

Lesser devil rays *Mobula cf. hypostoma* from Venezuela are almost twice their previously reported maximum size and may be a new sub-species

N. R. EHEMANN*†‡§, L. V. GONZÁLEZ-GONZÁLEZ*† AND A. W. TRITES||

**Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas, Apartado Postal 592, La Paz, Baja California Sur C.P. 23000, Mexico*, †*Escuela de Ciencias Aplicadas del Mar (ECAM), Boca del Río, Universidad de Oriente, Núcleo Nueva Esparta (UDONE), Boca del Río, Nueva Esparta, C.P. 06304, Venezuela*, ‡*Proyecto Iniciativa Batoideos (PROVITA), Caracas, Venezuela* and ||*Institute for the Oceans and Fisheries, University of British Columbia, Vancouver, BC, Canada*

(Received 8 September 2016, Accepted 23 November 2016)

Three rays opportunistically obtained near Margarita Island, Venezuela, were identified as lesser devil rays *Mobula cf. hypostoma*, but their disc widths were between 207 and 230 cm, which is almost double the reported maximum disc width of 120 cm for this species. These morphometric data suggest that lesser devil rays are either larger than previously recognized or that these specimens belong to an unknown sub-species of *Mobula* in the Caribbean Sea. Better data are needed to describe the distribution, phenotypic variation and population structure of this poorly known species.

© 2017 The Fisheries Society of the British Isles

Key words: batoids; by-catch; Caribbean Sea; Chondrichthyes; Myliobatiformes.

There is limited biological and fisheries information about the body size at maturity, population size, stock, maximum age and length–mass relationships of *Mobula hypostoma* (Bancroft, 1831), better known as the lesser devil ray. It was first described by Bancroft (1831), but no specimen was preserved (Notarbartolo di Sciara, 1987). Later, Coles (1916) published some notes about *Mobula olfersi* (Müller 1834), currently recognized as *M. hypostoma*, caught at Cape Lookout Bight, North Carolina. He wrote that this species reaches maturity with a width of 44 inches (111.7 cm) and that adult specimens rarely exceed 48 inches (121.9 cm). He also noted that they attain a masses of <50 lbs (22 kg). A subsequent specimen from New Jersey was 108 inches wide (274.3 cm) (Fowler, 1930), but its large size cast doubt about whether it truly was *M. hypostoma*, or another species [devil ray *Mobula mobular* (Bonnaterre 1788)] that originated from European waters (Bigelow & Schroeder, 1953). A beach-cast specimen, however, recovered in 1965 in Venezuela that was probably *M. hypostoma*, was

§Author to whom correspondence should be addressed. Tel.: +52 1 612 131 9315; email: nehemann@yahoo.com

150 cm disc width (W_D) (Cervigón & Alcalá, 1999) and a more recent specimen caught off Alabama was 129 cm W_D (Patella & Bullard, 2013). Collectively, these sparse observations have led to the commonly reported conclusion that *M. hypostoma* attain a maximum W_D of 120 cm (Robins & Ray, 1986; Cervigón & Alcalá, 1999; McEachran & Carvalho, 2002; Tobón-López *et al.*, 2011; Navia & Mejía-Falla, 2014).

The primary goal of this study was to collect additional data on *M. hypostoma* from the centre of their distributional range and to provide morphometric information that contributes to the biological description of the species and its conservation.

In February 2013, three *Mobula* Rafinesque 1810 (Fig. 1) were collected as by-catch from artisanal fishermen targeting tuna *c.* 83 km (45 nautical miles) north of Margarita Island, Venezuela.

Literature and species identification keys for *Mobula* and other ray fish were consulted (Notarbartolo di Sciara, 1987; Cervigón & Alcalá, 1999; McEachran & Carvalho, 2002; Mejía-Falla & Navia, 2011; Navia & Mejía-Falla, 2011, 2014; Tobón-López *et al.*, 2011) and identifications were made using the main distinguishing features of *Mobula*. Unfortunately, the teeth plates and the branchial arches of the three specimens could not be examined because the fishermen kept the heads for personal consumption.

Each of the three specimens was measured, weighed and sexed. All morphometric measurements were taken to the nearest cm, with W_D corresponding to the distance between the tip of the pectoral fins and total length (L_T) was the distance from the tip of the cephalic fin to the tip of the tail. The sex was externally determined by the presence or absence of claspers and male sexual maturity was ascertained from the calcification state (flexible or calcified) and clasper lengths (L_C). Each specimen was weighed in four pieces after being gutted and chopped by the artisanal fishermen (head, guts and pectoral fins) using a digital scale (± 0.1 g). The pregnant female was weighed after removing the embryo and therefore did not include the mass of her pup. Fluids that were lost after cutting the fish into four pieces were not collected and weighed and were considered insignificant.

