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Biological and fishery aspects of the devil rays; a case study from Negombo fish harbour, Sri Lanka

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Short communication

Abstract

Devil rays are large, zooplankton feeding elasmobranchs in the ocean, which are globally threatened due to the high level of exploitation. There are seven species of devil rays in the world. Of this, five species are found in the Indian Ocean. There is a growing demand for their gill plates, flesh and cartilage, which are used as soup fillers in the Asian region. This growing demand is leading to the risk of the devil ray stocks declining. Therefore, devil rays are categorized as Appendix II species under CITES and Appendix I and II of CMS. A study on Mobula ray fishery and some aspects of their biology in Sri Lankan marine waters was conducted at Negombo, one of the major fish landing centres, from April to November 2019. The results showed that the highest juvenile percentage was represented by *Mobula japanica* (48%). The highest sub-adult and the adult percentage were recorded for *M. tarapacana* (52%) and *M. kuhlii* (52%) catches, respectively. The observed minimum and maximum disc widths of the devil rays showed a declining trend. Most of the devil rays were entangled in gillnet (66%) rather than longline, most were entangled in gillnet of mesh size 13.6 to 16.0 cm. The present study provides baseline information on devil ray species which will be helpful for policymakers to implement regulation and conservation management in the devil ray fishery.

Keywords: *Devil rays, elasmobranches, management, threatened*

Introduction

Worldwide, there are seven members of devil rays but only five species are recorded in the Indian Ocean *viz.*, *Mobula japanica, Mobula eregoodootenkee, Mobula thurstoni, Mobula kuhlii* and *Mobula tarapacana* (Evgeny, 2010; Fernando and Stevens, 2011). They are zooplanktivorous (Nair, 2015) and are distributed throughout the tropical and temperate oceans between 40º N and 40º S, which is at a temperature range of 20-26 ºC (Dewar *et al.*, 2008; Clark, 2010; Canese *et al.*, 2011; Marshall *et al.*, 2011). The distribution of the Devil rays depends on food availability, local productivity and their breeding season (Couturier *et al.*, 2012). They are k-selected species and show ovoviviparous reproduction. They produce one pup during their breeding period, which occurs every 2 to 3 years and their gestation interval is estimated as 1 to 3 years (Marshall, 2008). Due to their low fecundity, there is a higher chance of overexploitation as compared to other elasmobranches and fishes. Mobulid fishery either may be a target or by-catch fishery. In some countries, mobulids are landed as bycatch, while in some others it is a targeted fishery (Croll *et al.*, 2016). In general, artisanal fisheries and small-scale fisheries target them for meat consumption, cartilage and skin (Alava *et al.*, 1997; Bizzarro, 2001). In Sri Lanka, mobulids are entangled as a by-catch of gillnet fisheries targeting *Katsuwonus pelamis* (Fernando and Stevens, 2011). There is a possibility of entanglement of mobulids as by-catch in both the multi-day and the single-day boats. Mobulids have growing markets for their gill plates, which are especially used in Chinese Traditional Medicine (CTM) and their flesh is used for Asian dried seafood markets (O'Malley *et al.*, 2017). Singapore, Taiwan, and China are the major countries that use mobulids' ray gill plates massively. In the Qingping market, 500 g of Mobula ray gill plate is sold for US$ 132 - US$ 322 (Hau *et al.*, 2016). There are also some biological factors which contribute to their vulnerability such as slow growth rate, low fecundity, late maturation, etc. Mobula species have a higher level of exploitation than manta species. In 2016, both manta and mobula are categorized under CITES Appendix II (Rueness *et al.,* 2016). There is a paucity of reliable information on historical or recent changes in the regions. Therefore, this study aimed at providing preliminary biological information and insight into the conservation status of mobula ray species.

Material and methods

The study was conducted from April to November 2019 at the Negombo fishing harbour. During the study period, the biological data of the landed devil rays (n=74) were collected from the anchored boats in the Negombo fishing harbour. Landed devil rays were identified using photographs taken from harbours (Evergrny, 2010), and biological data on disc width (DW), disc length (DL), and body weight (BW) were obtained during the study period. Their sex was determined by the presence or absence of claspers. The life stages of the landed devil rays were determined according to the standard disc width data in the different life stages of devil rays (Rambahiniarison *et al.*, 2018). Both 156 multi-day and single-day boat skippers were interviewed and data on the length of the vessel, gear type, and the number of fishing days were collected.

