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RESEARCH PAPER

Speak of the devil ray (*Mobula mobular)* fishery in Gaza

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Abstract Little is known about the giant devil ray (*Mobula mobular*), an endangered species endemic to the Mediterranean. Gaza is the only region where this species is targeted, hence, this fishery was studied to address the knowledge gap on fishery interactions, species behavior, and life-history traits. Devil rays have been frequenting this maritime area for at least the past 50 years for a short window from February to April. Landings are reported from 2005 to 2016, along with disc-width (DW) measurements for recent years. A total of 304 *M. mobular* (over 90% males) were landed in Gaza from 2014 to 2016, most which were mature and appeared to be mating (over 90% of males had sperm-filled claspers), providing critical insight that this area may serve as a mating ground. Yearly landings are shown here to closely match the allowed fishing distance from shore, which changes regularly, indicating that the rays are normally caught between 6 and 12 n.m. offshore. Width-weight conversion parameters are calculated for the first time for this species: $a = 2.68 \times 10^{-6}$ and $b = 4.39$. Fresh protein drives this local fishery, as food security is a major issue. An export market for gill plates was reported

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intermittently, and is no longer possible due to strict trade restrictions. We highlight the lack of awareness of fishers regarding the IUCN's Red List 'Endangered' status of devil rays, and stress the urgent need for national protection of this species, particularly due to the species' very slow life-history traits and probable usage of this area as a mating ground.

Keywords Conservation · Endangered species · Food security · Mediterranean Sea · Mobulidae · Palestine

Introduction

Manta and devil rays (Family Mobulidae, collectively referred to as mobulids) span the tropical, subtropical and temperate waters of the world, and the largest of the genus *Mobula* is the giant devil ray (*Mobula mobular*), with a maximum disc width greater than 4.5 m and which can exceed 1.5 tonnes in weight (Bigelow and Schroeder 1953). *Mobula mobular* (Bonnaterre 1788) is an epipelagic giant, which feeds by funnelling planktonic crustaceans and small schooling fishes using their cephalic fins and then trapping/filtering the food through specialised gill plates. This species may be among the least understood of the largest marine vertebrates (Graham et al. 2012), since they are quite elusive and also under general protection in the Mediterranean. Both this elusive behavior and protection status have inhibited the collection of scientific data, resulting in a lack of information on the species ecology and life history.

Mobula mobular is the only devil ray known to occur in the Mediterranean Sea (Notarbartolo di Sciara 1987). Due to the conspicuous resemblance of this species to the smaller, circumtropical *Mobula japanica* (Müller and Henle 1841), recent *Mobula* reports from various Mediterranean locations, such as Tunisia (Capapé et al. 2015; Rafrafi-Nouira et al. 2015) and Turkey (Sakalli et al. 2016) identified some individuals as spinetail devil rays, *M. japanica,* on the basis of morphological characteristics (white tip of dorsal fin, teeth arrangement, etc.), however these are not diagnostic characteristics for *M. japanica*. Considering that morphologic and genetic investigations (G. Notarbartolo di Sciara and D. Fernando, pers. comm.) are ongoing to ascertain whether *M. japanica* should indeed be considered a junior synonym of *M. mobular*, it seems prudent to consider for the time-being that all *Mobula* specimens found in the Mediterranean belong to a single species, *M. mobular*. In addition to the Mediterranean Sea, *M. mobular*'s occurrence was also reported from various north Atlantic localities (e.g., coastal African waters from Morocco to Senegal, the Canary Islands, Madeira, the Azores, Portugal, and southern Ireland: Bigelow and Schroeder 1953). However, given the semblance of *M. mobular* to *M. japanica*, the latter which is found in the tropical and warm-temperate north Atlantic, the presence of *M. mobular* outside the Mediterranean Sea should still be considered uncertain (Ebert and Stehmann 2013).

