool for mapping species' occurrence, cost can be prohibitive, particularly in remote locations.

An interesting and still underutilized resource to locate records of rare, cryptic, and threatened taxa are reports on various social media platforms, wherein laypeople regularly post photographs and information about species they encounter during a variety of activities (Di Minin *et al.*, 2015; 2018). Such content can supply important and otherwise unavailable information, as some posts contain textual descriptions, geotags (thus providing spatial data), as well as useful details concerning (1) what activity the poster was engaged in when the species was encountered, (2) any resource, trade, or use value, (3) any cultural, symbolic, or totemic value, and (4) the poster's attitude toward the taxon, and/or (5) conservation knowledge of the species. Thus, reviewing social media species encounter data is a useful approach to locate important records in an era where biodiversity is increasingly imperiled, funding is limited, and logistical constraints may restrict access to remote regions and countries (Di Minin *et al.*, 2015). Indeed, social media platforms allow observers to access information from anywhere in the world, providing for global information searches.

As part of a broader study using wedgefish encounter records for Southeast Asia to assess species composition, distribution, cultural information, and resource use, social media search data were examined for records of *R. cooki*. From July through February 2020, a systematic search of social media posts on the Instagram, Twitter, and Facebook platforms, as well as through Google image searches, was performed utilizing standard common names and ad hoc local names for wedgefish in Indonesian, Malaysian, and Thai languages (including Thai, Bahasa Melayu, Bahasa Indonesia, Acehnese, Batak, Minangkabau, Javanese, Sudanese, Madurese, Balinese, Makassarese, and Buginese) to collect records of encounters. These languages were selected as the region represents the centre of diversity for wedgefishes (Kyne *et al.*, 2020) as well as the centre of regional shark and ray fishing and trade. Additionally, because accurate common names are not always utilised, general descriptors such as 'fishing', 'catch', 'shark', and, 'ray' were searched in the various local languages. Both standard and #hashtag searching was employed.

Where *R. cooki* records were located, the following details were recorded (where available): (1) poster or encounter location, (2) post and/or encounter date; (3) common name employed, (4) context of post (e.g., what activity the poster was engaged in during the encounter), and (5) any use made of the animal. All research was undertaken online and did not involve the collection of, or the experimental use of, animals.

The broad wedgefish encounter social media survey has yielded over a thousand records, encompassing at least four species: Bottlenose Wedgefish *Rhynchobatus australiae* Whitley, 1939, Broadnose Wedgefish *R. springeri* Compagno & Last, 2010, Smoothnose Wedgefish *R. laevis* (Bloch & Schneider, 1801), and *R. cooki*. This included six records of *R. cooki* encounters, all located within the Lingga Islands, part of the Provinsi Kepulauan Riau of Indonesia (Figure 1).

Rhynchobatus cooki records were identified from posted photographs using a combination of characters outlined in Last *et al.* (2016a; 2016b), primarily: (a) a long, bottlenose rostrum with

two rows of enlarged thorns on the dorsal surface; (b) four large white spots between the eyes with a dark band in between, forming a cruciform shape; (c) a conspicuous, continuous white margin around the body; and, (d) no distinct rows of small white spots along the body or tail.

The first record was encountered in a post by a local resident who had caught a *R. cooki* on 17 July 2015 while fishing (apparently subsistence fishing) near the village of Sungai Pinang, southeast Lingga Island. The Lingga Island fisher employed the common name *kemejan*, a generic term for wedgefish. The fisher expressed a negative attitude towards the animal, lamenting the fact that only a small wedgefish had been caught that day (Figure 2a).

The other five records came from the same source/poster, who utilized the generic name *hiu mejan* for wedgefish. An individual residing in the town of Dabo on Singkep Island made posts on their social media account almost daily concerning food products for sale from their residence. This alerts followers to the availability of prepared foods and freshly caught fish and other marine and freshwater fauna (i.e., crabs, slipper lobsters, spiny lobsters, *Macrobrachium* prawns, and cephalopods). To date, this seller has posted five batches of food fishes that included a *R. cooki* (Figure 2b–g). Videos of some fish catches at the residence clearly show live animals, strongly implying that the catches are local. The dates of the four fish batches including a landed *R. cooki* were: 01 July 2019; 09 September 2019; 28 September 2019; 09 October 2019; and, 05 February 2020. Two of the posts by this seller lists the price for each whole *R. cooki* as Rp 20,000 (= ±US $1.42) per kilogram, with one animal expressly listed as weighing 2 kg. None of the posted photos of *R. cooki* for sale as food by this Dabo seller had been finned or had the rostrum removed for use in shark-fin or shark-head dishes, respectively.