Results and discussion

A total of 74 devil rays were examined from both multi-day boats and single-day boats from April to November 2019. The most abundant devil rays were, *Mobula japanica*, *Mobula kuhlii* and *Mobula tarapacana*. The number of males and females of the three species is represented in Fig. 1. The disc width of the landed devil rays is shown in Table 1. When compared to the disc width of *M. japanica* in the previous studies (Fernando and Stevens, 2011; Rambahiniarison *et al.*, 2018) the minimum disc width (104 cm) of *M. japanica* in the present study was higher. But the average and maximum disc width of the *M. japanica* in the present study was lower than the previous studies. When compared with the disc widths of *M. tarapacana* with previous

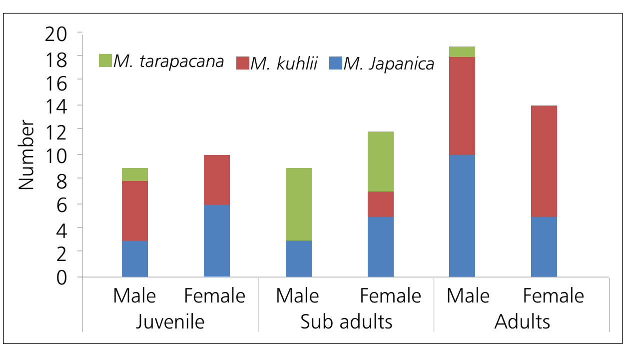

Fig. 1. The number of males and females of landed devil rays in three different life stages

Table 1. Minimum, maximum and the average disc widths of the *M. japonica, M. kuhlii, M. tarapacana* landed in Negombo fishery harbour

Species	Minimum disc width (cm)	Average disc width (cm)	Maximum disc width (cm)
M. japonica (n=32)	104.0	177.0	250.0
M. kuhlii (n=28)	46.0	92.0	138.0
M. tarapacana (n=14)	184.0	225.0	266.0

studies carried out in 2011 and 2018 in Sri Lanka and the Bohol Sea in the Philippines, it shows a similar pattern to that of *M. japanica* (Fernando and Stevens, 2011; Rambahiniarison *et al.*, 2018). Due to the lack of previous data on *M. kuhlii*, the disc width comparison was not done. The average disc width of the mobula rays was different when compared with the previous studies. Further, mobula rays migrate thousands of miles during their breeding season and also for feeding (Couturier *et al.*, 2012). Therefore, this might also affect the changes in disc width of the entangled mobula rays in different oceans.

The percentage of devil rays caught and their different life stages observed during the study are shown in Fig. 2. The majority of *M. japanica* (48%) were landed as juveniles compared to the other two devil rays landed. *M. tarapacana* were (landed 52%) as sub-adults. The majority of adult