While the life history traits of all mobulids make them vulnerable to depletion by fishing (Dulvy et al. 2014), *M. mobular* seems to be especially vulnerable to anthropogenic mortality due to: (a) its range being limited to the Mediterranean Sea; (b) its habit of mainly cruising at shallow depths less than 50 m, thus leaving them particularly exposed to both targeted and bycatch fisheries (Canese et al. 2011); and (c) it's very low reproductive potential, with a currently unknown gestation period (Couturier et al. 2012), and the birth of just one huge pup (Notarbartolo di Sciara and Serena 1988). Pardo et al. (2016) have argued that the combination of the devil rays' low growth rate, low productivity and low maximum population growth rates imply a very slow population recovery time compared to other elasmobranch taxa, emphasizing the threat of driving devil rays to local extirpation by even low levels of artisanal fishing pressure. Until recently, only limited and occasional target catches of giant devil rays—ranging from 3 to 4 individuals/year in Algeria (Hemida et al. 2002) and Sicily (Celona 2004)—were known in the Mediterranean. Fishery bycatch does however contribute to giant devil ray mortality in the Mediterranean, particularly in the now illegal large-scale pelagic driftnet fishery (Notarbartolo di Sciara et al. 2015a). Unfortunately fishers rarely record bycatch, so these numbers remain a mystery.

Considering all the above sources of mortality, the conservation status of the giant devil ray was assessed as "Endangered, A4d" in IUCN's Red List (Notarbartolo di Sciara et al. 2015b). The species is also protected under national law in Croatia, Malta, and Israel, and is listed in Annex II ("List of Endangered and Threatened species") to the Barcelona Convention Protocol on Specially Protected Areas and

Biological Diversity (SPA/BD) in the Mediterranean (adopted in 1995, listing the protection and conservation of species as one of its main elements). They are also listed in Appendix II ("Strictly Protected Fauna species") to the Bern Convention on the Conservation of European Wildlife and Natural Habitats, and in both Appendices I and II to the Convention on the Conservation of Migratory Species of Wild Animals (CMS). In 2016, all mobulids were added to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which regulates any international trade.

The recent discovery of a directed seasonal purse-seine fishery in the Levantine Sea off of Gaza ominously raised concern for the need for giant devil ray conservation, as the Palestine territories are not bound by any of the above-mentioned international legal instruments. What global media (Duell 2013) erroneously reported in February 2013 as a 'mass stranding' event, when over 200 giant devil rays lined the Gaza Strip shores (Fig. 1), the reality was in fact fishers showing off their catch from a seasonal, local opportunistic target fishery, which exists for the sole provision of a fresh and cheap protein source for domestic consumption.

In 1982, the United Nations Law of the Sea (UNCLOS) gave each signatory exclusive rights over their territorial seas, extending 12 nautical miles (n.m.) from shore for their territorial sea and 200 n.m. from shore for their exclusive economic zone (EEZ). When several countries are in close proximity to each other, a median line is drawn to mark this boundary. If a country has not signed UNCLOS, they are not obliged to follow the law, as is the case for instance with Israel, USA and Turkey. Furthermore, any recognition of Gaza's right to utilize their territorial sea signals the recognition of a Palestinian state, which is a politically complex issue. According to the UN, the Palestinian EEZ is supposed to extend 20 n.m. out to sea, but constrained relations with Israel resulted in a restriction of Palestine's EEZ to 12 n.m. in 1994, and then to either 3, 6, 9 or 12 n.m. between 2006 and 2016 (See Fig. 2 below for annual limitations). A 6 n.m. boundary results in a total fishing area of only 270 km^2 (Melon 2011) and according to the UN, most fish, especially sardines which drive the fishery in Gaza, are caught at a greater distance than 6 n.m. from shore.

Fig. 1 A policeman observing the devil ray landings in Gaza in April 2013 (photo credit: Wissam Nasser), which was originally publicized as a mass-stranding event but later learned to be a local opportunistic target fishery

As of 2016 there were 125 small purse-seine boats employing approximately 600 people and 53 large purse-seine boats employing approximately 500 people. Hence about 1100 fishers have the opportunity of encountering and catching *M. mobular* during a narrow temporal window from February until April each year, when these rays visit Gaza's waters.

Additional political and economic isolation since 2007 in the Gaza Strip saw its GDP (gross domestic product) further reduced by half. This, combined with an unemployment rate of 46% in Gaza, the world's highest (The World Bank 2015), makes the voluntary protection of endangered *M. mobular* a tough sell to fishers.

As Gaza is the only Mediterranean territory targeting *M. mobular*, details learned from the specimens landed in this fishery present a unique opportunity not only to better understand the species' biology (e.g., with the first width/weight relationship in *M. mobular*), but also provide the first science-based foundations for the species' conservation and sustainable management of its fishery.

Methods

First, surveys with fishers were conducted at the fish landing sites to obtain background information on the elasmobranch fisheries in Gaza. There are four parts to the survey: background information, boat and fishing gear, shark and devil ray catches, and lastly perceptions. Fishers were chosen completely at random at fish markets. The survey was mostly semi-structured allowing for some open-ended replies, when necessary. The survey is made available here as 'Supplementary data'. Additionally, landings data were compiled from 2005 onwards to try to better understand the fisheries.

