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White Band on Upper Jaw of Megamouth Shark, *Megachasma pelagios*, and Its Presumed Function (Lamniformes : Megachasmidae)

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Abstract

The white band on the upper jaw of the megamouth shark, *Megachasma pelagios*, was investigated in all fourteen specimens reported since its original description in 1983. The band was found to be present in all specimens, except for one that was discarded without any description or photographs, and thus it was concluded that this band is a species-specific character of the megamouth shark. The white band was redescribed based on two specimens at hand. Two possible functions of the white band were speculated. First, this band may have a luring or attracting function on planktonic prey under dark light conditions. The second possible function is as a sort of social signal to conspecifics or other species.

Key words : Megamouth shark, *Megachasma pelagios*, White band, Upper jaw, Function, Lure, Social signal

Introduction

The megamouth shark, *Megachasma pelagios*, was described by Taylor et al. (1983), based on a male specimen caught in Hawaiian waters. Since then, fourteen individuals have been reported from the world oceans (Amorim et al., 2000).

While examining a specimen stranded on a beach at Fukuoka, Japan in 1994, I noticed that it had a conspicuous white band along the upper jaw and reported it briefly (Nakaya et al., 1997). I also had a chance to examine the tenth specimen captured off Mie, Japan, in 1997, and the white band was also present on this specimen. Since Nakaya et al. (1997), only Amorim et al. (2000) has mentioned the presence of this white band on a Brazilian specimen.

Here I redescribe this band, investigate the presence of the white band in other specimens reported, and discuss its possible function.

Materials

1) Fukuoka specimen (seventh specimen) : A female, 471 cm in total length (TL), 790 kg, stranded on a tidal flat near Gannosu (34° 40′ N, 130° 50′ E), Higashi-ku, Fukuoka City, Japan, on Nov. 29, 1997.

2) Mie specimen (tenth specimen) : A female, 544 cm TL, 1,040 kg, captured by a surrounding net at 12 miles off Owase(33° 44′ N, 136° 16′ E), Mie Prefecture, Japan, on April 30, 1997.

Results

White band in the Fukuoka and Mie specimens (Fig. 1) :

The bright white band is present horizontally along the dorsal margin of the upper jaw, below the nostrils, and its coloration is pure white (Fig. 1A). The white band is about 45 cm long and 4 cm wide in Fukuoka specimen. This band is strongly demarcated and contrasts starkly with the surrounding areas of the blackish snout and the glossy black upper jaw. The upper jaw is supported by a pair of huge palatoquadrate cartilages, and is greatly protrusible. When the upper jaw is protruded, the white band is clearly exposed transversely on the anterior surface of the snout region (Fig. 1A). When the upper jaw is partially retracted, the white band runs in a groove made by the upper jaw and snout (Fig. 1B). When the jaws are fully retracted, the white band apposes the ventral side of the snout, and it is invisible from the side (Fig. 1C).

Re-investigation of the white band in the other specimens (Fig. 2) :

A figure in the original description of this species from Hawaii (Fig. 5b in Taylor et al., 1983) clearly depicts the white band in the holotype (446 cm TL, male).

A photograph of the second megamouth specimen, a 449 cm TL male from California (Fig. 2A), shows a dorsal view of the snout region where the upper jaw is strongly protruded, and the white band is clearly visible.