The three specimens consisted of a pregnant female and two males {one of which was immature [Fig. 1(a)]} and were identified as *Mobula cf. hypostoma* based on the ventral position of the mouth, the entirely white ventral surface, the absence of a caudal serrated spine and blackish dorsal surface that lacked a white spot at the tip of the dorsal fin. The largest individual was a mature male (230.8 cm W_D), followed by the pregnant female (228.6 cm W_D) and the immature male (206.5 cm W_D) (Table I). The L_C of the immature male was 14.8 cm and did not exceed the distal margin of the pelvic fin. In contrast, the mature male had an L_C that was almost twice as long at 27.6 cm.

The masses of the three fish ranged between 90.5 and 116.1 kg, with the pregnant female the heaviest [Fig. 1(b)]. A single unborn female pup was extracted from the trophonemata of the mother. The pup was 96.8 cm W_D , 170.5 cm L_T , weighed 9.4 kg and its pectoral fins were folded over its dorsal surface [Fig. 1(c)]. The size of this pup was much larger than the reported size at birth for *M. hypostoma* of 55 cm W_D (McEachran & Carvalho, 2002). There is, however, a published photograph of an unborn male *M. hypostoma* 75 cm W_D and mass of 4.2 kg (Cervigón, 2011); while another study reported three embryos with W_D from 32.6 to 71.4 cm (Tagliafico *et al.*, 2014). All five of these unborn pups were identified as *M. hypostoma* and came from the Caribbean Sea, particularly Margarita Island, north-east of Venezuela. What is particularly noteworthy about these five embryos is that their sizes exceeded the

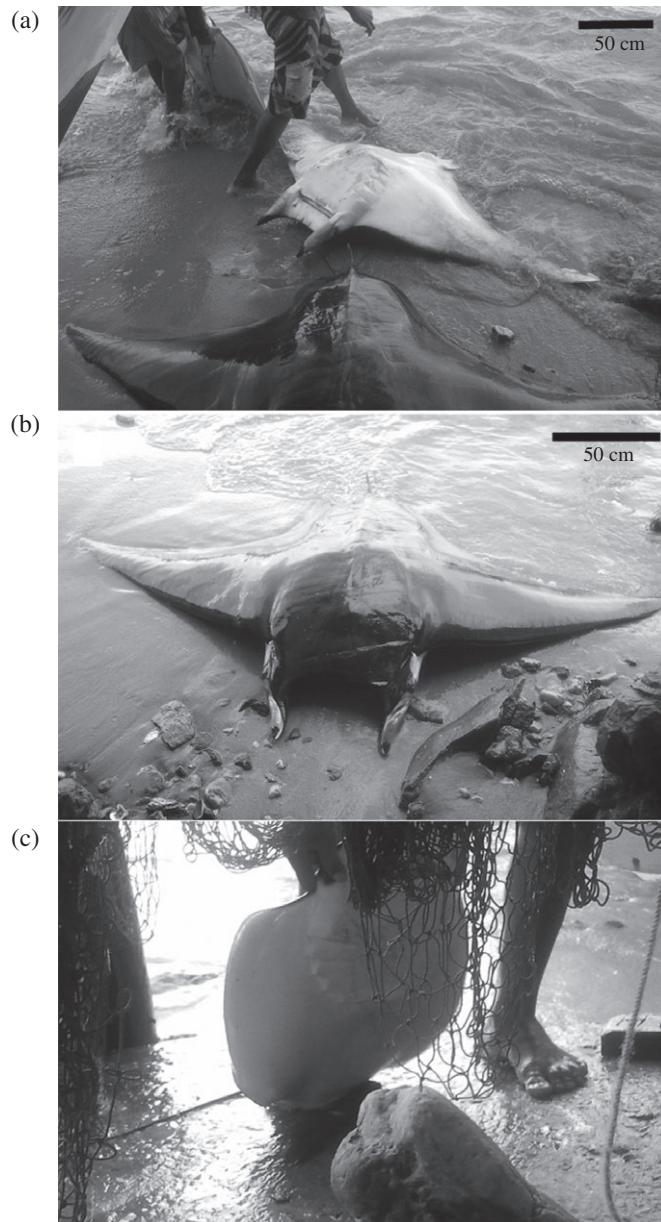


FIG. 1. The *Mobula cf. hypostoma* caught by the artisanal fishermen showing (a) all three individuals, (b) the pregnant female and (c) the unborn female.

sizes of free-swimming adults caught in Argentina [70 cm adult W_D ; Cousseau & Menni (1983); Brazil (71.4 cm and 83.4 cm W_D), Jamaica (72.8 cm W_D), Gulf of Mexico (66.6–71.1 cm W_D) and U.S.A. (60.1–102.6 cm W_D); all material examined by Notarbartolo di Sciara (1987)] .