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

The utility of social media surveys as a method to record rare and threatened species has been demonstrated here, yielding the first range records for the Critically Endangered *R. cooki*. The freshness of the catches, the apparent small-scale nature of the fisheries involved, and videos of live animals in catches, support that the *R. cooki* reported here were caught locally. Historic specimens (see Last *et al.*, 2016a), and even the most recent published record (Clark-Shen *et al*.,

2019) of *R. cooki* were collected from large fish markets, precluding any understanding of the natural, wild range of the species. This lack of information concerning the origin of the collected specimens has hampered study of the past and current status, life history, range, and exploitation of the species. An understanding of range now allows a focus for conservation and management efforts.

The full extent of the species' range remains unknown as records identified here are from a small area of Indonesia (two islands of the southwest Riau Islands). The historic records from large fish markets (i.e. Jakarta and Singapore) allow only speculation on the natural range of the species since these ports act of hubs of landings and trade from the wider region (Last *et al.*, 2016a). The Malay Archipelago consists of >25,000 islands including many remote locations, which may not have been surveyed scientifically for their marine fauna. Larger efforts to survey the elasmobranch fauna of eastern Indonesia (White and Dharmadi, 2007), Borneo (Last *et al.*, 2010), and the Philippines (Compagno *et al.*, 2005), amongst other ongoing surveys in the region, have not recorded *R. cooki*, supporting the notion that the species may have a small distribution. Delineating the species' full geographic range, its habitat preferences, and bathymetric range are priorities for future survey effort.

It is unknown if *R. cooki* has undergone a range contraction due to the effects of exploitation and the noted declines regionally in wedgefishes (Kyne *et al.*, 2020). Historic collections at Jakarta fish markets could suggest that Java was part of the historic range of the species. The Java Sea is heavily exploited and major population reductions of rays have occurred there (Blaber *et al.*, 2009; Kyne *et al.*, 2020). Hypothetically, if the Lingga Islands represents the contemporary range of *R. cooki*, and it is indeed a micro-endemic species (either naturally or the result of range contraction), its risk of extinction may be elevated compared to wider-ranging Indo-West Pacific wedgefishes (Kyne *et al.*, 2020).

The recent Singapore specimen reportedly originated in Indonesia (Clark-Shen *et al*., 2019). This specimen had both of its dorsal fins and caudal fin removed, indicating that it enters the international shark-fin trade. Singapore is a major supplier of shark-fin to Hong Kong (the global hub of shark-fin trade) (Shea & To, 2017) but the scale of imports of this species is unknown. Despite its small size (estimated to reach <1 m total length; Clark-Shen *et al*., 2019) it is clear that the fins are entering international trade. Small fins are a widely traded low value component of the international shark-fin trade (Cardeñosa *et al.*, 2019). In contrast to the Singapore specimen, photos of *R. cooki* on sale on Singkep Island all showed fins attached.

Rhynchobatus cooki advertised for sale were from an apparent home-based business. It is common in Indonesia for women to sell a variety of prepared foods and products through home businesses as a source of regular income for families (Melissa *et al.*, 2003; Renaldi & Wijaya, 2018). Given limited opportunities for full time employment in many rural areas of Indonesia, and cultural factors that encourage women to cease employment when they are married, a

184 growing trend has seen women establish home-based businesses selling prepared foods, freshly
185 caught fish, make-up, and/or clothing, employing social media to communicate to a pool of local
186 and non-local customers (Melissa *et al.*, 2003). This negates the necessity for a traditional store-
187 front, for significant capital, and such sales may be made on a flexible schedule, allowing for a
188 balance between business endeavors and household responsibilities (Melissa *et al.*, 2003). Many
189 customers also prefer such home businesses, as products and foods may be obtained locally and
190 cheaply in less developed areas where such goods are not readily available, or where traffic
191 congestion in cities dissuades customers from traveling to traditional stores (Melissa *et al.*, 2003).
192 One recent news article confirmed that some Indonesian women who immigrate to Australia
193 continue their home businesses, utilizing Facebook posts to alert their customer base of the
194 foodstuffs available for purchase each day (Renaldi & Wijaya, 2018).