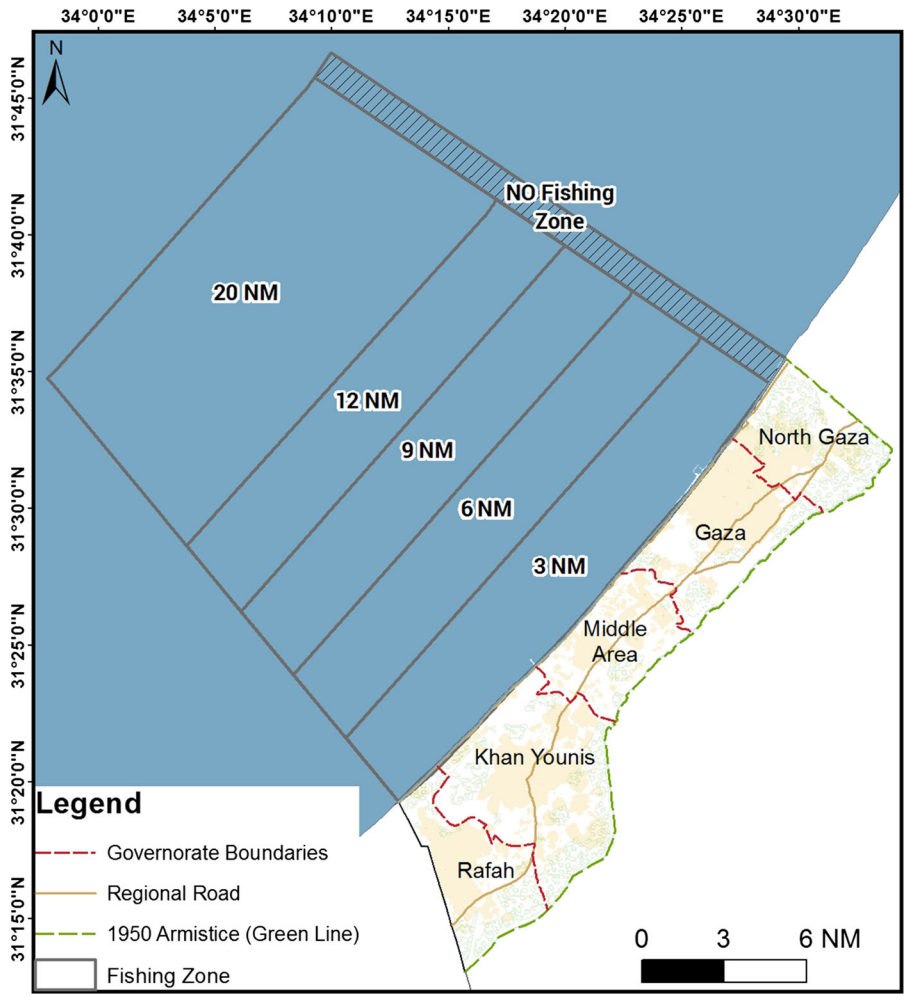

Fig. 2 Map of the Gaza Strip, with its 3, 6, 9, 12 and 20 n.m. fishing zones illustrated, including the buffer zone in the north

Qualitative interview data

Personal, semi-structured interviews were conducted with 30 fishers, 15 fishmongers, 10 consumers and five governmental fishery industry personnel to understand the background and the drivers behind the *M. mobular* fishery, awareness of international trade in gill-plates, and local awareness of *M. mobular's* IUCN 'Endangered' status.

Quantitative landings data

Landing data from the Ministry of Agriculture were made available from 2005 to 2015 for *M. mobular*. From 2014 to 2016, between February and April, more detailed data on landed specimens were collected by personnel stationed at six of the eight main fishery landing sites in the Gaza Strip (Fig. 3) including size [disc-width (DW) to the nearest cm], sex, maturity, and weight (when possible).

Sex was determined by the presence or absence of claspers. Sexually matured males were determined by length of claspers, i.e., if the claspers extended beyond the base of the pelvic fin (approximately 20 cm), which was usually accompanied by the presence of sperm emanating from the claspers. Females were assumed matured when having a minimum DW of 200 cm.

Weight was measured from some rays, on the rare occasions they were brought to the market with their heads still attached. Each was then portioned into four pieces and all pieces were weighed together on a digital scale to the nearest kg.

