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Description of a juvenile megamouth shark, *Megachasma pelagios*, caught off Brazil

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Synopsis

A juvenile male megamouth shark was caught by a commercial longline vessel off Brazil. This specimen is the only juvenile megamouth examined and the only one from the Atlantic Ocean. Megamouth shark is one of the rarest sharks in the world. Only 14 specimens have been reported since its description in 1983 by Taylor et al. All previous specimens examined have been adults from the Pacific and Indian Oceans. It appears that the species is cosmopolitan.

Introduction

A juvenile megamouth shark was accidentally caught by the Brazilian longline vessel 'Tooshin Maru 106' off southern Brazil (27°08′S–43°55′W) on 18 September 1995 (Amorim[1]). The specimen, a male measuring 190 cm in total length (144.8 cm fork length) and weighing 24.4 kg, was hooked in the mouth at depth of 15–40 m over water approximately 1400 m deep. The specimen was recognized as unusual and donated by Hiromi Ishikawa to the Instituto de Pesca in Santos, Brazil. While in the vessel the specimen was kept on ice and was in excellent condition after the vessel arrived in port four days later.

The specimen was measured, weighed, and the body cavity was opened. Stomach contents were inspected and discarded at that time. The specimen was then placed in a formalin tank at the Instituto de Pesca where it remained until removed for this study on 6 August 1997. At that time we noticed that the formalin had penetrated little, but in spite of the poor penetration, the specimen was in fairly good condition on that date. The specimen was very flexible, and all body parts could be moved easily. Coloration was remarkably preserved based on a comparison with photographs taken when the animal was received at the Instituto. Most of the accompanying photographs were taken at the time of inspection by the junior author in August 1997.

Material and methods

The specimen was stored in a very large formalin container following preservation. Total length was measured on a horizontal line between perpendiculars, with the tail at its maximum extension in line with the body axis. Other fin measurements were taken with calipers. Photographs were taken on Fujichrome Velvia film.

Results

The specimen is an immature male 190 cm TL (144.8 cm FL), weighing 24.4 kg. It has a tadpole-like,

[1] Amorim, A.F., L. Fagundes, C.A. Arfelli & F.E.S. Costa. 1995. Occurrence of megamouth shark, Megachasma pelagios Taylor, Compagno & Struhsaker, 1983, in the Atlantic. p. 17. *In*: VII Reunião do Grupo de Trabalho sobre Pesca e Pesquisa de Tubarões e Raias no Brasil, 20–24, Nov., Rio Grande, 1995. Programa e Resumos.

