

FIRST RECORD OF *MOBULA JAPONICA*
(MÜLLER ET HENTLE),
A LITTLE KNOWN DEVIL RAY
FROM THE GULF OF THAILAND
(PISCES : MOBULIDAE)

Thosaporn Wongratana*

Abstract

A specimen of young *Mobula japonica* (Müller & Henle), measured 661 mm across wings, is here described together with a note on the sighting of 12 big specimens from Koh Chang, Trat Province, in the Gulf of Thailand. This is the first documentary report of the family Mobulidae for Thailand and of the species for the South China Sea. Previously, the species were occasionally recorded from Japan, Honolulu, Samoa, Korea and Taiwan waters. Its inferior mouth with a band of teeth in both jaws, the very long whip-like tail, and a prominent serrated caudal spine provide the main distinct characteristics and separate it from other related species. The full measurements of this young specimen and of the Naga Expedition's specimen of *Mobula diabolus* (Shaw), taken from Cambodian water, are also given.

Introduction

In order to update the knowledge of marine fish fauna of Thailand, regular observation of fish landing and occasional procurement of fish specimens are made at the Bangkok Wholesale Fish Market, operated by the Fish Marketing Organization of the Ministry of Agriculture and Cooperatives. On 4 December 1973, the author came across a young devil ray or sea devil, known in Thai "Pla rahu" (ปลาฉลาม). The fish measured 661 mm across the width. He has no hesitations to make a further look for other specimens. And this led him to spot other 8 big males and 3 females of about the same size. Other fishes, landed along with these interesting rays and probably taken in the same fishing ground, were 6 fairly large specimens of *Tetrapturus brevirostris* (Playfair), 3 baskets of *Sphyræna picuda* Bloch, and numerous medium-sized *Euthynnus affinis* (Cantor). Later, on 28 December, 1973, another

* Fisheries Biologist, Marine Fisheries Laboratory, Department of Fisheries, Bangkok, Thailand.

similar big female devil ray was seen and identified by the author at the market. These 12 adults devil rays ranged from 120-145 cm in widths and weighed about 45-65 kg. They are said to be captured from Ko (= island) Chang, Trat Province, in the Gulf of Thailand by gillnet fishermen. This finding aroused the author's interest considerably because many great efforts have been spent over years to collect this locally known "pla rahu" for identification.

However, the mentioned 12 big fishes or their parts could not be purchased for the museum and could not be identified right at the market; the only single young specimen could be purchased and was the basis of this study. It is now deposited in the Reference Collection of the Marine Fisheries Laboratory, Department of Fisheries, Bangkok.

The examination of the literatures for Thai-record of any devil ray of the family Mobulidae shows the lack of information of previous reports, and the alternation of the local Thai name. Upon reviewing the valid Indo-Pacific species, in addition to the author's notes on the account of the gross similarities or dissimilarities and the fresh color pattern of the mentioned big ones, the author found that they seemed to agree with most of the description of *Mobula japonica* (Müller & Henle). The present account will be included the measurements, and identification of this immature specimen of *M. japonica* in comparison to a little larger Naga Expedition's specimen of *M. diabolus* (Shaw) from Cambodian water (Pl. II, fig. 1) with a greater detail than the older account.

Although it has been known for a few decades that devil rays are occasionally seen in Thai waters and that the name "pla rahu" has long been given for the fish, the photographs, drawings, specimens and printed records of their occurrences are not available locally. This unexpected sighting represents the first substantiated record of the member of Mobulidae for Thailand and it confirms the occasional statements of the fishermen that "pla rahu" is present in the Gulf of Thailand. Curiously, the more detailed information given by those fishermen on the presence of caudal spine is in good agreement with the characteristic of the *M. japonica* (*M. mobular* of the Mediterranean and eastern Atlantic is also equipped with a caudal spine, but has a much shorter tail and isolated distribution).