TABLE I. Sex, sexual maturity, total length (L_T), disc width (W_D), mass (M) and clasper length (L_C) of three specimens of *Mobula cf. hypostoma* landed in Playa La Pared and caught c. 83 km north of Margarita Island, Venezuela, in February 2013. Note that the unborn female embryo was removed from the mature female and that the mature female mass does not include the mass of the embryo

Sex	Sexual maturity	L_T (cm)	W_D (cm)	M (kg)	L_C (cm)
Male	Immature	255.5	206.5	90.5	14.8
Male	Mature	271.4	230.8	105.3	27.6
Female	Mature	272.9	228.6	116.1	–
Female	Unborn	170.5	96.8	9.4	–

Identifying the taxon of *Mobula* to species can be problematic because of the similarities between some *Mobula* species (Couturier *et al.*, 2012; De Boer *et al.*, 2015). This is particularly true for the smaller species of *Mobula* such as *M. hypostoma*.

Of the nine species of *Mobula* (Table II), only two are sympatric in the western Atlantic: Chilean devil ray *Mobula tarapacana* (Philippi 1892) and *M. hypostoma*. There may be a third sympatric species, the lesser Guinean devil ray *Mobula rochebrunei* (Vaillant 1879) based on a questionable report of an adult female being caught off the coast of Brazil in 1989 [Barletta, M. pers. comm. cited in Gadig *et al.* (2003)]. Whether or not this specimen was correctly identified or whether it was a vagrant from the eastern Atlantic Ocean (McEachran & Carvalho, 2002; Notarbartolo di Sciara, 2016) is unknown.

The three specimens of *Mobula* measured in this report all had the external characteristics of *M. hypostoma* except for their body sizes, which were almost twice the maximum body size reported for this species. This marked difference in body size

TABLE II. Species, maximum size of disc width (W_{Dmax}) and distribution for the valid scientific names for the genera *Mobula* (from Froese & Pauly, 2016)

Species	W_{Dmax} (cm)	Distribution
<i>Mobula eregoodootenkee</i>	100	Indo-west Pacific Ocean
<i>Mobula kuhlii</i>	120	Indo-west Pacific Ocean
<i>Mobula hypostoma</i>	120	Western Atlantic Ocean
<i>Mobula rochebrunei</i>	133	Eastern Atlantic Ocean and Brazil
<i>Mobula munkiana</i>	220	Eastern Pacific Ocean
<i>Mobula thurstoni</i>	220	Eastern Atlantic Ocean, Indian Ocean, Western Pacific, eastern Pacific Ocean
<i>Mobula japonica</i>	310	Indo-Pacific; eastern Pacific Ocean, eastern Atlantic Ocean
<i>Mobula tarapacana</i>	328	Eastern and western Atlantic Ocean, eastern and western Pacific Ocean, Indian Ocean
<i>Mobula mobular</i>	520	Mediterranean Sea, and possibly in the nearby north-east Atlantic Ocean, outside of the Mediterranean Sea must be considered uncertain for now

raises the possibility that previous descriptions of this species have been incomplete, or that these specimens are members of an unreported sub-species of *M. hypostoma* or even a new species within the *Mobula* genus that occur only in the Caribbean Sea.

The possibility of an unknown sub-species of *Mobula* occurring in the Caribbean Sea is intriguing in light of other recent discoveries. For example, Marshall *et al.* (2009) have proposed an endemic putative species (*Manta* sp. cf. *birostris*) for the Caribbean Sea and recommended further studies of its ecology and behaviour. Similarly, Nirchio *et al.* (2016) reported the presence of two sympatric and cryptic species of fishes for Margarita Island (Venezuela) based on cytogenetic and molecular studies. Similar tools might be used to resolve the questions raised by the three specimens reported here regarding the *Mobula* species in the western Atlantic Ocean.