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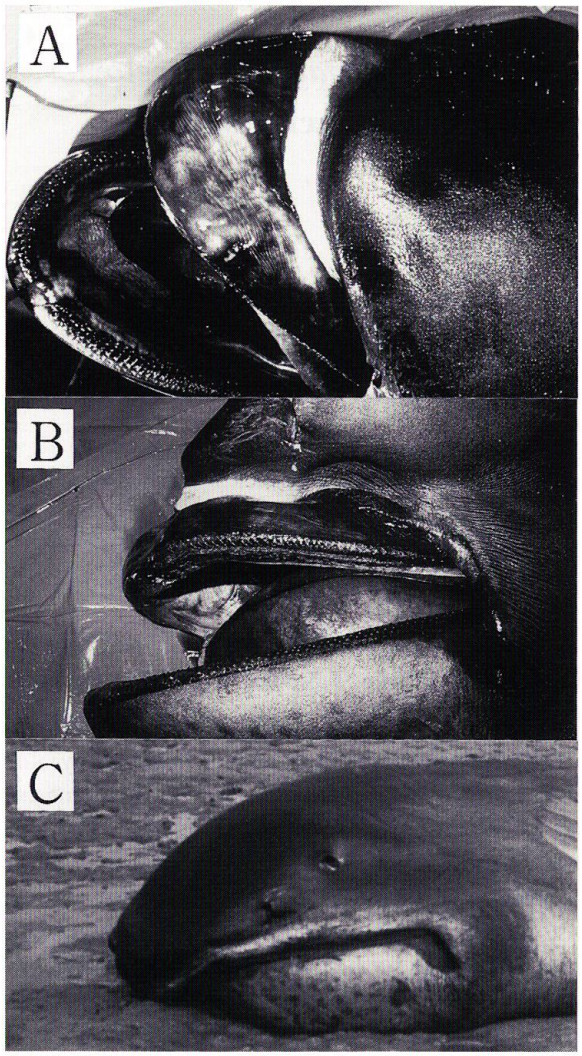

Fig. 1. White band and snout region of Fukuoka specimen (seventh specimen). (A) the white band in antero-dorsal view, with upper jaw fully protruded ; (B) lateral view of mouth, with upper jaw partially retracted ; (C) antero-lateral view at landing site, with upper jaw fully retracted.

A photograph of the third specimen, a 515 cm TL male from western Australia (Fig. 2B), shows this white band just below the snout on the upper jaw.

The fourth megamouth shark from Hamamatsu, Japan (ca. 400 cm TL, male) has a distinct white band (a figure on p. 145 in Nakaya, 1989).

Miya et al. (1992) reported the fifth individual (ca 490 cm TL, sex unknown), caught and released alive from a set net off Yaizu, Japan, and one of their photographs (Fig. 2C) shows the white band positioned on the ventral side of the snout.

The sixth megamouth specimen (490 cm TL, male), caught and released in California, also had a white band on the ventral margin of snout (a figure on p. 39 in Lavenberg, 1991).

The eighth specimen from Senegal reported by Seret (1995) was caught in a purse seine, but it was discarded without any description or photographs.

Amorim et al. (1995) reported the ninth specimen, an immature individual (190 cm TL, male) from the Atlantic Ocean. As shown in Fig. 2D and as also described by Amorim et al. (2000), this specimen has the white band.

The eleventh specimen (less than 549 cm TL, male) reported from the Philippines on the webpage by E.T. Elizaga (http://cdo.weblinq.com/-econews/Megamouth.html) possesses this white band.

The photograph of the twelfth specimen (ca. 550 cm TL, female) from off Mihama, Mie Prefecture clearly shows the white band (Fig. 2E).

The web-photographs of the thirteenth specimen (ca. 500 cm TL, unknown sex ; by P. Pecchioni and C. Benoldi, http://www.ozemail.com.au/-bilsons/Sharks4.htm) from North Sulawesi, Indonesia, and of the fourteenth specimen (ca. 518 cm TL, female ; by D. Petersen, http://www.flmnh.ufl.edu/fish/Sharks/Megamouth/Mega14.htm) caught and released in California, show the white band on both specimens.

Discussion

The white band was confirmed in all the available specimens, including juveniles and adults, and both sexes. The coloration of the band is bright white, and this white area is sharply demarcated and surrounded by the black area of the snout and upper jaw. Considering these facts, the white band on the upper jaw is not an artifact of abrasion, but a species-specific character of the megamouth shark.

The white band and the jaw movements of the megamouth shark are semi-diagrammatically shown in Figure 3. When the upper jaw is completely retracted, the white band is occluded and is hardly visible from the side (Fig. 3A). When the jaw is protruded, the white band is exposed transversely on the anterior surface of snout region (Fig. 3B).

Generally, a white object reflects maximally all wavelengths of the visible spectrum, while a black object absorbs the wavelengths of the visible spectrum and its visibility is easily lost as it gets darker (Myrberg, 1991). For example, Myrberg showed that as an oceanic whitetip shark faded into the dark background, only the white tips of the fins remained visible.