The first printing reference, in which the name "pla rahu" was mentioned is the "Index to fishes of Siam", by Professor Chote Suvatti

in the year 1936. In that reference, however, the name is referred as a second Thai-vernacular name for a hammer-head shark, *Sphyrna blochi* (Cuvier). Nevertheless, this account was explained by him that it was according to the labelled card of the fish in the National Museum in Bangkok.¹ Twenty-three years later, SUVATTI (1959) again used this name for the same shark in his "Fauna of Thailand". Until recently, the Department of Fisheries, Bangkok, (ANON. 1971) used this local name for a fish of the family Mobulidae with a short description illustrated by a figure from a Japanese document.

Upon this study, Prof. Suvatti (personal communication) fully agreed with the author that "pla rahu" is the Thai name properly given to the ray which has remarkable characteristics of fleshy projection, a cephalic fin or ear horn on both sides of the head. This particular name was also promptly called for the mentioned fish by several fishermen, who also saw them at the market or the relevant photographs (Pl. I. figs. 1-2). Since *M. japonica* is similar in form and behavior to other widely distributed Mobulidae, the author feels that its other close relatives, especially *M. diabolus* (Shaw) and *Manta birostris* (Walbaum) which may occur also in Thai waters also shared the same vernacular name.

The news of the capture and examination of devil ray have been of considerable interests not only to the marine biologist but also to the fishermen. The young specimen of *M. japonica* has therefore been kept for displaying in a glass box and maintained at the Reference Collection of the Marine Fisheries Laboratory, Bangkok.

Accordingly, any further Thai specimens should be fully described and measured. Moreover, it must be recorded whether there are teeth in both jaws and mouth underneath (Genus *Mobula*) or teeth in lower jaw only and mouth terminal (Genus *Manta*), caudal spine present or absent and how long is the tail in proportion to the disc length.

Method of Measurements

The method of measurements and proportional studies of the body parts of the fish were made according to the standard procedures as outlined by FOWLER (1941), SCHULTZ *et al.* (1953) and APPLIGATE & FITCH (1964). The curved structures were measured across in line subtending

¹ This collection, as informed by Prof. Chote Suvatti, was donated to the U.S. National Museum about 35 years ago or after the departure of Dr. Hugh M. Smith from Thailand.

to greatest arches. However, in the table showing proportional measurements, it is rather dubious whether it is applicable to larger fishes, because the studied specimens probably have not yet reached their final proportion of ontogenetic development. While the above statement may still be open to arguments, there is no case problem in specific identification. Whereas, the presence of teeth bands in both jaws, the inferior mouth, the very long tail of about three and a half times body length and a caudal spine are their best distinguishing characteristics.

Distribution and Behavior

Fishes of the family Mobulidae date back to Tertiary times of South Carolina. Living forms are now distributed in all tropical and subtropical oceans, and particularly common along the shores of tropical America (NIKOLSKII, 1961). They are one of the extremes in development among Batoidei (FOWLER, 1930) and representing the broadest of all fishes.

There are only two valid genera in the same family, the great manta ray or *Manta* Bancroft, and the little devil fish or *Mobula* Rafinesque. The genus *Mobula* comprises almost a dozen species, and the number of the valid species is uncertain. However, several have been described and recognized from the adjacent seas of the Thai territories. *M. diabolus* (Syn. *M. eregoodootenkee* or *M. kuhlii*) from Indian Ocean to East Indies, Japan and Queensland grows to 18 feet wide; it is the largest and commonest species of this genus through the literature. The second species is *M. japonica* ranging from Japan, Hawaii, Korea, Samoa, Taiwan and the Gulf of Thailand. It reportedly grows to at least 8 feet in width. The third valid species is *M. formosa* from Taiwan. The collection of an immature and the sight of 12 big specimens of *M. japonica* represented the first scientific report of the occurrence of this species in the Gulf of Thailand, and at the same time, its known distributional range extends to east of 102° Longitude.

All Mobulidae, however, are specialized in their feeding habit and movement. It is believed that they feed by rushing at schools of planktons and small fishes; during which time, the cephalic fins are moved and used to funnel and scoop plankton into the mouth. Some-

times, they drive the preys toward shallow water near the shore and may even beach themselves temporarily in their vigorous feeding rushes. It is said that although the fishes of this group are plankton feeders but sometimes they take the bite on bait, and put up a spectacular fight. Hence, they are regarded as one of the famous game fishes in several regions of the world.

