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A specimen of megamouth shark, *Megachasma pelagios* (Megachasmidae) from Western Australia.

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Introduction

On 18 August 1988 the Fisheries Inspector at Mandurah contacted the second author to report that a large, strange-looking sharklike beast had washed ashore near the entrance to Mandurah estuary (32°31'S, 115°43'E). Upon inspection two hours later, the identification as *Megachasma pelagios* Taylor, Compagno, and Struhsaker 1983 was confirmed (Figure 1), this being the third known specimen of the species, and the first from the Indian Ocean. Surfboard riders reported sighting the shark the previous day in shallow water. Believing it to be a small whale intent on beaching itself, they had tried to coax it into deeper water. However, the following morning it was stranded by a receding tide, and although still alive when found, died soon afterwards. The 5.15 m long shark was transported to Perth, snap-frozen, and subsequently preserved in formalin, details of which are presented below.

The first specimen of this shark, subsequently described as a new species, genus, and family, was collected on 15 November 1976 about 42 km northeast of Kahuku Point, Oahu, Hawaii (approximately 21°51'N, 157°46'W). The 4.46 m male was entangled in a large parachute used as a sea anchor by a U.S. Navy research vessel at a depth of 165 m over water 4,600 m deep. The shark, weighing 750 kg, appeared to be a filter feeder as its stomach contained a large quantity of the euphausid *Thysanopoda pectinata*. This individual was referred to by its captors as "megamouth" because of its large cavernous mouth.

The second specimen of *Megachasma pelagios* was caught on 29 November 1984 in a gill net set no deeper than 38 m at a distance of 14 km off the east end of Santa Catalina Island, California (approximately 33°25'N, 118°25'W) (Lavenberg and Seigel 1985). The shark, a male of 4.5 m and estimated to weigh 700 kg, was still alive when found. Stomach contents included fragments of euphausids, copepods, and the jellyfish *Atolla vanhoeffeni*. The preserved specimen is on display at the Natural History Museum of Los Angeles County, Los Angeles, California.

While the present paper was in preparation, a fourth specimen of megamouth shark washed ashore at Hamamatsu, Japan (34°42'N, 137°42'E) on 23 January 1989 (Nakaya 1989). The specimen was photographed, but before it could be saved, washed back out to sea. The photographs revealed that it was a male approximately 4 m long.

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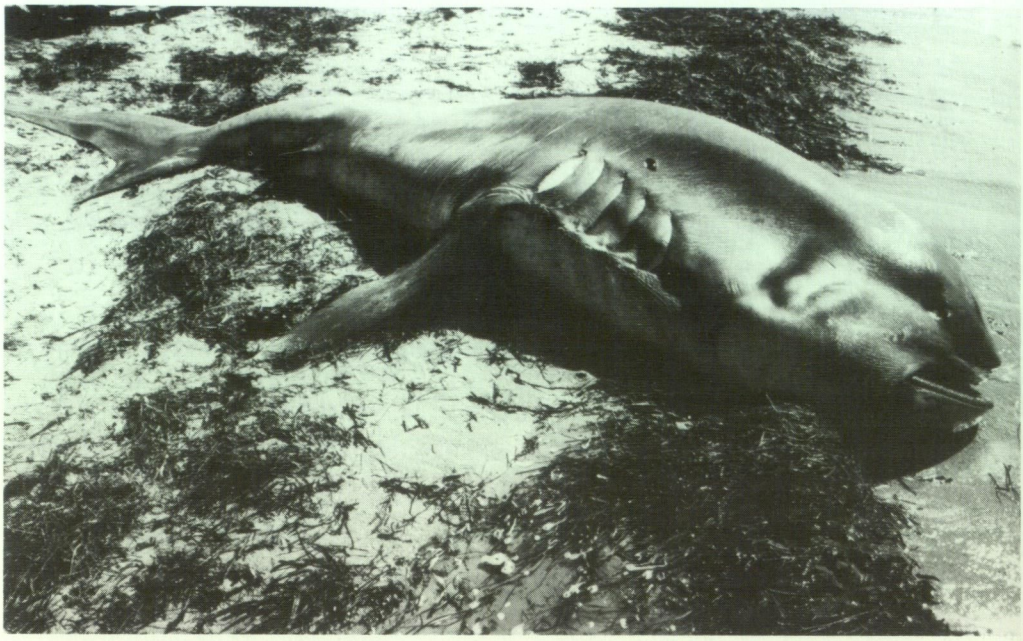

Figure 1. The Western Australian specimen of *Megachasma pelagios* (WAM P. 29940-001) shortly after it washed ashore at Mandurah on 18 August 1988. Note the possible cookiecutter shark crater wound above the gill slits.