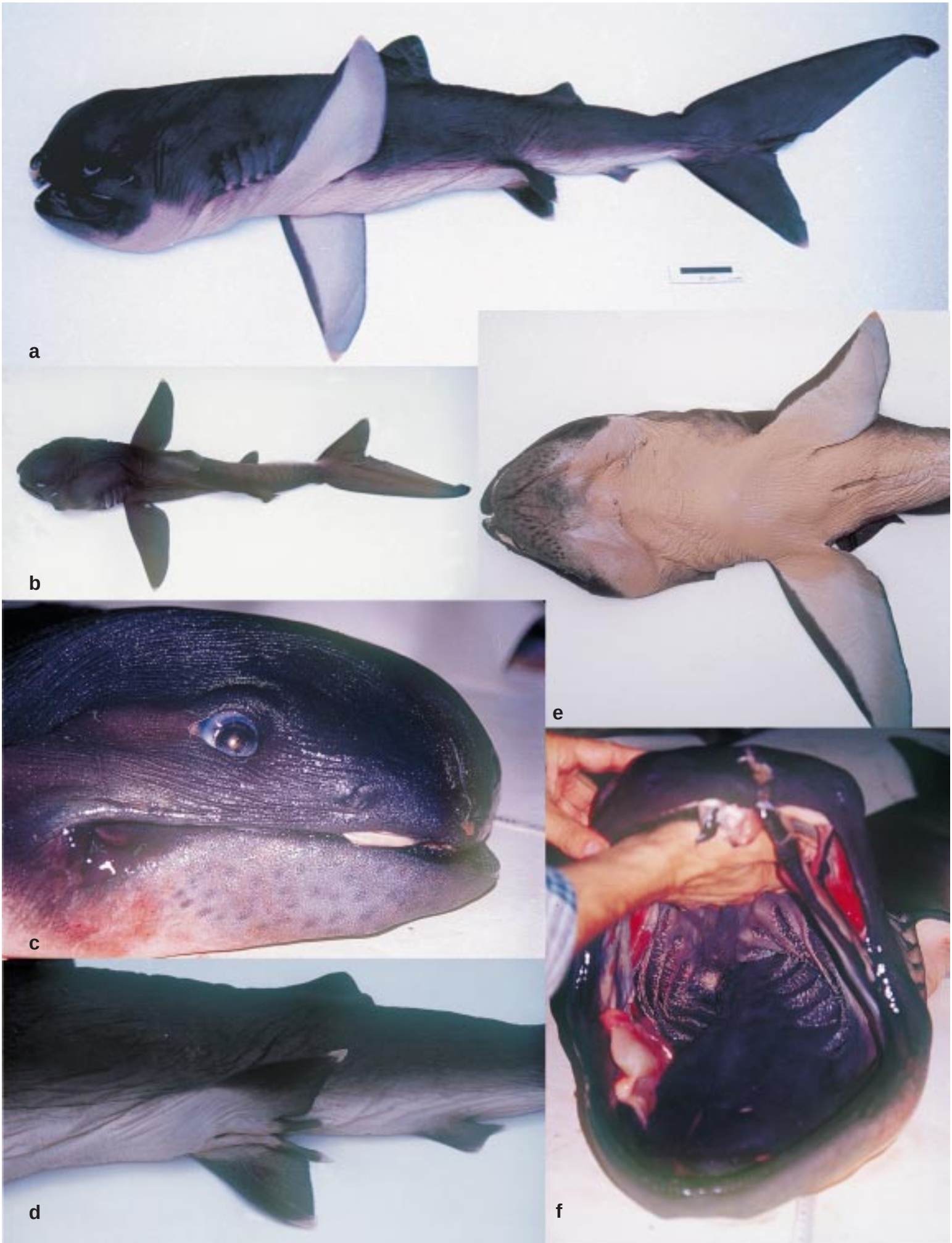
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Table 1. Proportional measurements of the Brazilian megamouth compared to previous specimens: the holotype (Taylor et al. 1983); no. 7 from Fukuoka (Nakaya et al. 1997); and no. 3 of the Western Australian Museum (WAM; Berra & Hutchins 1990).