It was revealed by some fishermen from Chon Buri Province as well as from other places on the east coast of the Gulf that about 20-30 years ago they occasionally caught "pla rahu" in great numbers by bamboo stake traps. Since the drag-net fishing were introduced into Thai fisheries a few decades ago, the population of this fish has greatly diminished, and it is now rarely seen. It has also been observed that the females having faetus are seldom seen. Regarding the reproduction, it is known that all members of this group of ray are ovo-viviparous and would produce only a single baby at one season (NIKOLSKII, 1961; and some other authors). However, the author has been informed that the fish delivered more than one baby at one pregnancy. Such happenings occurred when the pregnant rahu was caught and left on board.

Regarding the fish's movement behavior, it is also worthwhile and very interesting to learn from the communicated fishermen that they have neither known nor seen the rahu leaping out of water. Whereas in relevant literatures devil rays were reported to leap clear out of the water and some leaped only partly above the water surface. This is therefore questionable: Does *M. japonica* leap or produce only one baby at one pregnancy?

Mr. Anong Wongvian, age 46, the Captain of our research trawling M.V. Pramong 2, who has seen the rahu fish in the Gulf of Thailand, told the author that, the fish would move and rush just above the bottom surface and feed by scooping on small organisms. This exciting experience was gained while he was catching euphausiids (krills) in very shallow waters for making home-made fish paste, near Ban Phe Marine Fisheries Station in Rayong Province of the east coast of the Gulf of Thailand. He added that the fish was sometimes caught by set-lines with barbless hooks, purposely for catching sting rays. And about 5 years ago, during his official trip at sea off Prachuap Khiri Khan Province,

on the west side of the Gulf, he also observed a rahu fish feeding near the water surface.

Hence, the occurrence of the adult and young specimens of rahu or *M. japonica* in the region, especially along the east coast of the Gulf, might not be uncommon in those days and now it is only very occasionally netted.

Forklore or Socio-belief

Etymologically the name "Rahu" has its origin from Sanskrit, and is applied to a half-bodied Hindu raksa or demon who, in the course of swallowing the moon, caused the lunar eclipses. Astronomically, "Rahu" is the other name for the Planet Earth in Thai. In calling "rahu" for *M. japonica* or apparently the other members of the same family, some fishermen gave the reason that the fish has the fleshy "horns" or "earhorns" that resemble to those of the mythological Hindu demon; this understanding is also given by two European marine biologists, RAY & CIAMPI (1958, p. 174). They recognized the devil rays as follows: "Devilfishes are easily identified by the large cephalic fins that look like devil's horns on either side of the mouth." Correspondingly, according to the mythological study, the drawing of imagined "rahu" has a pair of characteristic big and long "ears" (ศัลวิธานนิเทศ, 1973), and resemble to the so-called "horn" (Pl. II, fig. 2).

As far as this name is concerned, it is also mythologically known that "Rahu" and his escort are dressed in black costumes which correspond (personal idea) to the black colour of the back of all the known devil rays or mantas. Because of their weird appearance and great size fishermen regard them with fear and believe that they are ferocious and cunning, though they are actually quite mild and non-aggressive.

Additionally, in the study of astrology so far widely believed by many Thais and Chinese, "Rahu" is a god that sometimes brings bad luck. Besides, it was told and believed by the old maritime people of this country that the catch of this fish always thereafter causes the absolute fall of the business or happiness of that fishermen. So the fishes were thrown away when they occurred in their catch during those days, like dolphin or dorado, *Coryphaena hippurus* (Linnaeus), zebra shark,

Stegostoma fasciatum (Hermann) and also specimens of swordfish, marlin and sailfish of the families Istiophoridae and Xiphiidae. Such belief was the cause of the absence of the specimens in local markets in the past, besides their huge size that cause a lot of trouble in transportation or preserving. Meanwhile, at the present days, this superstition is minimized and all the said fishes are landed from time to time for making fish-balls or dried and salted products.