The same phenomenon could happen in the megamouth shark. The white band, reflecting all wavelengths from its surface, would remain prominent even in darker light conditions, where the shark body shape becomes undifferentiated from its surroundings.

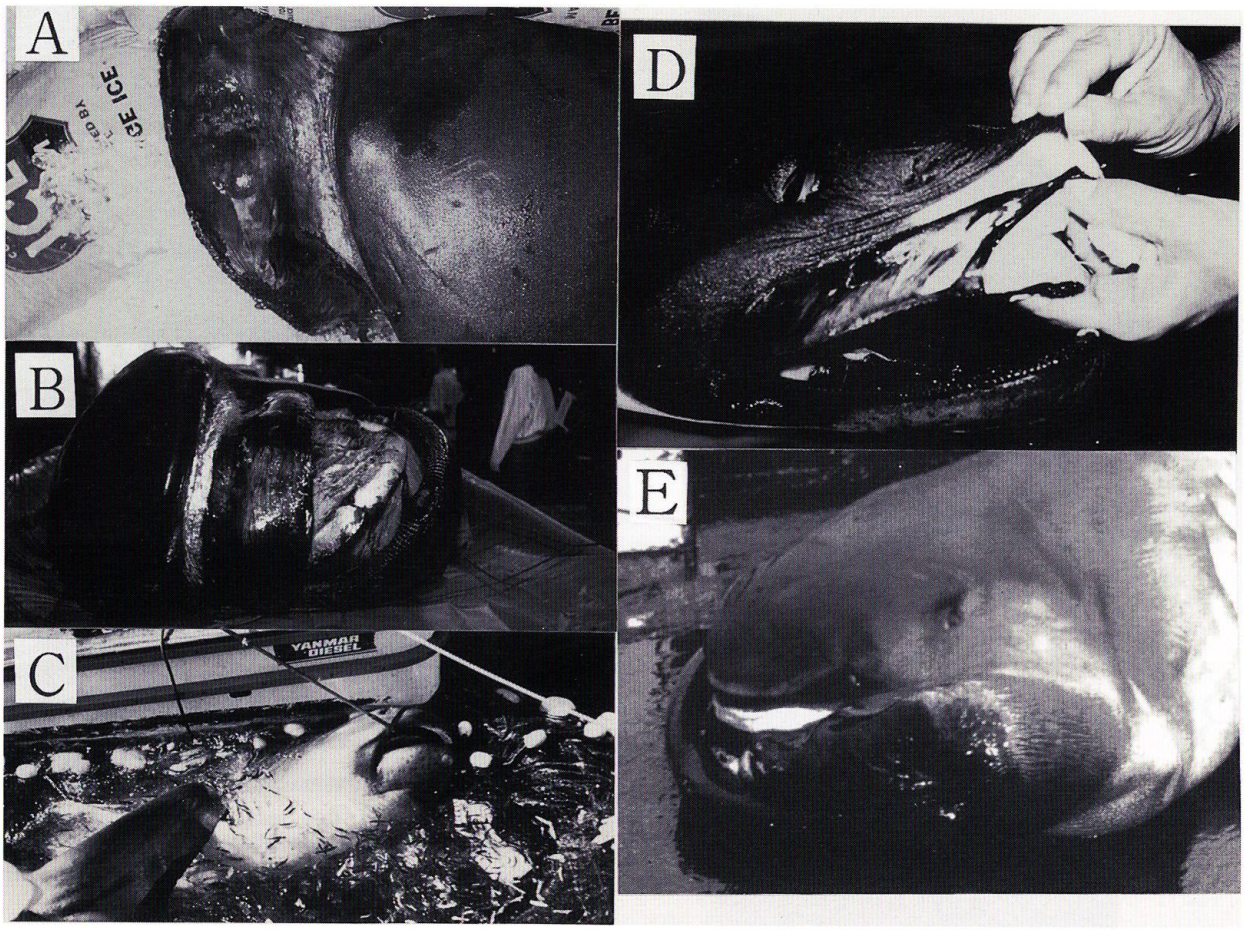

Fig. 2. White band in other specimens. (A) Californian specimen (second specimen), with upper jaw fully pulled out (courtesy of J. DeLeon, Los Angeles County Museum) ; (B) Australian specimen (third specimen) (courtesy of T. Berra) ; (C) Japanese specimen from Yaizu (fifth specimen)(courtesy of M. Miya) ; (D) immature Atlantic specimen from Brazil (ninth specimen)(courtesy of A. Amorim) ; (E) Japanese specimen from Mie (twelfth specimen) (courtesy of E. Tanaka).