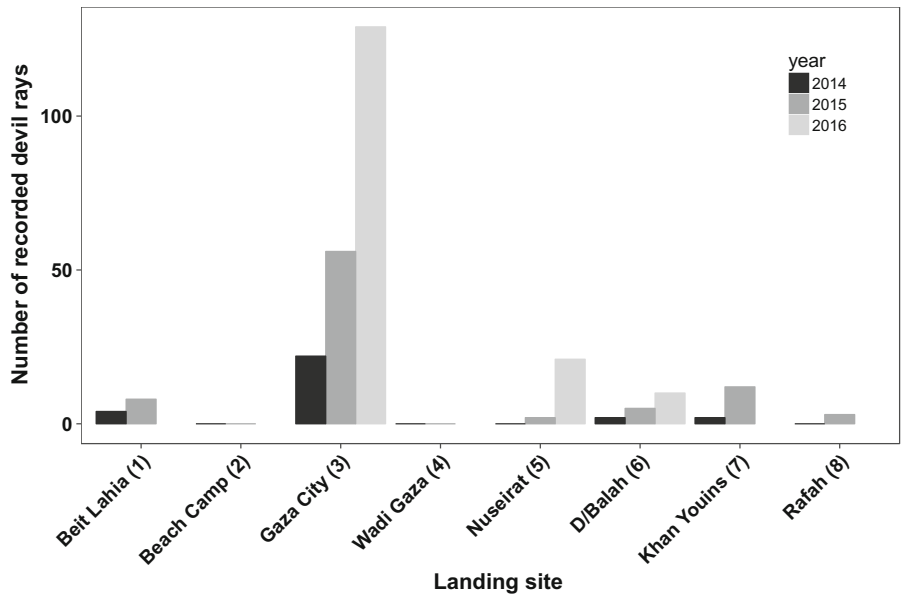

Fig. 3 Number of recorded landed *M. mobular* specimens by landing site

Data analysis

Finally, width–weight relationships for landed *M. mobular* specimens were examined for both sexes combined using disc-width for length, the standard measurement for mobulid rays. Length (cm) and weight (g) were log-transformed. Plots of both the raw and log-transformed data were examined to detect and remove extreme outliers. The traditional length–weight formula used was $W = a*L\text{^}b$, where W = weight (g), a = intercept, L = length (cm), and b = slope, however, W and L were log-transformed, so the equation used was linearized: $\ln(W) = \ln(a) + b*\ln(L)$. All calculations were performed using R statistical software (R Development Core Team 2006). The histogram for frequency of disc-width measurements was created using the StatPlus Program.

Results

Qualitative data from interviews

Mobula mobular is not a primary target species in Palestine, but rather is opportunistically fished by local '*Shanshula*' (purse-seine) boats ranging from 4.5 m to 21 m in length, during a very short seasonal window to supplement the tuna fisheries, when there is ample space to do so on the vessel. The oldest fishers recalled that *M. mobular* have been sighted in Palestinian waters since at least the 1960s, and began to be caught in the early 1970s.

The purse-seine nets are made of polyester, measure an average of 5.4 km^2, are 2.7 mm thick, and have a mesh size of 42 mm. There is a cork rope surrounding and holding the net, which is 1 cm thick. The net is first deployed underwater using a hoist, and after the fish gather over the net, the net is raised to enclose the area and trap the rays.

Local fishers also explained that if a school of *M. mobular* is encountered while fishing, the purse-seine nets are not cast right away, as the nets can get badly damaged from entanglement or can sink under the massive cumulative weight of the aggregation. Rather, when *M. mobular* are present, they are targeted at the end of a fishing day due to the large amount of space the rays occupy on the vessel; hence, catches early in the day are normally either released (alive) or discarded (dead). When targeted, the individuals are captured alive and then the fishers must haul the nets in very quickly, having less than 35 live specimens per haul. Deceased individuals can contribute to sinking nets, rendering the nets impossible to haul in.

Once the rays are brought to one of the major fish markets, they are purchased (nearly) whole by local fishmongers, excluding the head, which is normally previously discarded either at sea or on land. The meat

from the wings and body is portioned at one of the major fish markets, and then sent to smaller fish markets for a fixed price (the equivalent of US $1.50/kg). The Gaza City fish market is the most popular for fishers to land their *M. mobular* catch because it is the most populated area in Gaza (Fig. 3). All respondent's confirmed that the meat, as a protein source, is the primary force driving this fishery.