MOBULA Rafinesque, 1810

Mobula japonica (Müller & Henle), 1841

(Pl. I, figs. 1 & 2)

Diagnosis: *Mobula japonica* is the most easily distinguished member of the genus, it is differentiated from *M. diabolus* and *M. formosa* of the Indo-Pacific and Taiwan waters respectively, by the presence of caudal spine and the extremely long tail which is more than twice the length of disc.

Colour on back generally dark in adults. An immature specimen from the Gulf of Thailand shows a contrasted white saddle bar on nape and a paler blotch on middle of either side of pectorals. These white markings have never been reported for any recorded individual of *Mobula*.

Description: *Disc* very broad, wing tips narrowly pointed, its length when measured from the median concavity of snout to hind pectoral edge twice in its width or 3.5 times in tail; along middle of the back with a low keel; depth at last pair of gillslits greatest and 4.5 times in disc length. *Head* thick, notably and broadly depressed and free from pectorals, its width at behind eyes slightly shorter than its length including branchial part or 2.4 times in disc length; length to first gill opening 4 times in disc length or 1.6 times in its own width; between spiracles and eyes with a low V-shaped ridge (Pl. I, fig. 1) diverging anteriorly towards each side of snout. *Snout* wedge-shaped, dorsoventrally, very broadly concave as seen from above and adjoined to the rostral or cephalic fins of both sides of head. *Cephalic fins* thin, leaf-like; base directed forward and obliquely downward but rolled from below outward in a subcylindrical roll; ventral edge length approximately

twice in width or equal to distance between both lobes or only slightly greater than its length from anterior eye margin which is 0.65 time in head length to first gill opening. *Eyes* prominent, lateral, hind edge with inwardly arising skin to form a somewhat low eyelid; vertical eye diameter 13 times in interorbital and little shorter than its horizontal diameter. *Mouth* inferior, wide, straight and as long as head or almost 4 times in disc length, or 7.6 times in greatest disc width; flaps above jaws not fringed. *Teeth* very small, numerous, blunt tubercles, arranging in bands and extending almost to mouth angle in both jaws; teeth bands comprise 128 transverse series in upper jaw and 120 rows in lower jaw (compared to FOWLER, 1941 in giving only 84 rows above and 101 rows below for an incomplete Honolulu specimen), at anterior edge of bands teeth not so concentric as those on inner posterior edge; pavement of teeth on lower jaw lying along front edge of lower lip. *Interorbital* widely depressed, with a low ridge on each side. *Nostrils* largely hidden posteriorly by a produced lobe of a fleshy flap of the upper lip (Pl. I, fig. 2). *Internarial space* somewhat less than width of mouth or equal to half length of interorbital space. *Gill openings* large, second and third largest and 2.16-5.25 times in interorbital respectively, last smallest 1.6 times of the third; equidistant. *Spiracles* small but prominent and clearly seen from above, aperture somewhat transverse, situated above front of pectoral and below ridge in a short groove.

Skin on back largely smooth especially near edge of disc and on head, the rest part or middle of back and hinder portion of body concentrated with very tiny rough tubercles or asperities of which longitudinally arranged to the axis of body, under surface smooth; in the much larger individuals, these tubercles occupy much greater area and largely intermediated with numerous tiny apertures, the latter also observable on the under surface especially at the region between gill slits and cloaca. *Tail* rounded, extremely long and very slender, 3.5 times length of body but shorter with growth; with a series of small white tubercles along each side. *Caudal spine* present, inserted directly behind dorsal fin, single, stout, serrate, side barbs form a continuous outer edge through its length.

