Manatee hearing good enough to sense approaching motorboats

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Every year, manatees are injured in boat collisions. Why don't they just move when they hear a boat approach? A team of scientists led by Joe Gaspard from Mote Marine Laboratory and Aquarium, USA, have found that manatee hearing is likely good enough to detect sounds of approaching craft above loud background noise, but their findings point to new questions about how this hearing operates in the wild and why manatees remain susceptible to collisions.

Grazing sea grass along the subtropical Florida coast, manatees would seem to have a peaceful life. But motorboats and other watercraft can injure the mammals, sometimes shattering their ribcages or leaving scars from collisions. Joe Gaspard from the Mote Marine Laboratory and Aquarium, USA, explains that many factors put manatees at risk and it isn't clear why the animals are so vulnerable to human activity. For more than 14 years, Mote research has focused on how manatees use their senses to perceive their environment in an effort to understand the factors that put manatees at risk. Their studies have already shown that manatees' vision is poor, compounded by the turbid and tannic waters where they spend much of their lives. But can manatees hear boats? And can they hear them above the cacophony of sounds in their natural environment? Sound is absorbed less in water than in air, potentially allowing it to travel farther. It also travels five times faster in water than in air, theoretically warning the animals earlier of an approaching threat, Gaspard said. Teaming up with Gordon Bauer, Roger Reep and David Mann, and a group of trainers from the aquarium, Gaspard tested the hearing of two resident manatees, Buffett and Hugh – the world's only

manatees trained to participate in behavioural research and husbandry procedures – to find out what they are capable of hearing. The discovery, published in The *Journal of Experimental Biology*, indicates that manatees can hear within the frequency range where boats operate but lead to new questions about why manatees remain at risk.

'Buffett and Hugh are very cooperative and picked up on the elements of the study quickly', remembers Gaspard, who worked with Kim Dziuk, Adrienne Cardwell and LaToshia Read to train the animals to swim down to a listening station 1 m beneath the surface. Switching on a light to indicate to the animals that a test was about to start, the team then trained the manatees to touch a yellow response paddle in return for a tasty fruit or vegetable snack when they heard a sound. They also trained the manatees to stay in place (in return for another snack) when they heard nothing. Once Hugh and Buffett had got the task in hand, the team tested their hearing by selecting a particular sound frequency (pitch) and gradually lowering the volume of the sound until the manatee could no longer hear it. Plotting these 'hearing thresholds' on a graph, the team could see that the manatees had good hearing between 8 and 32kHz and could even hear sounds as low as 0.25kHz – so long as they were quite loud. However, they were even more amazed when Buffett appeared to be able to hear ultrasonic frequencies as high as 90.5kHz. 'Buffett did the task but refused to continue after the first round at that frequency, so we think it was aversive or annoying', Gaspard recalls.

Intrigued by the manatees' apparently sensitive hearing, the team then tested how well the mammals performed when the sounds were accompanied by background noise. Playing test tones – ranging from 4 to 32kHz – against background noise centered on the same pitch, the team recorded the difference between the volume of the tone and background noise when the manatee could no longer distinguish the tone. Plotting the critical ratio – the level at which the background noise swamped the manatee's hearing – against pitch for each animal, the team

saw that the manatees struggled to hear lower and higher pitched sounds above background noise. However, their hearing was much sharper at 8kHz – the frequency at which manatees communicate – where they could still distinguish tones that were only 18.3dB louder than the background.

So, it appears that manatees should be able to hear approaching motorboats above background noise — but it's much more difficult to know whether manatees can always focus on these sounds in nature, Gaspard says. 'Manatees might be less aware of these sounds when they are sleeping, eating or performing other activities related to their daily lives that require their full attention,' says Gaspard. "There are also a multitude of environmental factors that come into play. Understanding how animals use their various senses is a complex process. Could their sense of touch also be playing a role here? We are working on that question now."

More information: Gaspard, J. C. III, Bauer, G. B., Reep, R. L., Dziuk, K., Cardwell, A., Read, L. and Mann, D. A. (2012). Audiogram and auditory critical ratios of two Florida manatees (Trichechus manatus latirostris). J. Exp. Biol. 215, 1442-1447. jeb.biologists.org/content/215/9/1442.abstract

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