Preservation of Megamouth III

The beached shark was rolled onto concrete reinforcing wire mesh, lifted by frontend loader onto a truck, and transported to a deepfreeze in Perth where it was snap frozen later that afternoon. Because of the public interest in its capture, the shark was displayed three days later. The still frozen megamouth was placed on a flatbed trailer, and moved to a shaded parking lot at the Western Australian Museum. After three hours of viewing by the public, the shark was returned to the freezer. During these moves, the wire mesh was replaced by a canvas sling, and two samples of tissue from inside the mouth were removed for future study (one was stored in Bouin's solution, and the other refrigerated in modified Karnovskii's solution). It was also weighed at a public weighing station which indicated a weight of 690 kg (± 20 kg).

In order to accommodate the specimen for fixation, a large coffin-shaped pit (approximately 6.5 m x 3 m) was dug in sandy soil, padded with cardboard, and lined with a double layer of 0.2 mm swimming pool plastic liner. The hole was filled with water and the frozen specimen lifted by crane into the hole where it thawed over a weekend. About half the water was then pumped out to facilitate the rolling of the shark for measuring. Seventy-three measurements were made as described in Compagno (1984: 10-12) (Table 1).

Table 1. Measurements in millimetres and proportions as percentages of total length of the Western Australian specimen of *Megachasma pelagios* compared with the holotype's measurements as given by Taylor, Compagno, and Struhsaker (1983). Measurements of the Californian specimen have not been published. Measurements follow Compagno (1984: 10-12).

Character	Holotype		WAM P.29940-001	
	mm	%TL	mm	%TL
Total length	4460		5150	
Precaudal length	3090	69.3	3430	66.6
Prenarial length	100	2.2	105	2.0
Preoral length	66	1.5	60	1.2
Preorbital length	240	5.4	350	6.8
Prespiracular length	450	10.1	935	18.2
Prebranchial length	850	19.1	1090	21.2
Head length	1180	26.5	1320	25.6
Prepectoral length	1110	24.9	1390	27.0
Prepelvic length	2270	50.9	2510	48.7
Vent-caudal length	2165	48.5	2450	47.6
Pre-first dorsal length	1540	34.5	1670	32.4
Pre-second dorsal length	2530	56.7	2720	52.8
Interdorsal space	625	14.0	640	12.4
Dorsal-caudal space	395	8.9	430	8.4
Pelvic-anal space	330	7.4	370	7.2
Anal-caudal space	230	5.2	215	4.2
Eye length	56	1.3	60	1.2
Eye height	54	1.2	40	0.8
Interorbital space	370	8.3	550	10.7
Nostril width	30	0.7	30	0.6
Internarial space	340	7.6	400	7.7
Anterior nasal flap length			7	0.1
Mouth length	273	6.1	450	8.7
Mouth width	827	18.5	580	11.3
First gill slit height	265	5.9	220	4.3
Second gill slit height	258	5.8	225	4.4
Third gill slit height	264	5.9	225	4.4
Fourth gill slit height	256	5.7	210	4.1
Fifth gill slit height	234	5.2	200	3.9
Caudal peduncle height	237	5.3	280	5.4
Girth	1800	40.4	1790	34.8
Pectoral anterior margin	837	18.8	990	19.2
Pectoral base	262	5.9	330	6.4
Pectoral height			870	16.9
Pelvic anterior margin	264	5.9	330	6.4
Pelvic base	207	4.6	320	6.2
Pelvic height	255	5.7	185	3.6
Pelvic inner margin length	38	0.8	35	0.7
Pelvic posterior margin length	181	4.1	195	3.8
Clasper outer length	355	8.0	360	7.0
Clasper inner length	550	12.3	560	10.9

Table 1. (continued)