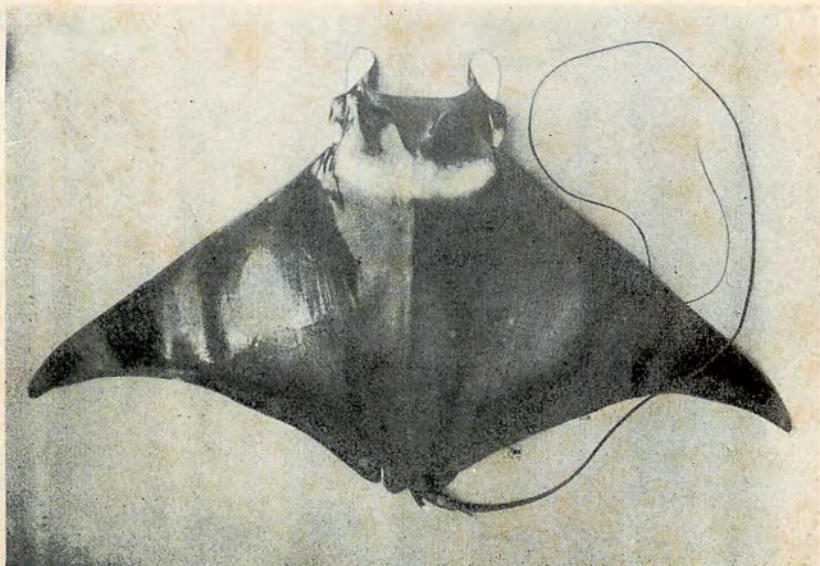


Figure 1. Dorsal aspect of the immature specimen of *Mobula japonica* (Müller & Henle), 661 mm. across width, from Ko Chang, Gulf of Thailand, via Bangkok Wholesale Fish Market, on December 4, 1973.

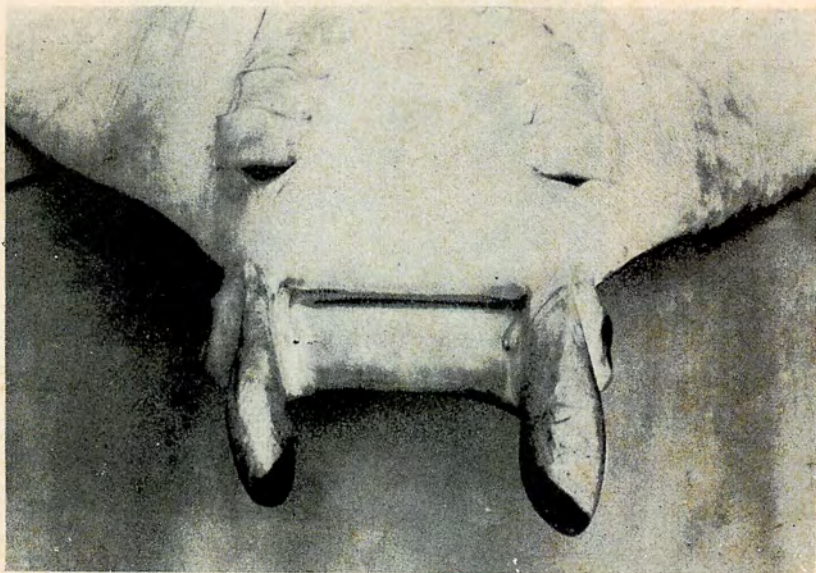


Figure 2. Ventral aspect of the head of *Mobula japonica* (Müller & Henle), same specimen of the figure 1. Upper jaw teethband is observable from this photograph (dark streak).