Total length (mm)		Brazil 1900	Holotype 4460	Fukuoka 4710	WAM 5150
Sex		Male	Male	Female	Male
Scale	mm	%TL	%TL	%TL	%TL
Precaudal length	1230	64.7	69.3	66.6	66.6
Prenarial length	32	1.7	2.2	*****	2
Preoral length	15	0.8	1.5	*****	1.2
Preorbital length	89	4.7	5.4	5.4	6.8
Prespiracular length	199	10.5	10.1	7.9	18.2
Prebranchial length	340	17.9	19.1	20.8	21.2
Head length	462	24.3	26.5	27.2	25.6
Prepectoral length	453	23.8	24.9	27	27
Prepelvic length	872	45.9	50.9	51.4	48.7
Vent-caudal length	960	50.5	48.5	*****	47.6
Pre-first dorsal length	560	29.5	34.5	33	32.4
Pre-second dorsal length	980	51.6	56.7	53.6	52.8
Interdorsal space	238	12.5	14	11.7	12.4
Second dorsal-caudal space	170	8.9	8.9	8.1	8.4
Pectoral-pelvic origins	415	21.8	26	24.3	21.7
Pectoral-pelvic space	312	16.4	*****	19.3	*****
Pelvic-anal space	128	6.7	7.4	4.6	7.2
Pelvic-caudal space	273	14.4	*****	12.1	13.9
Anal-caudal space	100	5.3	5.2	4.5	4.2
Eye length	32	1.7	1.3	1.1	1.2
Eye height	25	1.3	1.2	1	0.8
Interorbital space	155	8.2	8.3	10.8	10.7
Nostril width	9	0.5	0.7	0.7	0.6
Internarial space	120	6.3	7.6	8.7	7.7
Anterior nasal flap length	3	0.2	*****	*****	0.1
Mouth length	142	7.5	6.1	11.3	8.7
Mouth width	220	11.6	18.5	9.6	11.3
First gill slit height	89	4.7	5.9	5.1	4.3
Second gill slit height	78	4.1	5.8	5.1	4.4
Third gill slit height	80	4.2	5.9	5	4.4
Fourth gill slit height	87	4.6	5.7	4.2	4.1
Fifth gill slit height	92	4.8	5.2	3.3	3.9
Caudal peduncle height	90	4.7	5.3	5.6	5.4
Girth	> 600	> 31.6	40.4	*****	34.8
Pectoral anterior margin	379	19.9	18.8	19.6	19.2
Pectoral base	109	5.7	5.9	5.9	6.4
Pectoral height	335	17.6	*****	17.5	16.9
Pelvic anterior margin	137	7.2	5.9	6.8	6.4
Pelvic base	90	4.7	4.6	5.5	6.2
Pelvic height	106	5.6	5.7	4.9	3.6
Pelvic inner margin	20	1.1	0.8	2.2	0.7
Pelvic posterior margin length	75	4	4.1	5.1	3.8
First dorsal anterior margin	190	10	9.3	9.4	5.4

Figure 1. The juvenile megamouth from Brazil: a – side view of preserved specimen, b – dorsal view of the specimen, c – detail of head prior to preservation, d – detail of pelvic fins showing white fin and clasper tips, e – ventral view of head area, f – detail of mouth cavity, with the tongue at the bottom of the picture.

Table 1. Continued.

Total length (mm)		Brazil 1900	Holotype 4460	Fukuoka 4710	WAM 5150
Sex		Male	Male	Female	Male
Scale	mm	%TL	%TL	%TL	%TL
First dorsal base	170	8.9	9.1	8.7	9.7
First dorsal height	128	6.7	5.1	6.2	4.9
First dorsal inner margin	41	2.2	1.8	1.9	1.6
First dorsal posterior margin	125	6.6	5.9	6.1	5.7
Second dorsal anterior margin	67	3.5	4.4	5.4	4.7
Second dorsal base	73	3.8	4.3	5.4	5
Second dorsal height	50	2.6	2.3	2.5	1.9
Second dorsal inner margin	41	2.2	1.8	1.7	1.5
Second dorsal posterior margin	70	3.7	3.5	3.7	3
Anal length	84	4.4	5.1	4.5	2.8
Anal anterior margin	54	2.8	4.4	2.9	3
Anal base	48	2.5	3.6	2.7	1.6
Anal height	40	2.1	1.7	1.8	1.6
Anal inner margin	36	1.9	1.5	1.8	1.3
Anal posterior margin	48	2.5	1.8	1.8	1.7
Dorsal caudal margin	670	32.3	32.3	34.6	33.6
Preventral caudal margin	311	16.4	14	16	14
Lower postventral caudal margin	200	10.5	8.5	7	8.4
Upper postventral caudal margin	410	21.6	27.4	22.5	23.5
Terminal caudal margin	50	2.6	2.2	*****	2
Subterminal caudal margin	35	1.8	*****	1.2	1.7
Spiracle diameter	8	0.4	*****	0.4	*****

slender shape. The body is very soft and flaccid in spite of the preservation in formalin. The vertebrae are uncalcified and indistinct. The spiracle is relatively large and located directly behind the eye. When the large mouth is open, the large tongue and the gill raker papillae are clearly visible (Figure 1f). The liver is remarkably small, divided into two unequal, triangular lobes, the larger lobe measuring about 100 mm at its widest point and 200 mm in length. The liver weighed 470 g. Both the stomach and the spiral valve were opened at a previous time, and their contents appear to have been lost. No parasites were detected anywhere in the coelomic cavity, stomach, or gills. The claspers are uncalcified and relatively small, indicating that the specimen is immature.