The year most specimens were landed was 2013 (nearly 400, Fig. 4), in what was originally and erroneously described by the international media as a 'mass stranding event' (Duell 2013), these high catches can be attributed to a relaxation of the imposed EEZ to 12 n.m. that year (Fig. 4). From 2014 to 2016, the total numbers of landed specimens were 30, 85 and 160, respectively.

Due to very strict control on imports and exports from Palestine, there was no export market for mobulid gill plates in 2014, 2015 or 2016, however in 2013 there were reported gill plate exports to China. The majority of the surveyed fishers, dealers and government officials (92%) interviewed were unaware of the international mobulid gill plate trade and their use in Chinese medicine. This is in contrast to the shark fin export market, which 25% of Palestinian fishers are aware of.

Noteworthy, but not all that unsurprising, is that all fishers and fishmongers were unaware that *M. mobular* is listed as 'Endangered' by the IUCN and in the SPA/BD Protocol to the Barcelona Convention. Only one out of the five governmental employees were aware of the species' 'Endangered' status after recently researching the matter himself.

Landings data

Mobula mobular are seasonally caught in Palestinian waters approximately a week in total in sometime between February and April, i.e., they were only caught in Palestinian waters for a total of 4 days in 2014, 3 days in 2015 and 8 days in 2016 (Supplementary Data: Tables 1a–c). The largest *M. mobular* specimen recorded from this study was a female landed on 8th April 2016 with a DW of 320 cm (see Supplementary data: Tables 1a-c). The largest male specimen recorded was landed on 7th April 2015 with a DW of 306 cm. The female/male ratio of the landed specimens from 2014–2016 was 8.8/100. Over 90% of landed male specimens had sperm oozing out of their claspers. The landed rays which were weighed from this study ranged from 25 to 295 kg, averaging 198 kg (n = 21).

The width–weight relationship was calculated for disc-width with a and b parameters ($W = a*L^b$) being $a = 2.68*10^{-6}$ and b = 4.39 for disc width–weight (Fig. 5). It must be taken into consideration that firstly, only 21 individuals were weighed, therefore this

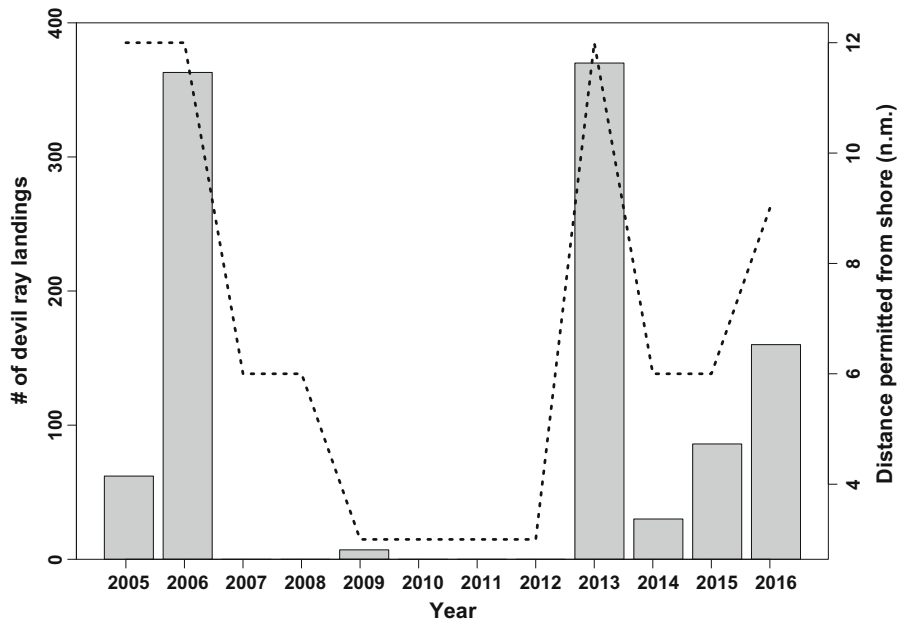

Fig. 4 Number of *M. mobular* landed in Palestine from 2005–2016, with permitted distance from shore to fish on the secondary Y-axis, represented by the *dashed line*