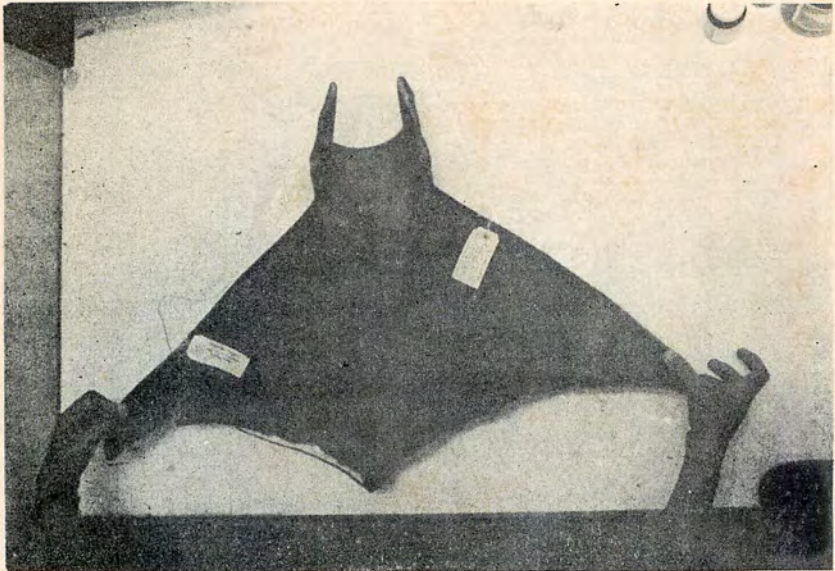


Figure 1. Dorsal aspect of *Mobula diabolus* (Shaw), 755 mm. across width; Naga Expedition's specimen no. 2558, from W.S.W. Ko Samet Gulf of Thailand, Cambodia, on May 3-6, 1961.



Figure 2. Mythological "Rahu" of Thailand, after ศลวิธานนิเทศ (1973) in Thai Junior Encyclopaedia, I, by Royal Command of H.M. the King.

Dorsal fin single, originated a little in advance of the beginning of pelvic or just above end of cloaca, its base extending as far backward as the terminations of pectorals or pelvics, triangular in shape, its tip rounded, anterior edge straight, posterior edge short and slightly concave, posterior free margin extremely short. *Pelvics* (♀) small, inserted at space between pectoral and caudal fin bases; posterior edge somewhat truncate, outer edge convex, inner edge concave; pelvics of much larger fishes straight in profiles laterally, and more or less rounded posteriorly. *Claspers* in large male fishes short but very stout. *Pectorals* falcate, forming a wide disc, triangular, much wider than long not continuous at the sides of head; front margins almost straight and slope to a point distally at an angle of approximately 25-27 degree.

Colour when fresh: Dorsal surface of the studied specimen steel blue on back, the under side purely white. Behind the root of V-shaped ridge on head or across the nape of the neck with a conspicuous crescentic white patch or white "saddle", its both lateral ends curve and terminating at the upper edges of both spiracles. This marking is obsolete in much larger fishes to be seen at the Bangkok Wholesale Fish Market. On the middle portion of either side of the pectorals greatly marked with a large paler blotch, and on this paler area there longitudinally striated with series of contrasting darker streaks. Dorsal, caudal, upper surface of pelvics, regions at above and around eyes, and front edge of snout dark. Tip of dorsal of all seen specimens and outer edges of pelvics white. Inferior edge of lower lip and inner surface of the cephalic fins dusky black in young, in much bigger specimens whitish; superiorly inner surface of the cephalic fins deep black and this is more distinctive in the young fish, their outer surface creamy white.

Table 1. Measurements of body parts (mm.) and their proportions expressed in percent of extreme disc width (EW.) of *Mobula japonica* (Müller & Henle) from Ko Chang, Thailand, in comparison with *M. diabolus* (Shaw) from Cambodia, both in the Gulf of Thailand.

Characters	<i>M. japonica</i>		<i>M. diabolus</i>	
	measurements mm.	proportions % EW.	measurements mm.	proportions % EW.
Extremely disc width (EW.)	661.0	—	755.0	—
Greatest depth	73.0	11.04	71.0	9.40
Tail : length (from posterior insertion of pelvics)	114.0	17.25	59.4	7.87
: its greatest base width	15.4	2.33	13.8	1.83
Middle of snout to: tip of tail	1458.0	220.57	987.0	130.72
: rear end of pectoral (= disc length)	327.0	49.47	429.0	56.82
: centre of cloaca	291.0	44.02	—	—
: dorsal origin	299.0	45.23	360.0	47.68
: pectoral acute tip, right/left	414.0/422.0	62.63/63.84	507.0/504.0	67.15/66.75
: mouth	29.0	4.39	40.7	5.39
: line between posterior parts of first pair of gill clefts	83.0	12.56	110.5	14.63
: line between posterior parts of last pair of gill clefts	150.0	22.69	199.0	26.35
Width across head (at behind eyes)	131.6	19.90	147.0	19.47
Rictus to : nostrils, right/left	17.8/19.0	2.70/ 2.87	29.3/ 29.5	3.88/ 3.81
: tips of cephalic lobes, right/left	80.3/78.8	12.15/11.92	128.0/128.0	16.95/16.95
: inner edge of first gill cleft, right/left	45.2/44.0	6.84/ 6.66	62.0/ 61.0	8.21/ 8.08
: inner edge of last gill cleft, right/left	111.6/111.2	16.88/16.82	150.0/151.0	19.86/20.00
Cephalic lobes : length (of ventral edge), right/left	69.0/69.0	10.44/10.44	96.0/ 95.3	12.71/12.62
: length (from eyes), right/left	79.0/81.5	11.95/12.33	— /126.0	— /16.68
: width (obliquely across base), right/left	56.0/53.5	8.47/ 8.09	— / 78.0	— /10.33
: greatest transverse width, right/left	41.0/42.0	6.20/ 6.35	— / 46.3	— / 6.13
: distance between	81.7	12.36	99.6	13.19