Character	Holotype		WAM P.29940-001	
	mm	%TL	mm	%TL
Clasper base width	47	1.1	70	1.4
First dorsal anterior margin	415	9.3	280	5.4
First dorsal base	404	9.1	500	9.7
First dorsal height	226	5.1	250	4.9
First dorsal inner margin	82	1.8	80	1.6
First dorsal posterior margin	265	5.9	295	5.7
Second dorsal anterior margin	198	4.4	240	4.7
Second dorsal base	191	4.3	255	5.0
Second dorsal height	104	2.3	100	1.9
Second dorsal inner margin	80	1.8	75	1.5
Second dorsal posterior margin	158	3.5	155	3.0
Anal length	226	5.1	145	2.8
Anal anterior margin	196	4.4	155	3.0
Anal base	159	3.6	80	1.6
Anal height	78	1.7	80	1.6
Anal inner margin	67	1.5	65	1.3
Anal posterior margin	80	1.8	85	1.7
Dorsal caudal margin	1443	32.3	1730	33.6
Preventral caudal margin	625	14.0	720	14.0
Lower postventral caudal margin	377	8.5	430	8.4
Upper postventral caudal margin	1220	27.4	1210	23.5
Terminal caudal margin	96	2.2	105	2.0
Caudal fork length			480	9.3
Subocular pocket depth			40	0.8
Second dorsal origin-anal origin			415	8.1
Intergill length			320	6.2
Abdomen height			640	12.4
Tail height			420	8.2
Pelvic-caudal space			715	13.9
Caudal fork width			450	8.7
Subterminal caudal margin			85	1.7

The body musculature of the specimen was injected with about 20 l of approximately 30% formalin (12% formaldehyde solution) via 130 mm long needles of 2 mm diameter attached to 20 ml syringes. A long 1300 mm needle of 10 mm diameter was used to pump 40 l of about 50% formalin deep into the body and the body cavity.

The pit was then drained and clean fresh water added to cover the shark by about 30 cm. The volume of water in the hole was crudely estimated by the flow rate and time. It was calculated that 1,660 l of concentrated formalin (40% formaldehyde solution) would be needed to produce a 10% formalin mixture. The preserving solution was analyzed shortly after, and tested at 8.25% formalin. Two months later, it had dropped to 4.25% formalin, but after the addition of another 400 l of concentrated formalin, the solution tested at 11.75% formalin.

At present, the specimen is still in the covered, formalin-filled pit awaiting construction of a permanent display tank.

Remarks

The new family Megachasmidae was erected by Taylor, Compagno, and Struhsaker (1983) within the order Lamniformes. However, Maisey (1985) suggested that *Megachasma* is the primitive sister group of all other extant lamniforms based upon similarities in jaw suspension and dental array. He concluded that *Megachasma* and *Cetorhinus*, the Basking Shark, form a monophyletic group of specialised filter-feeding lamniforms that could be included in the Cetorhinidae. He furthermore considered the Cetorhinidae to be the sister group of the Alopiidae (thresher sharks) plus the Lamnidae (makos and pointers). We prefer to tentatively retain the Megachasmidae as a distinct family until a more thorough investigation of the phylogeny of lamniform sharks has been completed.

The Western Australian megamouth specimen has a small circular craterlike wound just above gill slits 2-3 on the right hand side (Figure 1). Taylor, Compagno and Struhsaker (1983) reported similar scars on the throat and behind the right pectoral fin on the holotype of *Megachasma pelagios*. They suggested that these scars represent bite marks of the ectoparasitic cookiecutter shark, *Isistius brasiliensis*, which is known to attack fishes and whales (Jones 1971). The apparently slow swimming speed of megamouth would make it an easy target for the active cookiecutter shark (Diamond 1985).

The measurements made on the Western Australian specimen were compared with the same measurements from the holotype (Taylor, Compagno, and Struhsaker 1983) (see Table 1). The values for most characters are similar in both specimens, but some are quite different. A variety of factors could be responsible for these differences, including individual variation, the position in which the animal was laying, the easily deformed soft flesh, and its state of preservation.

Megachasma pelagios is now known from the central, eastern, and western Pacific Ocean and the western Indian Ocean. All four specimens have appeared in winter months, and all four were male. It is probable that this species, like other gigantic filter-feeding sharks, is wide ranging, and perhaps Atlantic specimens will eventually be found.

Acknowledgements

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