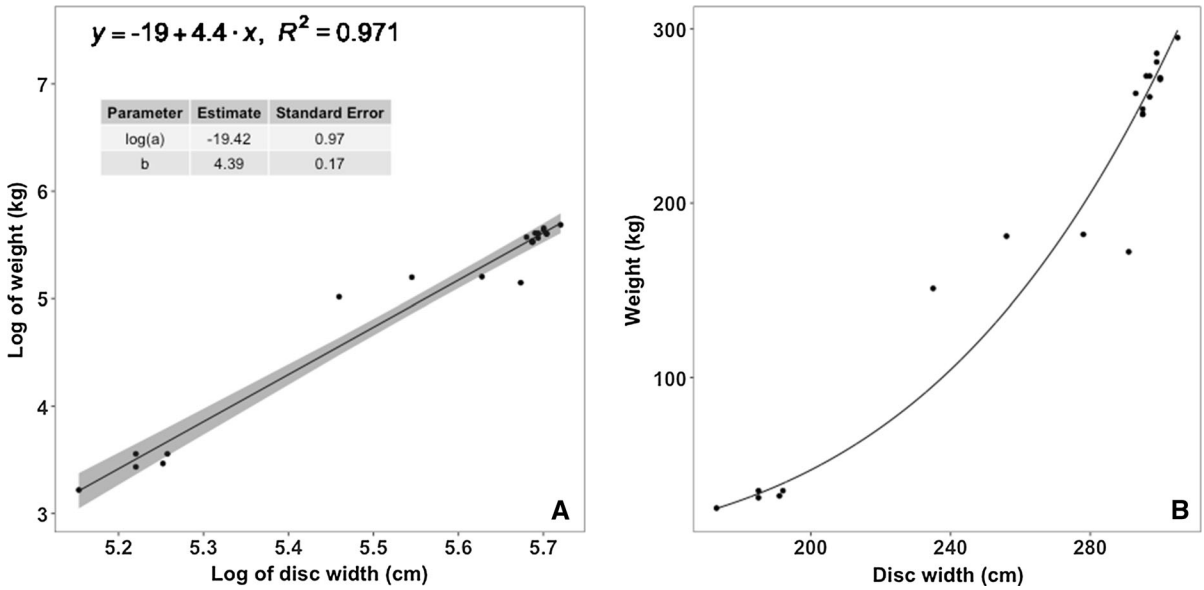

Fig. 5 Width–weight relationship for landed *M. mobular* specimens in Palestine from 2014–2016. Relationship is shown in log space (**a**) and real space (**b**). *Shaded area* indicates 95% confidence intervals and the table contains parameter values and standard errors

growth curve is based on a small sample size, and secondly, all individuals collected were classified as adults, which indicate that the juvenile stages, when most of the body growth occur, are not represented in the data.

A direct correlation is observed between the distance from shore fished (i.e., least restricted fishing zones), and the number of caught *M. mobular* (see Fig. 4), with 2006 and 2013 having the highest catches, coinciding with a maritime area extending 12 n.m. from the shore; the largest allowable maritime area within the last decade. Contrarily, almost no catches were reported between 2007 and 2012, with the exception of 7 individuals in 2009. During this period fishing was restricted to 6 n.m. (2007–2008) and to 3 n.m. (2009–2012) (Table 1).

The landed rays from 2014 to 2016 ranged from 173 to 320 cm DW, with an average of 273 cm DW. Most of the landed specimens were between 260–280 cm (34% of specimens), and 280–300 cm in disc-width (43% of specimens, Fig. 6).

Table 1 Number of caught *Mobula mobular* by month from 2005–2016

Year	Jan.	Feb.	Mar.	Apr.	Total
2005	6	22	33	1	62
2006	0	84	279	0	363
2007	0	0	0	0	0
2008	0	0	0	0	0
2009	0	0	2	5	7
2010	0	0	0	0	0
2011	0	0	0	0	0
2012	0	0	0	0	0
2013	0	299	71	0	370
2014	0	0	26	4	30
2015	2	0	0	84	86
2016	0	0	0	160	160

Note that *M. mobular* have never been caught outside of these months

Discussion

Globally, three-quarters of assessed oceanic pelagic sharks and ray species are threatened with extinction stemming from overfishing (Dulvy et al. 2008), and the situation is thought to be worse in the Mediterranean Sea, although the lack of reliable historical data acts as an impediment to tracking changes in population sizes (Ferretti et al. 2008; Lawson et al. 2017). Since Palestine is the only territory to regularly target *M. mobular* (Notarbartolo di Sciara et al. 2015a), a monitoring program in Gaza has been implemented to