The silvery surfaces around the mouth and lower jaw, and the mottled markings on the lower jaw might add more effect to the merging of the mouth region into the background, making the white band more visible.

Usually the color patterns of fishes are present on the lateral side of the body and fins, and they are most effectively recognizable when seen from the lateral side. However, the white band in the megamouth shark is unique in that it is located on the anterior surface of the snout, and the color pattern is most prominent when seen from the front. In addition, the white band is located just above the mouth, and the appearance of the band depends on jaw movements. This suggests its presence is related to feeding.

Known stomach contents of the megamouth shark include a euphausiid shrimp (*Thysanopoda pectinata*) in the Hawaiian specimen (Taylor et al., 1983), euphausiids, copepods and pancake sea jelly (*Atolla vanhoeffeni*) in the Californian specimen (Lavenberg and Seigel, 1985), and possibly a euphausiid *Euphausia nana* in the Fukuoka specimen (Yano et al., 1997), all planktonic organisms.

Compagno (1990) suggested a mechanism for feeding in the megamouth shark. He considered that the species swims slowly through aggregations of planktonic prey, or floats within such aggregations with its jaws retracted and mouth open, then it protrudes its jaws and drops its tongue and pharynx, increasing the volume and negative pressure of the pharynx, and sucking prey into the mouth. This scenario mostly depends on a luminescent organ in the mouth for attraction of the prey, though its presence is doubted (Lavenberg, 1991).

It is possible that, instead of a luminescent organ inside the mouth, this white band has a luring function or attracting effect on this planktonic prey. In this new scenario, the megamouth shark slowly swims or floats near an aggregation of prey animals, with upper jaw dropped, showing the white band, and with the gape almost closed and its huge tongue elevated to the mouth roof minimizing the pharyngeal cavity. Then, it sud-