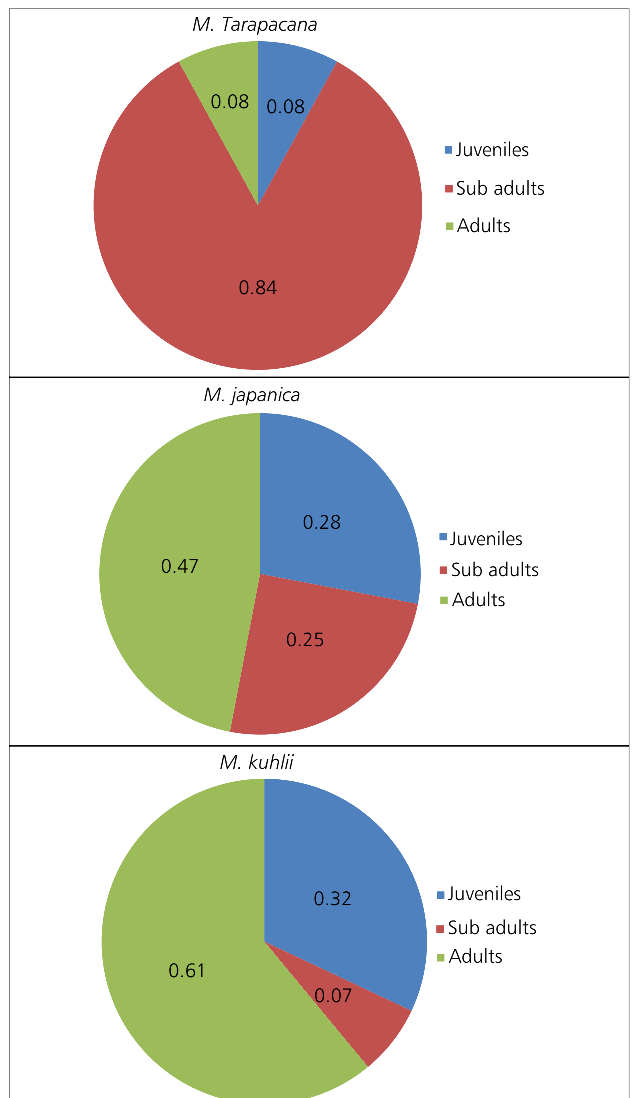

Fig. 2. The percentage of landed devil rays in different life stages

devil rays were represented by *M. kuhlii* (52%) followed by *M. japanica* (45%) and *M. tarapacana* (3%). Further, *M. japanica* was caught majorly in adults (47%) when compared to the juvenile (28%) and sub-adult (25%) stages. Further, *M. kuhlii* were also caught as adults (61%) when compared to the other two life stages. But the majority of *M. tarapacana* were landed as sub-adults (84%) and the percentage contribution for the other two stages of adults and juveniles was (8%). The present study revealed that *M. japanica* and *M. kuhlii* were landed as adults in Negombo fishery harbour.

According to the personal communication received from multi-day and single-day boat skippers, devil rays were entangled in the gillnets rather than long lines and other fishing gears. The percentage of entangled devil rays in different fishing gears is represented in Fig. 3. The percentage of entangled devil rays in gillnets was 66% and for longliners, it was 33%. The percentage of entangled devil rays in different mesh sizes of the gillnet was shown in Fig. 4. The highest percentage of devil rays were entangled in 13.6-16.0 cm mesh size gillnets (66.67%). The mesh size of the gillnets was not chosen to catch the mobula rays but was aimed at tuna schools. The interviews with the boat skippers of both types of boats revealed that devil rays were more entangled than the manta rays. The findings of the present study will support the management and conservation of these valuable elasmobranches when developing effective solutions to protect them.

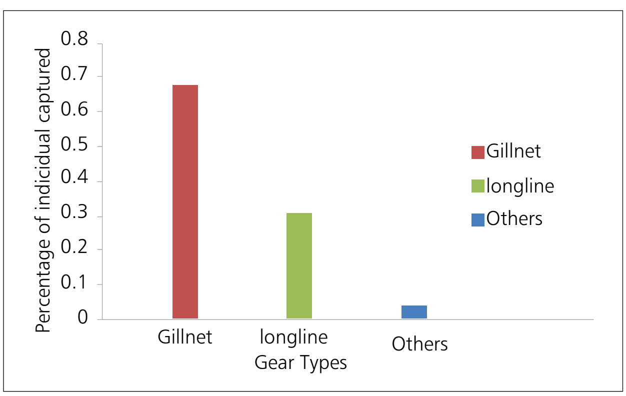

Fig. 3. The number of entangled mobulids in different fishing gears in the Negombo fishing harbour

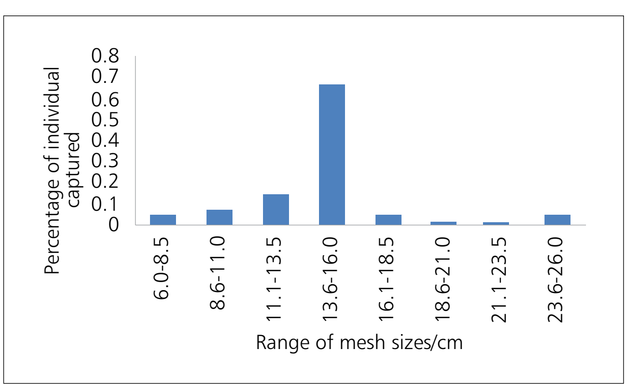

Fig. 4. The percentage of entangled devil ray individuals in different mesh sizes of the gillnet

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