195 Fishing remains an important economic activity for households in coastal Indonesia (Stacey *et al.*,
196 2019). Amongst fisher households in Indonesia, it has been observed that women play an
197 important role in both fishing and post-harvest activities, contributing almost half the income for
198 the family, and processing and selling the majority of fishes caught by their husbands, with some
199 women also engaging in regular near-shore fishing and gathering of marine resources for sale
200 (Fitriana & Stacey, 2012; KIARA, 2015).

201 The area where *R. cooki* records were located faces considerable international development
202 interest. In October 2019, it was reported that Rp 1.2 trillion in development projects are soon
203 beginning, and that Chinese investors visited Dabo on Singkep Island, investigating possible major
204 investment in development projects (Anon., 2019). Depending on the scale and scope of these
205 projects, they are potentially deleterious to *R. cooki* habitat particularly if these result in the
206 development or expansion of local aquaculture, fisheries, mining, and tourism (Anon., 2019).
207 However, unregulated fishing remains the immediate threat to the *R. cooki* population. All
208 wedgefishes, including *R. cooki*, were listed on Appendix II of the Convention on International
209 Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2019. This means that Indonesia
210 now has obligations to ensure any international trade is not to the detriment of the population.
211 While managing both international trade and localized exploitation for a rare and poorly-known
212 species such as *R. cooki* in Indonesia will be challenging, its Critically Endangered status requires
213 urgent conservation intervention. Understanding the species natural geographic range is the first
214 step.

215 **ACKNOWLEDGEMENTS**

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

220 **AUTHOR CONTRIBUTIONS**

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

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

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

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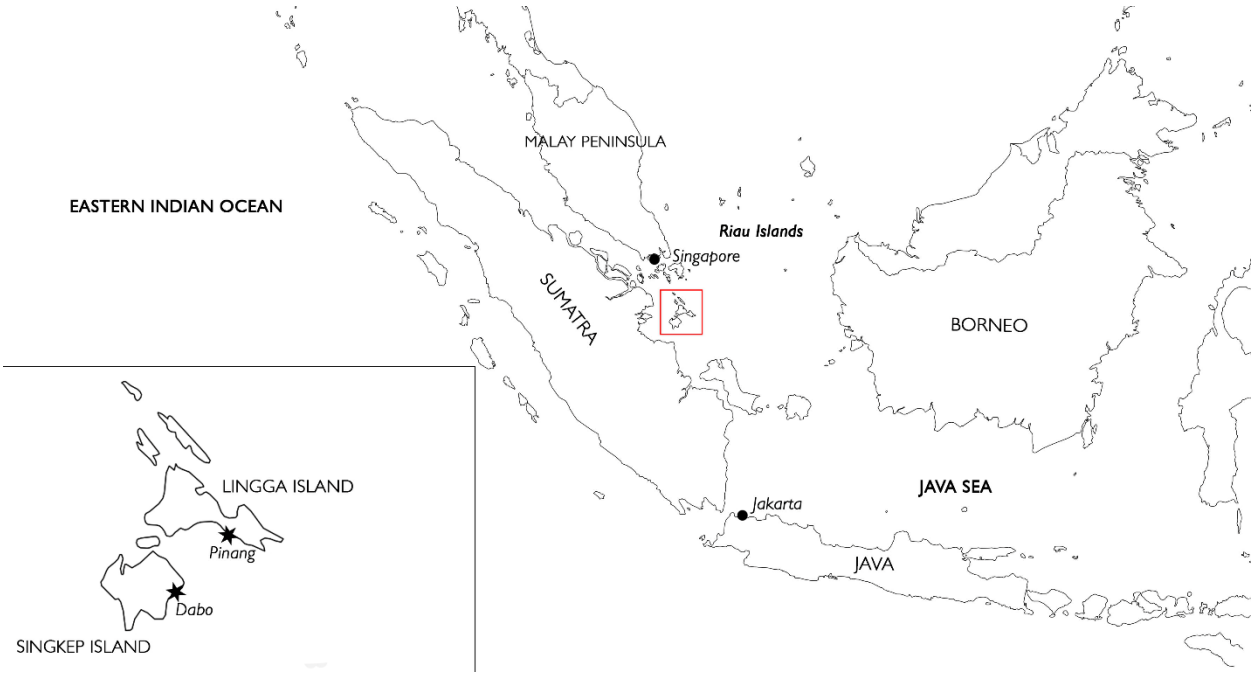