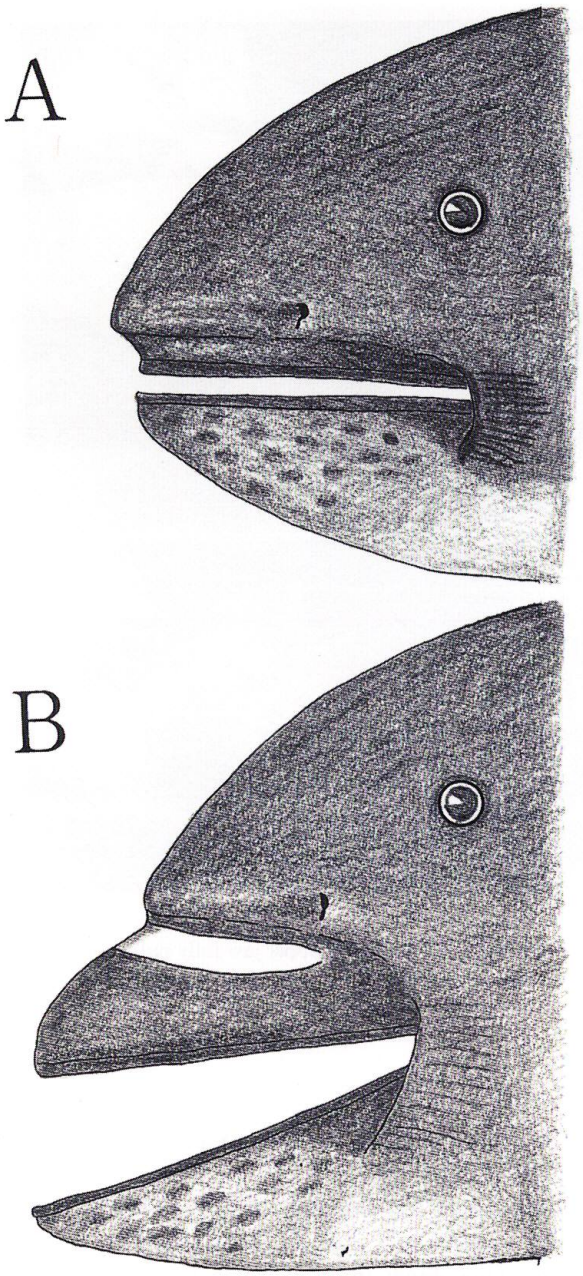

Fig. 3. Schematic drawings, showing jaw movements and the white band in the megamouth shark. (A) jaws fully retracted and the white band invisible; (B) jaws extended and the white band exposed.

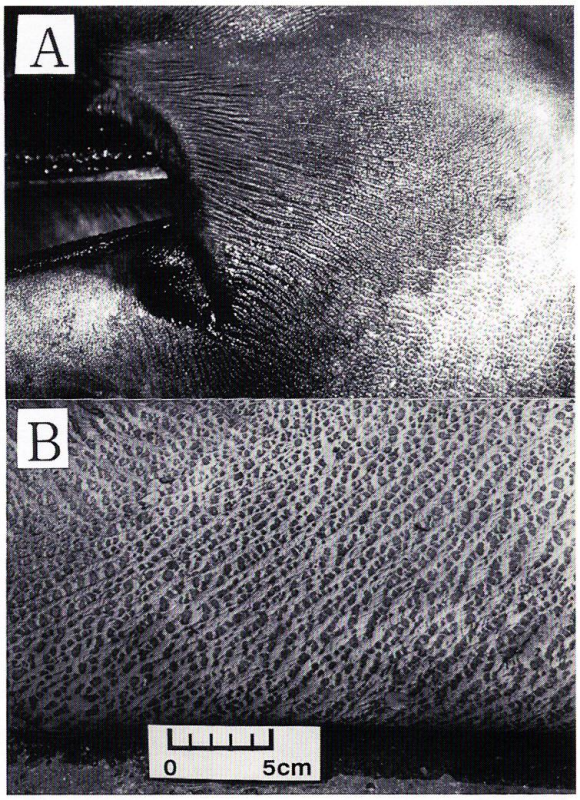

Fig. 4. Close-up of the head. (A) wrinkled skin at mouth corner in Fukuoka specimen, (B) patchy distribution of dermal denticles on throat region in Mie specimen.

denly opens the gape, pushes the jaws forward, drops its tongue, maximizes the size of the mouth cavity, and sucks the prey inside. Then, it closes its gape, retracts both jaws, raises its tongue, squeezes the pharyngeal cavity, pushes the water out through the gill openings, and sieves the prey animals with its peculiar gill rakers. The white band may be superfluous in the feeding behavior of the megamouth shark, especially when aggregations of prey plankton are dense.

The wrinkled loose skin on the lateral sides of the mouth (Fig. 4A) apparently stretches to cover mouth corners, and also provides a wider gape while the jaws are protruded. Usually the dermal denticles of the sharks are uniformly distributed on the body surface, but those on the throat region of the megamouth shark are quite irregularly distributed in innumerable small patches, which are interspaced with naked skin (Fig. 4B). The naked skin net work indicates that the throat region of the megamouth shark is easily expandable during suction of planktonic prey, just like the folded skin seen on the throat and belly of baleen whales.

An additional function of the white band might be that as a social signal. Teleost fishes readily change color and their color patterns for feeding, fighting, courtship, etc., or for camouflage, but the elasmobranchs are unable to quickly change their color and color patterns. Therefore, the megamouth shark is unique among elasmobranchs, because it has the ability to quickly change color patterns on the front of the head by protrusion of the upper jaw. As jaw movements are under voluntary control, the white band can be shown or hidden at will. Together with the fact that the white band is so conspicuous, sharply demarcated and surrounded by the black area, the megamouth shark may

use this white band as a sort of social signal to conspecifics or other species.

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