Wide heads give hammerheads exceptional stereo view

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Hammerhead shark. Image: Wikipedia

Hammerhead sharks are some of the Ocean's most distinctive residents. 'Everyone wants to understand why they have this strange head shape,' says Michelle McComb from Florida Atlantic University. One possible reason is the shark's vision. 'Perhaps their visual field has been enhanced by their weird head shape,' says McComb, giving the sharks excellent stereovision and depth perception. However, according to McComb, there were two schools of thought on this theory. In 1942, G. Walls speculated that the sharks couldn't possibly have binocular vision because their eyes were stuck out on the sides of their heads.

However, in 1984, Leonard Campagno suggested that the sharks would have excellent depth perception because their eyes are so widely separated. 'In fact one of the things they say on TV shows is that

hammerheads have better vision than other sharks,' says McComb, 'but no one had ever tested this'. Teaming up with Stephen Kajiura and Timothy Tricas, the trio decided to find out how wide a hammerhead's field of view is and whether they could have binocular vision and publish their results on November 27 2009 in the Journal of Experimental Biology.

Hammerheads come in all shapes and sizes so McComb and Kajiura, opted to work with species with heads ranging from the narrowest to the widest. Fishing for juvenile scalloped hammerheads off Hawaii and bonnethead sharks in the waters around Florida, the team successfully landed the fish and quickly transported them back to local labs to test the fish's eyesight.

The team tested the field of view in each shark's eyes by sweeping a weak light in horizontal and vertical arcs around each eye and recorded the eye's electrical activity. Comparing the hammerheads with pointy nosed species, the team found that the scalloped hammerheads had the largest monocular visual field, at an amazing 182 deg., and the bonnethead had a 176 deg. visual field, which was bigger than that of the pointy nosed blacknose and lemon sharks, at 172 deg. and 159 deg., respectively.

Having collected the animals' monocular visual fields, the team plotted the visual fields of both eyes on a chart of each fish's head to see whether they overlapped. Amazingly, they did. The scalloped hammerhead had a massive binocular overlap of 32 deg. in front of their heads (three times the overlap in the pointy nosed species) while the bonnet head had a respectable 13 deg. overlap. And when the team measured the binocular overlap of the shark with the widest hammerhead, the winghead shark, it was a colossal 48 deg. The hammerheads' wide heads certainly improved their binocular vision and depth perception.

Finally, the team factored in the sharks' eye and head movements and found that the forward binocular overlaps rocketed to an impressive 69 deg. for the scalloped hammerheads and 52 deg. for the bonnetheads. Even more surprisingly, the team realised that the bonnethead and scalloped hammerheads have an excellent stereo rear-view: they have a full 360 deg. view of the world.

'When we first started the project we didn't think that the hammerhead would have binocular vision at all. We thought no way; we were out there to dispel the myth,' says McComb. But despite their preconceptions, the team have shown that the sharks not only have outstanding forward stereovision and depth perception, but a respectable stereo rear view too, which is even better than the TV shows would have us believe.

More information: McComb, D. M., Tricas, T. C. and Kajiura, S. M. (2009). Enhanced visual fields in hammerhead sharks. J. Exp. Biol. 212, 4010-4018. http://jeb.biologists.org

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