The description of the coloration of the specimen is based on photographs taken at the Instituto de Pesca at the time it was received on 22 September 1995 and the examination and photographs of 6 August 1997. In spite of its prolonged storage in formalin, most of the colors were little changed from those in the original photographs. Black, brown and white colors remained basically unchanged. The slight metallic hues around the mouth that are visible in the earlier photographs have faded.

The specimen is clearly countershaded, being black and brown above and white below (Figure 1a). The head area is black above, while the rest of the dorsal surface is of a rich brown color (Figure 1b). The dark upper color extends downwards along the sides to below the gill slits and the level of the pectoral and pelvic fins. The lower jaw and the gular area between the mandibles are dusky or grey with dark spots about 10 mm in diameter (Figure 1c,e). In the fresh specimen this area had grayish-blue metallic hues, but these have faded in the preserved specimen. There is a narrow band of white along the upper lip. The ventral surface is white (Figure 1e). Both dorsal fins are fully dark brown. The pectoral fins are dark brown above and white below. A band of the upper brown color extends 20–22 mm along the anterior margin of the fin into the ventral side of the pectoral fins. A similar dark band extends 5–6 mm along the rear margin of the fin. The very tips of the fins are yellowish, this color extending about 10–13 mm on both sides. The dorsal surface of the pelvic fins is black above, with a thin 5–6 mm white edge along the trailing edge, and white tips. The ventral surface of the pelvic fins is blackish brown with clearly demarcated white tips (Figure 1d). The claspers are brown with white tips, the white coloration extending 10–15 mm from the tip.

Table 2. Specimens of megamouth caught or reported to date.

Number	Date	Location	Body of water	Size (cm)	Sex	Capture	Depth	Status	Reference
1	15 Nov 1976	Kahuku Point, Oahu, Hawaii 21°51′N, 157°46′W	Pacific	446	M	Dead, entangled in parachute used as sea anchor	165 m	Bemice P, Bishop Museum, Honolulu	Taylor et al. (1983)
2	29 Nov 1984	Santa Catalina Island, California 33°25′N, 118°25′W	Pacific	448	M	Dead, caught in gillnet	< 38 m	Los Angeles Natural History Museum	Lavenberg & Seigel (1985)
3	18 Aug 1988	Mandurah, Australia 32°31′S, 115°43′E	Indian	515	M	Dead, washed ashore near estuary		Western Australian Museum, Perth	Berra & Hutchins (1990, 1991)
4	23 Jan 1989	Hamamastu, Japan 34°42′N, 137°42′E	Pacific	~400	M	Dead, washed ashore		Washed back to sea, photos only	Nakaya (1989)
5	12 Jun 1989	Suruga Bay, Japan 34°50.4′N,138°20.4′E	Pacific	~490		Alive, in set net	< 40 m	Released alive, photos only	Miya et al. (1992)
6	21 Oct 1990	Dana Point, California 33°28′N,117°42′W	Pacific	490	M	Alive, in drift gillnet	40–145 m	Released and acoustically tracked	Lavenberg (1991), Nelson et al. (1997)
7	29 Nov 1994	Hakata Bay, Fukuoka, Japan 34°40′N, 130°50′E	Pacific	471	F	Dead, stranded on beach		Marine World, Fukuoka, Japan	Takada et al. (1997), Yano et al. (1997)
8	4 May 1995	Dakar, Senegal 15°08′N, 18°22′W	Atlantic	180	M	Caught in purse seine		Discarded	Séret (1995)
9	18 Sep 1995	Southern Brazil 27°08′S, 43°55′W	Atlantic	190	M	Caught in longline	15–40 m	Instituto de Pesca, Sao Paulo, Brazil	Amorim et al.[1] this paper
10	30 Apr 1997	Mikizaki, Owase City, Mie, Japan 33°46′N, 136°16′E	Pacific	544	F	Caught in purse seine	< 150 m	Toba Aquarium	Yano et al. (1999)
11	20 Feb 1998	Cagayan de Oro, Philippines	Pacific	~549	M	Caught in gillnet		Consumed	Elizaga[a]
12	23 Apr 1998	Osawe, Honshu, Japan	Pacific	520	F	Caught in large set net		Discarded	webpage[b]
13	30 Aug 1998	Manado, North Sulawesi, Indonesia 124°50′3″N,1°46′W	Pacific	~500		Alive, was being attacked by sperm whales		Swam away	Pecchioni & Benoldi[c]
14	1 Oct 1999	30 miles west of San Diego, California	Pacific	~518	F	Alive, caught in drift gillnet		Released	Don Peterson personal communication

