NUS scientist on a mission to uncover the language of dolphins

Spinner dolphin with different shaped dorsal fins. Dorsal fins are much like the dolphins' fingerprints. PHOTO: MATTHIAS HOFFMANN-KUHNT

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UPDATED JAN 2, 2023, 6:31 AM SGT

SINGAPORE - It's like first contact. A lone dolphin, which is the group's "sentinel", swims up to Dr Matthias Hoffmann-Kuhnt, and seems to be investigating him through the sound of clicks.

The clicks begin in the dolphin's head, go through a nasal sac in its bulbous forehead to focus the soundwave in its path, before bouncing off its object of interest through an echo.

Known as echolocation, this process allows the dolphin to understand its environment by determining the size of the creature approaching it, the distance from the creature, and whether it could be a potential threat.

After what sounds like a series of creaks, squeaks and critters – as the pod seems to be deliberating on its new visitor – several dolphins begin to emerge in clear view.

"It's like listening to a foreign language," said Dr Hoffmann-Kuhnt, who is a senior research fellow from the Acoustics Research Laboratory at the National University of Singapore's Tropical Marine Science Institute.

Indeed, dolphins are capable of many different forms of vocalisation, and the zoologist is on a mission to crack the code to this secret language. Taking a step towards this, he joined a two-week National Geographic expedition last September to the Hawaiian islands of Lanai, Maui and the Big Island.

Hawaii's most famed marine acrobats – the spinner dolphins – are very social creatures, but little is known about what they say to one another and how they are able to coordinate themselves in such large groups, said Dr Hoffmann-Kuhnt, who has been studying bioacoustics and animal behaviour for 30 years.

Spinner dolphins – a common dolphin species found in tropical waters – swim in informal troops of 15 to 20, sometimes even up to a pod of 100, he told The Straits Times.

And the larger the group is, the more complex their social interactions can be, he added.

"We don't know what they're talking about. Are they talking about the quality of the fish that they eat, for example? The larger the group, the more difficult it is to figure out the hierarchy, who's the boss, what do the juveniles do? How does the dolphin calf learn from its mother, how does it figure out how echolocation works?" said Dr Hoffmann-Kuhnt.

The expedition, which lasted from Sept 15 to 29, was done in collaboration with the Ocean Exploration Trust to collect acoustic data from a variety of dolphin species there – which also included the bottlenose dolphins – to help researchers better understand their behaviour and the complex nature of dolphin society.

Therefore, Dr Hoffmann-Kuhnt and his team assembled their own underwater recording device – also known as the acoustic source position overlay device (Aspod).

The Aspod has an underwater camera affixed to it, along with three underwater microphones known as hydrophones, which allow scientists to trace the source of the sounds – often at high frequencies – to the dolphins making them.

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Spinner dolphins vocalise at a frequency ranging from 100 hertz to 150kHz, while humans have a hearing range of 100 hertz to 20kHz.

Typically, when researchers observe the behaviours of marine creatures in the ocean, they use underwater cameras to film them and analyse the recorded videos later, said Dr Hoffmann-Kuhnt.

But most underwater cameras are equipped with only one hydrophone and researchers often have to rely on visual cues when they "speak", such as strings of bubbles from the dolphins' blowholes.

However, this would not allow them to reliably identify who said what and at what time, he noted.

Dr Matthias Hoffmann-Kuhnt with the acoustic source position overlay device (ASPOD), a type of underwater recording device, in his lab on Dec 18, 2022. ST PHOTO: CHONG JUN LIANG

Dolphins can also be visually identified through the shape of their dorsal fins – which range from those that are more triangular to fins that are curved or jagged around the edges.

Each fin is unique and is much like the dolphin's fingerprint, he added.

To track the paths taken by these dolphins, two underwater sound recording devices are also anchored close to the bottom of the seabed.

Each device has three hydrophones, a compass and a global positioning system attached, as well as a tool which records which direction the device is facing together with vocalisations of the dolphins in the area.

The data enables researchers to map out the path that the dolphins take when they communicate with one another.

This is especially helpful during nightfall, when researchers would have limited visibility.

Spinner dolphins hunt in offshore waters at night, and during the day, they spend their time closer to the shore to socialise, nurture their offspring, hide from predators and rest in preparation for hunting.

Over the long term, Dr Hoffmann-Kuhnt and his team hope to create a database to document the soundscape of dolphins, which would bring them a step closer to understanding their language and their associated behaviours.

"Eventually, when we have enough recordings, we could possibly say – well, every time this behaviour occurs, we get this type of vocalisation... and if this is true, we could even do a playback of the recording and see how the dolphin responds and in that way, we can communicate with them," he added.

Dr Matthias Hoffmann-Kuhnt carrying an Aspod to take videos and sound recordings of the spinner dolphins as they communicate with one another. PHOTO: OCEAN EXPLORATION TRUST

Tracking the vocalisations of dolphins over the long term can also provide some clues to the overall health of the ocean and its ecosystems.

"Dolphins sit at the top of the food chain, so when they disappear from their usual habitats, then you know that something has gone wrong," said Dr Hoffmann-Kuhnt.

For example, in 2013, a group of around 100 Atlantic spotted dolphins migrated from their home in the northern Bahamas to the island chain of Bimini, about 160km south, due to an unprecedented algae bloom in the area, he noted.

Algae blooms can be caused by nutrients from fertilisers entering the water, or huge storms or hurricanes altering the amount of nutrients available in a certain area.

Noise pollution from shipping and oil and gas exploration could induce hearing loss in dolphins, which could essentially threaten their survival, as they would not be able to communicate with one another, said Dr Hoffmann-Kuhnt.

For further research, he has his eye on the region.

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While uncommon in Hawaii, oil and gas exploration in the waters off Brunei could potentially threaten marine life, including dolphins residing there, he added.

Therefore, his team eventually hopes to closely study how dolphins respond to such anthropogenic noise, which will provide better insight into how noise pollution is affecting them.

South-east Asia is home to a variety of dolphin species, including spinner dolphins, which are known to reside between the islands of the Philippines. And Dr Hoffmann-Kuhnt is on a quest to get to know them.

"These dolphin populations are genetically different from the ones in Hawaii, and could therefore behave in slightly different ways. For example, they may be less familiar with humans, and may swim away once they hear our boat from a distance," he added.

Swimming with spinner dolphins had previously been a popular tourist activity in Hawaii, but the authorities there imposed a ban recently so as to allow the nocturnal animals undisturbed rest during the day.

"Therefore, being able to record dolphins as they interact with one another would require some familiarisation with their environment and for us to come up with an approach that would work," Dr Hoffmann-Kuhnt added.

- Note: All images and videos were taken under federal permit 19655 to Dr Adam Pack.