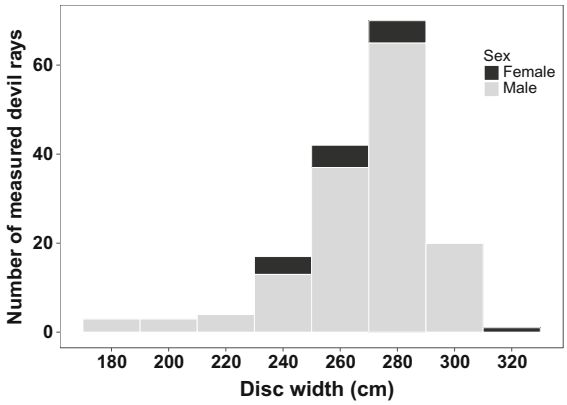

Fig. 6 Frequency distribution size class of *M. mobular* landed in Gaza from 2014–2016 by sex, *black* for females and *grey* for males (n = 274; disc width in cm)

learn about this fishery and this species. Here, we briefly discuss the global *Mobula* fisheries, and then the Gaza *M. mobular* fishery, what is currently known about their ecology, ecological findings from this study, current global conservation initiatives, the gill plate trade, and then possible initiatives to support the Palestinian conservation of *M. mobular.*

Global *Mobula* fisheries

Various species in the *Mobula* genus are targeted by fisheries in (at least) 13 other countries and have been caught as bycatch in at least 30 commercial fisheries, most of which stem from Asia (Croll et al. 2016). Bycatch mortalities of *M. mobular* have been reported from the following Mediterranean fisheries, large-scale driftnets (prohibited in 2002 by the EU and ICCAT in 2003, but are still in operation, Akyol et al. 2005; Muñoz-Chapuli et al. 1993; Northridge 1991; Scacco et al. 2009), purse seines and trawls (O'Malley et al. 2016), bottom set nets (Bradai and Capapé 2001; Holcer et al. 2013), trammel nets (Orsi Relini et al. 1999), longlines (Marano et al. 1983; Scacco et al. 2009), and even fixed traps for tuna (Boero and Carli 1979; Bradai and Capapé 2001; Storai et al. 2011).

Palestinian *Mobula mobular* fisheries

Mobula mobular have been frequenting the very small maritime area of Palestine for at least half a century, according to our oldest fishers, and have been a targeted fishery most years since the early 1970s. Annual *M. mobular* aggregations have not been observed or reported in neighboring Israeli or Egyptian maritime waters in recent years, although the odd sighting (from Israel and Lebanon) and occasional incidental catch (from Egypt and Turkey) have been reported (Akyol et al. 2005; Sakalli et al. 2016).

The strict spatial restrictions imposed on Palestine (ranging from 3 to 12 n.m.) may have served as an involuntary marine reserve (i.e., a no-take zone) for fish stocks, especially for *M. mobular*. The yearly landings strictly coincide with the changing spatial restrictions, showing that the rays are caught between 6 n.m. to 12 n.m. from shore. These restrictions come as a great cost to the livelihoods of the fishers, as the quantity and quality of fisheries catches have been substantially reduced (FAO 2014). In fact, due to the severity of these maritime restrictions, the percentage of fishers classified as either 'very poor' or 'poor' increased from 50 to 90% (Abudaya et al. 2014).

Mobula mobular market and the gill plate trade

The meat of *M. mobular* caught in the Palestinian fishery is exclusively sold in local markets for consumption. The head is usually discarded and thus is the only part of the animal not utilized as a protein source. With the exception of one report of gill plate export to China in 2013, most of the interviewed fishers were unaware of the growing demand for *Mobula* gill plates as an ingredient in Chinese medicine. Furthermore, the imposed restrictions on exports from Palestine prevents any legal international trade of gill plates, which may in turn act as a small deterrent for excessive catching of devil rays.

Ecology

Mobula mobular is one of the least studied elasmobranch species due to its elusiveness, with the exception of this extremely localized annual fishery. Many questions remain to be answered such as their Mediterranean distribution, and their population size and status. Densities of *M. mobular* have recently been estimated in two Mediterranean areas, the Adriatic Sea (Fortuna et al. 2014) and portions of the western Mediterranean (Notarbartolo di Sciara et al. 2015a). Population estimates in these areas were obtained from sightings made during aerial line-transect surveys targeting cetaceans. The observation that giant

devil rays frequently seen in the Ligurian and Tyrrhenian seas during summer and totally disappear from those areas in winter, in coincidence with the late winter (February until the beginning of April) appearance of the species in the easternmost part of the Mediterranean basin, led Notarbartolo di Sciara et al. (2015a) to hypothesize a region-wide seasonal migration of these rays.