299

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

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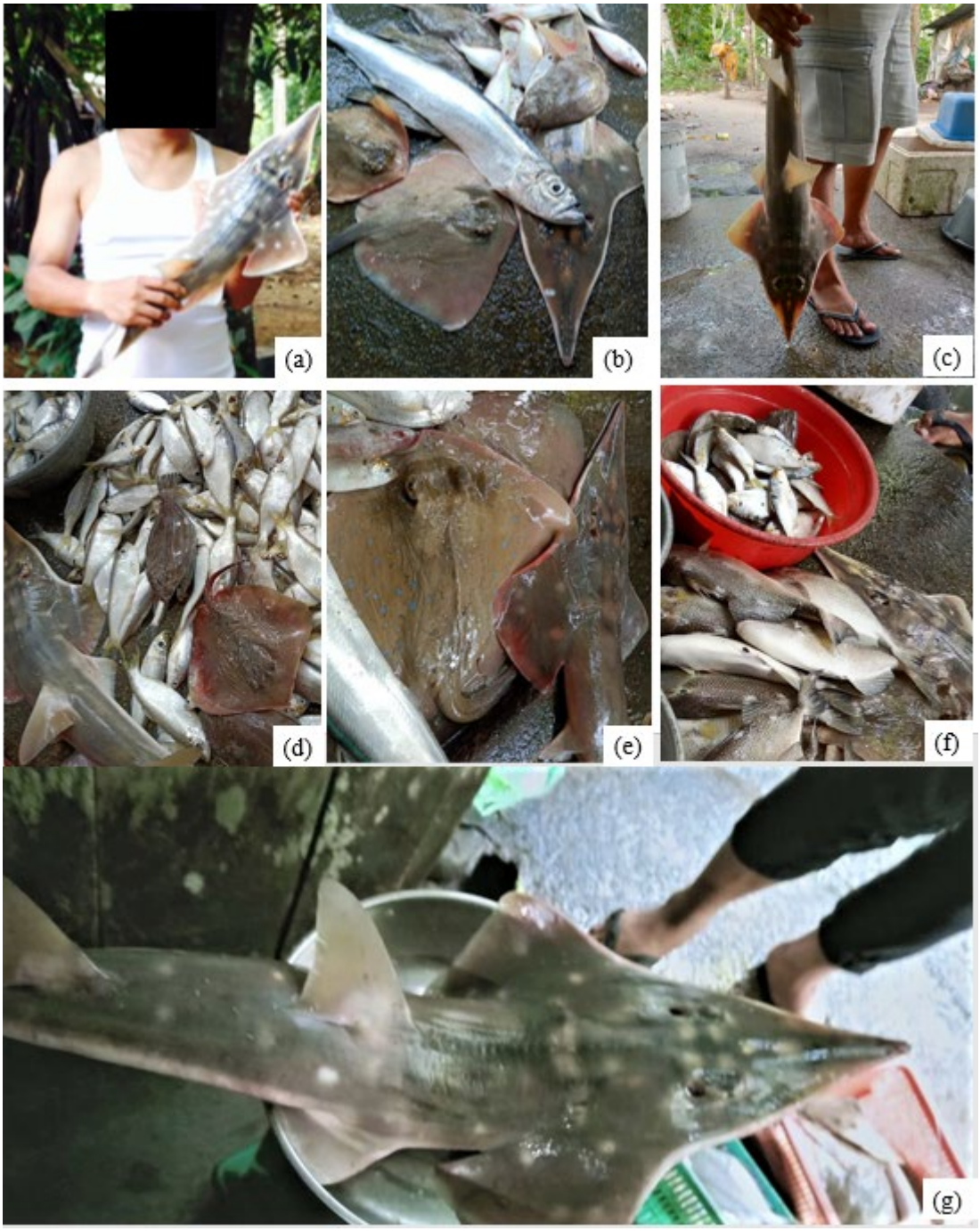

305

306 **FIGURE 2** *Rhynchobatus cooki* landings in the Lingga Islands, Indonesia (a) near Sungai Pinang,
307 Lingga Island, 17 July 2015; and Dabo, Singkep Island: (b) 01 July 2019; (c) and (d) 09 September
308 2019; (e) 29 September 2019; (f) 09 October 2019; and (g) 05 February 2020.