[a]Elizaga, E.T. 1998. Megamouth in Cagayan de Oro. EcoNews. <http://cdo.weblinq.com/~econews/Megamouth.html>
[b]<http://www.ozemail.com.au/~bilsons/Sharks4.htm>
[c]Pecchioni, P. & C. Benoldi. Sperm whales spotted attacking megamouth shark. <http://www.flmnh.ufl.edu/fish/Sharks/Megamouth/Mega13.htm>

The anal fin is brown with a white tip of only a few millimeters wide. The caudal fin is dark chocolate brown with a thin white edge.

Conclusions

This Brazilian megamouth is the first Atlantic specimen and the first juvenile megamouth examined, although the presence of megamouth in the Atlantic was long suspected (Castro 1983, Berra & Hutchins 1990). Séret (1995) related the anecdotal capture of a juvenile male about 180 cm TL off Dakar, Senegal in 1995. The specimen was discarded after the arrival in port and before ichthyologists could examine the specimen. However, according to Séret, the description given by the captain of the fishing vessel agrees perfectly with the characteristics of the megamouth shark. Although the presence of megamouth in the Atlantic is demonstrated by the Brazilian specimen, Séret's (op. cit.) account of the Senegalese specimen falls, by most standards, in the realm of 'anecdotal evidence', because it lacks any definitive identifying data, such as a specimen or parts, photographs, drawings, or sketches by witnesses.

The Brazilian specimen is clearly immature, but it agrees well with the adults collected in the Pacific Ocean (Table 1). They all appear to be the same species. Some of the small proportional differences may be accounted by allometric growth, being that a juvenile is being compared to adults.

Megamouth is one of the rarest species of sharks. As of January 2000, only 14 megamouth sharks (Table 2) have been recorded (if one includes Séret's anecdotal account) since the first megamouth known to science was caught in 1976. All the previous specimens have been adults caught in the Pacific and Indian Oceans. Of these, only six have been available for study and have been preserved.

Nelson et al. (1997) demonstrated that megamouth is a diel vertical migrator, ascending to the upper layers (12–25 m) at dusk, and descending 120–166 m at dawn. The capture of this specimen in the upper layers at night is consistent with this profile. This is the first specimen captured on a hook. Of the fourteen megamouths sharks known to science, nine have been entangled in nets or similar gear, three have washed ashore or become stranded on beaches. It is interesting that the only megamouth taken on a hook is a juvenile.

Why megamouth remained undiscovered for so long, and why so few specimens have been seen is a mystery. There are several likely explanations that partially explain the scarcity of specimens. First, its pelagic filter feeding habit has generally kept it from hooks of the ubiquitous tuna, swordfish, or other pelagic fishes. Second, the usual large size of megamouth specimens, lack of recognition of the species, and the reluctance of fishermen to bring back a large creature which may lack market value, probably have prevented many fishermen from bringing back megamouth sharks caught in their fishing gear. Why previous strandings, which must have certainly occurred, were not noticed, recognized, or reported, is not clear. Given the increased fishing pressure and the current spread of net fisheries, it is likely that more megamouth sharks will become entangled in nets.

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