The genus *Mobula* is known to have one of the lowest known fecundities of all elasmobranchs (Couturier et al. 2012), and there is no reason to suppose that *M. mobular* is different from the other species. In the absence of a clear understanding of the giant devil ray population structure in the Mediterranean, and with the current scant knowledge of population size(s) and productivity, it is impossible to set sustainable catch limits for *M. mobular* in Palestine. It is possible that the annual catches off Gaza (which average 169 specimens per year from 2013 to 2016) exceed the maximum sustainable yield for the population, thus rendering the fishery unsustainable. In fact, the combined low maximum population growth rate and related 'speed-of-life' traits may be the ultimate correlate of high extinction risk (Fernandes et al. 2017), for this species.

Variations in the mean size and captured sex ratio are strong indications of sex segregation for *M. mobular* in the study area, since predominantly males were retained (91.2%). Such size and sex segregation is not uncommon among elasmobranchs (Froese 2006), and it can thus be speculated that *M. mobular* return annually to this specific area to mate, which can be corroborated by the presence of enlarged male claspers with sperm oozing out of the majority (90%) of the landed males. The dearth of females in the catch is puzzling, considering that males appeared ready to mate. One hypothesis could be that for some reason, females were more difficult to catch; potentially owing to different behaviour, greater depth or greater distance from the coast.

This study provides the first width–weight data available for this species however, two factors might have affected the fit of the width–weight relationship: the small sample size (21 individuals), and the absence of juveniles in the sample. The juvenile stages are usually characterized by fast gain in width (growth spurt), and this stage is not characterized in our sample as almost only adult specimens were measured (only five landed males from 2014 to 2016 were under 200 cm in DW). We recommend that the parameter estimates reported here are considered with caution, particularly if applied to individuals outside the range of widths and weights found in this study.

Current and proposed conservation strategies

All species of *Mobula* were included in CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) Appendix II in 2016. This ensures that any global trade taking place is done so with the appropriate export permits certifying that trade is non-detrimental to the sustainability of the stocks. However, Palestine is not signatory to CITES, and when trade is reinstated, this lack of protection could potentially increase the threat to the conservation of this species.

All fishers interviewed in Gaza were unaware of the 'Endangered' status of *M. mobular* and the Mediterranean-wide protection of this species. When interviewed by one of our team to gain a better understanding of the fisheries, each fisher was made aware of *M. mobular's* 'Endangered' status and need for protection, which helped to deter some fishers in early 2017. In addition, posters relaying the same information have been displayed at local fish markets explaining the need for *M. mobular* conservation.

As *Mobula mobular* only frequent Palestinian waters for a very short period of time each year, only a few dozen purse-seine fishers directly benefit from the *M. mobular* catches. While it is understood that the first priority of Palestinian fishers is to meet their basic needs, this predicates that in order for fishers to willingly forgo this opportunistic target fishery, some form of compensation will be required. Considering there are only 1100 purse-seine fishers, and only a few dozen that directly benefit from target *M. mobular* catches, the total sum required to compensate these purse-seine fishers would be quite low.

In addition to restricting the target fishery, it is recommended that regulations be introduced to encourage the release of specimens caught as bycatch, and educational programs be run to address the lack of awareness with regard to status of species. To combat the unawareness matter, community outreach has been initiated with school children, fishers and government officials in Gaza to promote conservation awareness for *M. mobular*. However, future protection of this species at the national scale will likely require a more creative solution (i.e., by first ensuring nutritional

requirements are met) than just marine conservation awareness alone, as trade restrictions combined with loss of employment have had a detrimental impact on food security.

In conjunction with monitoring the Palestinian *M. mobular* fisheries, all elasmobranch catches are being recorded to learn of other locally endangered species possibly needing further protection, as over half of assessed elasmobranches were threatened with extinction in the Mediterranean in 2007, but the actual situation is believed to be much worse (Dulvy et al. 2014; Nieto et al. 2015). This work specifically contributes to the enrichment of several objectives in the 'Global Devil Ray and Manta Conservation Strategy' in helping to understand growth, fisheries drivers, and fisheries assessment (Lawson et al. 2017). Closer collaborations between scientists should also be promoted in order to better understand the Mediterranean *M. mobular* populations.

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