Interorbital width	144.0	21.78	144.0	19.07
Eye diameter : horizontal right/left	13.9/13.9	2.10/2.10	— / 14.0	— / 1.85
: vertical, right/left	11.0/11.0	1.66/1.66	— / 14.5	— / 1.92
Nostrils : widest dimension of aperture, right/left	14.5/14.0	2.19/2.12	—	—
: distance between	72.5	10.97	75.8	10.04
Spiracles : widest dimension, right/left	10.0/10.8	1.51/1.63	— / 5.0	— / 0.66
: distance between	116.9	17.68	126.5	19.13
Breadth of mouth	87.0	13.16	90.0	11.92
Upper jaw teeth band : width/length	5.5/65.5	0.83/9.91	— / 67.0	— / 8.87
Lower jaw teeth band : width/length	4.5/61.0	0.68/9.23	— / 70.0	— / 9.27
Length of gill opening: 1st., right/left	35.5/36.9	5.37/5.58	37.5/ 39.5	4.97/ 5.23
: 2nd., right/left	38.7/40.2	5.85/6.08	41.0/ 41.0	5.43/ 5.43
: 3rd., right/left	39.1/40.9	5.91/6.12	42.5/ 43.0	5.63/ 5.69
: 4th., right/left	37.5/37.4	5.67/5.66	39.6/ 41.4	5.24/ 5.48
: 5th., right/left	25.9/25.9	3.92/3.92	28.5/ 28.8	3.77/ 3.81
Width between outer edge of paired gill cleft : 1st.	145.5	22.01	166.0	21.98
: 5th.	84.8	12.83	89.8	11.89
Outer edge of first gill cleft to last gill cleft, right/left	75.7/74.0	11.45/11.19	98.5/ 97.3	13.05/12.89
Inner edge of first gill cleft to last gill cleft, right/left	70.0/69.8	10.59/10.56	90.4/ 92.5	11.97/12.25
Dorsal fin : base	30.5	4.61	51.5	6.82
: anterior margin	41.9	6.34	53.8	7.12
: superior margin	21.0	3.18	36.0	4.77
: free rare margin	2.6	0.39	6.5	0.86
Length of dorsal spine	34.0+ ? (broken)	—	spine absent	—
Pectorals : distance from axil to axil	135.0	20.42	141.7	18.76
: anterior margin, right/left	339.0/341.0	51.28/51.58	470.0/420.0	62.25/55.63
: posterior margin, right/left	311.0/313.0	47.04/47.35	390.0/378.0	51.65/50.06
Pelvics : outer edge of base to transverse distal tips, right/left	33.3/ 30.0	5.04/ 4.54	53.3/ 52.0	7.06/ 6.89
: distance between	21.1	3.19	11.0	1.46
: least breadth, right/left	16.5/ 17.6	2.45/ 2.66	20.0/ 18.9	2.65/ 2.50

Remarks : In *M. diabolus*, teeth longer than broad, close-set and pavement-like; tail without tubercles; angle of distal point of pectoral approx. 37°; color on back totally black.