Mobula hypostoma is catalogued as data deficient by the International Union for the Conservation of Nature (Bizzarro *et al.*, 2009). This concern for conserving rays was previously reflected by Mexico's prohibition on the capture and possession of live or dead *Mobula* spp. (entire or chopped parts) (Diario Oficial de la Federación SAGARPA, 2007). More recently, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) placed all species of *Mobula* on its Appendix II to ensure that international trade does not detrimentally affect their survival in the wild (CITES, 2016). Given such conservation concerns about *Mobula*, the historical and limited understanding of *M. hypostoma* needs to be addressed by collecting more specimens through a concentrated research effort and applying molecular techniques and in-depth morphometric studies to individuals collected from the centre of their distribution to resolve the uncertainties that surround them.

The authors are grateful to the artisanal fishermen of Playa La Pared for their help and patience in measuring this specimen that they caught. We are also very grateful for the helpful comments and suggestions made by the reviewers that improved this manuscript.

References

- Bancroft, E. N. (1831). Specimens were exhibited of several fishes, lately received from Dr. Bancroft of Kingston, Jamaica, Corr. Memb. Z. S. *Proceedings of the Committee of Science and Correspondence of the Zoological Society of London* **1830–31**, 134–135.
- Bigelow, H. B. & Schroeder, W. C. (1953). Sawfishes, guitarfishes, skates and rays. Fishes of the western North Atlantic. *Memoirs of the Sears Memorial Foundation for Marine Research* **1**, 1–514.
- Cervigón, F. (2011). *Los peces marinos de Venezuela Tomo 6*. Caracas: Fundacion Cientifica Los Roques.
- Cervigón, F. & Alcalá, A. (1999). *Los peces marinos de Venezuela Tomo 5*. Caracas: Fundacion Cientifica Los Roques.
- Coles, R. (1916). Natural history notes on the devil-fish, *Manta birostris* (Walbaum) and *Mobula olfersi* (Müller). *Bulletin of the American Museum of Natural History* **35**, 649–657.
- Cosseau, M. & Menni, R. (1983). *Mobula hypostoma* y *Kipphosus incisor* (Mobulidae y Kipphosidae) nuevas para la fauna argentina (Pisces). *Neotropica* **29**, 39–42.
- Couturier, L., Marshall, A., Jaïne, F., Kashiwagi, T., Pierce, S., Townsend, K., Weeks, S., Bennett, M. & Richardson, A. (2012). Biology, ecology and conservation of the Mobulidae. *Journal of Fish Biology* **80**, 1075–1119.
- De Boer, M., Saulino, J., Lewis, T. & Notarbartolo di Sciara, G. (2015). New records of whale shark (*Rhincodon typus*), giant manta ray (*Manta birostris*) and Chilean devil ray (*Mobula tarapacana*) for Suriname. *Marine Biodiversity Records* **8**, 1–8.
- Fowler, H. (1930). List of New Jersey fishes observed in 1929. *Fish Culturist (Philadelphia)* **9**, 115–117.

- Gadig, O. B. F., Namora, R. C. & dos Santos Motta, F. (2003). Occurrence of the bentfin devil ray, *Mobula thurstoni* (Chondrichthyes: Mobulidae), in the western Atlantic. *Journal of the Marine Biological Association of the United Kingdom* **83**, 869–870.
- Marshall, A., Compagno, L. & Bennet, M. (2009). Redescription of the genus *Manta* with resurrection of *Manta alfredi* (Krefft, 1868) (Chondrichthyes; Myliobatoidei; Mobulidae). *Zootaxa* **2301**, 1–28.
- McEachran, J. D. & Carvalho, M. R. (2002). Mobulidae. In *The living Marine Resources of the Western Central Atlantic. Vol. 1: Introduction, Molluscs, Crustaceans, Hagfishes, Sharks, Batoid Fishes And Chimaeras* (Carpenter, K. E., ed.), pp. 586–589. *FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and Herpetologists Special Publication No. 5*. Rome: FAO. Available at <http://www.fao.org/docrep/009/y4160e/y4160e00.htm/>
- Nirchio, M., Oliveira, C., Siccha-Ramirez, Z. R., Sene, V. F., Sánchez-Romero, O. R., Ehemann, N. R., Milana, V., Rossi, A. R. & Sola, L. (2016). Cryptic Caribbean species of *Scorpaena* (Actinopterygii: Scorpaeniformes) suggested by cytogenetic and molecular data. *Journal of Fish Biology* **89**, 1947–1957.
- Notarbartolo di Sciarra, G. (1987). A revisionary study of the genus *Mobula* Rafinesque, 1810 (Chondrichthyes: Mobulidae) with the description of a new species. *Zoological Journal of the Linnean Society* **91**, 1–91.
- Notarbartolo di Sciarra, G. (2016). Mobulidae. In *The living Marine Resources of the Eastern Central Atlantic. Volume 2: Bivalves, Gastropods, Hagfishes, Sharks, Batoid Fishes and Chimaeras* (Karpenter, K. E. & De Angelis, N., eds), pp. 1434–1440. *FAO Species Identification Guide or Fishery Purposes*. Rome: FAO. Available at <http://www.fao.org/3/a-i5712e.pdf/>
- Patella, R. & Bullard, S. (2013). Hexabothriids of devil rays (Mobulidae): new genus and species from gill of *Mobula hypostoma* in the northern Gulf of Mexico and redescription of a congener from *Mobula rochebrunei* in the eastern Atlantic Ocean. *Journal of Parasitology* **99**, 856–867.
- Robins, C. & Ray, G. (1986). *A Field Guide to Atlantic Coast Fishes of North America*. Boston, MA: Houghton Mifflin Company.
- Tagliafico, A., Rago, N. & Rangel, S. (2014). Length-weight relationships of 21 species of Elasmobranchii from Margarita Island, Venezuela. *Journal of Research in Biology* **4**, 1458–1464.

Electronic References

- Bizzarro, J., Smith, W., Baum, J., Domingo, A. & Menni, R. (2009). *Mobula hypostoma*. *IUCN Red List of Threatened Species* 2009. Available at www.iucnredlist.org/details/full/39418/0 (last accessed 12 December 2015).
- CITES (2016). *Convention on International Trade in Endangered Species of Wild Fauna and Flora*. Available at www.cites.org (last accessed 8 October 2016).
- Diario Oficial de la Federación SAGARPA (2007). *Norma Oficial Mexicana NOM-029-PESC-2006. Pesca responsable de tiburones y rayas. Especificaciones para su aprovechamiento*. SAGARPA 2007. Available at http://dof.gob.mx/nota_detalle.php?codigo=4962277&fecha=14/02/2007/ (last accessed 12 June 2015).
- Froese, R. & Pauly, D. (2016). *FishBase*. Worldwide Web Electronic Publication. Available at www.fishbase.org (last accessed 14 August 2016).
- Mejía-Falla, P. & Navia, A. F. (2011). *Guía para la identificación de especies del Programa de avistamiento de tiburones y rayas de la Reserva de Biosfera SEAFLOWER*. Bogotá: Fundación SQUALUS, Conservación Internacional. Available at www.academia.edu/3647563/Gu%C3%ADa_para_la_identificaci%C3%B3n_de_especies_del_Programa_de_Avistamiento_de_Tiburones_y_Rayas_Reserva_de_biosfera_SEAFLOWER.
- Navia, A. F. & Mejía-Falla, P. (2011). *Guía para la identificación de especies de tiburones y rayas comercializadas en el Pacífico Colombiano*. Bogotá: Fundación SQUALUS, Conservación Internacional. Available at www.academia.edu/2088429/Gu%C3%ADa_para_la_identificaci%C3%B3n_de_especies_de_tiburones_rayas_y_quimeras_

- de Colombia Identification guide of sharks rays and chimaeras species from Colombia.
- Navia, A. F. & Mejía-Falla, P. (2014). *Guía para la identificación de especies del programa de avistamiento de tiburones y rayas*, II edn. Bogota: Fundación SQUALUS, Conservación Internacional. Available at www.academia.edu/2088429/Gu%C3%ADa_para_la_identificaci%C3%B3n_de_especies_de_tiburones_rayas_y_quimeras_de_Colombia Identification guide of sharks rays and chimaeras SEAFOWER.
- Tobón-López, A., Bohórquez-Herrera, J., Tobón, M. & Bent-Hooker, H. (2011). Familia Myliobatidae. In *Guía para la identificación de especies de tiburones, rayas y quimeras de Colombia* (Mejía-Falla, P., Navia, A. F. & Puentes, V., eds), pp. 209–313. Bogota: Ministerio de Ambiente y Desarrollo Sostenible; Corporación para el Desarrollo Sostenible del Archipiélago de San Andrés, Providencia y Santa Catalina – CORALINA; Gobernación de San Andrés, Providencia y Santa Catalina, Fundación SQUALUS. Available at www.researchgate.net/publication/256657535_Familia_Myliobatidae_En_Guia_para_la_identificacion_de_especies_de_tiburones_rayas_y_quimeras_de_Colombia.