Acknowledgement

The author is grateful to Professor Dr. Boon Indrambarya in kindly reading the draft of this report, and to Dr. Deb Menasveta of the Department of Fisheries, Ministry of Agriculture and Cooperatives, Bangkok, for his review of the manuscript before editorial procedure. His sincerest thanks are also due to Professor Dr. Chote Suvatti and Mr. Anong Wongvian in contributing some useful informations to this paper; and to Miss Sunee Kruthanut of the Centre for Thai National Reference Collection (CTNRC), Bangkok, for allowing the author to examine the Cambodian specimen of *Mobula kuhlii* (Müller & Henle) of the Naga Expedition. Mr. Siri Timkrab, the author's assistant, was particularly helpful in typing the manuscript.

References

- APPLEGATE, S.P. and J.E. FITCH. 1964. A new species of eagle ray *Myliobatis longirostris*, from Baja California, Mexico. *California fish and Game*, **50** (3): 189-194.
- BIGELOW, H.B. and W.C. SCHROEDER. 1953. *Fishes of the Western Atlantic, Part 2, Sawfishes, Guitarfishes, Skates and Rays*. Bianco Luno's Printing, Copenhagen.
- CHEN, J.T.F. and I-Heng CHANG. 1971. A review of rays and sharks or Batoidea of Taiwan. *Biol. Bull.* **40**:50-51. Dept. Biol., Coll. Sci., Tunghai Univ., Taiwan.
- FOWLER, H.W. 1930. A list of the sharks and rays of the Pacific Ocean. *Proc. 4th (1929) Pacific Sci. Congr., Java*, pp. 481-508.
1941. Contributions to the biology of the Philippines archipelago and adjacent regions. *Bull. U.S. Nat. Mus.* **13** : 478-480.
- GARMAN, S. 1913. The plagiostomia (sharks, skates and rays). *Mem. Mus. Comp. Zool.* **36** : 449-451.
- GOSLINE, W.A. and V.E. BROCK. 1965. *Handbook of Hawaiian fishes*. Univ. of Hawaii Press, Honolulu, pp. 93-94.
- GÜNTHER, A. 1870. Catalogue of the Acanthopterygian fishes in the collection of the British Museum. **8** : 496.
- JORDAN, D.S. and A. SEALE. 1905. The fishes of Samoa. *Bull. U.S. Bur. Fish.* **25** : 185.

- JORDAN, D.S. and B.W. EVERMANN. 1905. The aquatic resources of the Hawaiian Islands, part 1, The shore fishes. Bull. U.S. Fish. Comm. **23** : 50-51.
- JORDAN, D.S. and H.W. FOWLER, 1903. A review of the Elasmobranchiate fishes of Japan. Proc. U.S. Nat. Mus. **26** (1324) : 665-666.
- LINDBERG, G.U. and M.I. LEGEZA. 1967. Fishes of the sea of Japan and the adjacent areas of the sea of Okhotsk and the Yellow Sea, part 1. Israel Program for Scientific Translation, Jerusalem, pp. 154-155.
- NIKOLSKII, G.V. 1961. Special ichthyology. Israel Program for Scientific Translation, Jerusalem, p. 68.
- RAY, C. and E. CIAMPI. 1958. The underwater guide to marine life. Nicholas Kaye Limited, London, pp. 174-176.
- SCHULTZ, L.P. *et al.* 1953. Fishes of Marshall and Marianas Islands. Bull. U.S. Nat. Mus. **202** (1) : 20-22.
- SUVATTI, C. 1936. Index to fishes of Siam. Bur. Fisheries, Bangkok, p. 3.
1950. Fauna of Thailand. Dept. Fisheries, Bangkok, p. 183.
- ศัลยนิเทศ, พระยา. 2516, (A.D. 1973). อุปราคา, ใน สารานุกรมไทยสำหรับเยาวชน, เล่ม 1, โดยพระราชประสงค์ของพระบาทสมเด็จพระเจ้าอยู่หัว. โรงพิมพ์คุรุสภา ลาดพร้าว, หน้า 23.
- หน่วยสำรวจแหล่งประมง, กรมประมง. 2514, (A.D. 1971). สัตว์ทะเลเป็นภัยต่อชีวิต. โรงพิมพ์เอกสารการพิมพ์, พระนคร, หน้า 32 และ 111.

