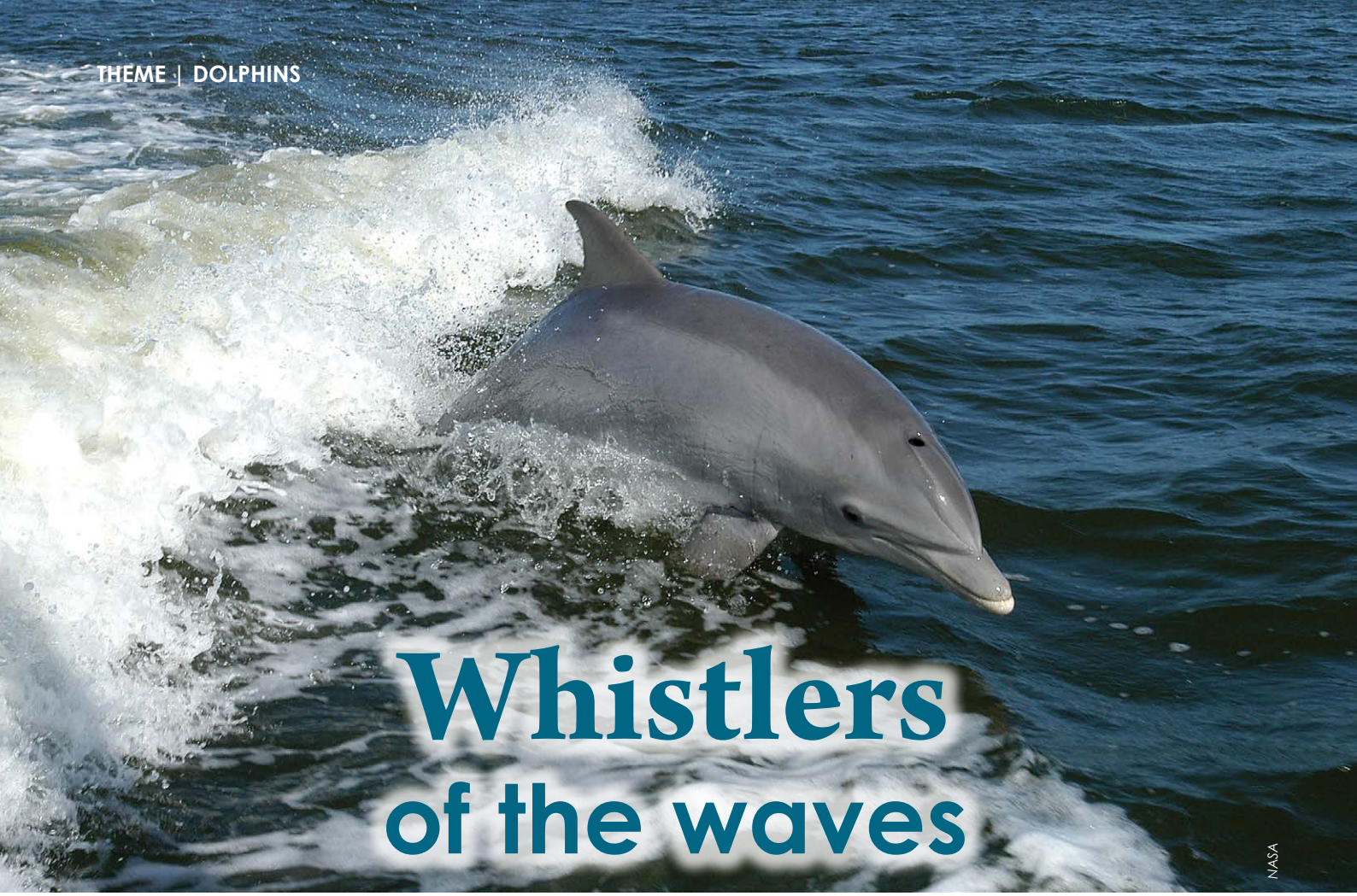


Whistlers of the waves

NASA

Tess Gridley reports on her team's research on dolphin communication

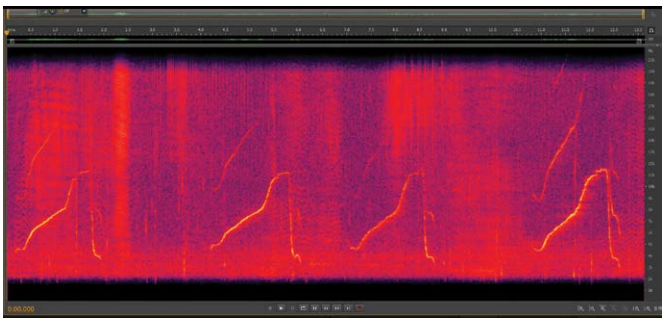
From the day they are born, dolphins produce high-pitched whistles. At first the whistle contours are quite varied and unclear, but within a few months calves develop an individually distinctive whistle contour, through learning and practice. These whistle contours are used by each dolphin when communicating with other dolphins, so they act somewhat like a name in human society. Called 'signature whistles', they remain very stable over time, with the result that dolphins recorded on separate occasions decades apart have been found to still be using the same whistle contour.

Dolphins may recognise each other's signature whistle for a similar time span. This communication system helps dolphins develop important relationships within the population, as well as ensuring that mothers and calves or affiliated males can stay together in the dynamic underwater environment. Such relationships continue over long periods, and communicating with signature whistles allows strong bonds between individuals to be formed and maintained.

More than 50 years of research has been carried out to understand how dolphins develop and use these signature whistles, with a wealth of information collected around the world from captive, temporarily restrained and wild dolphins. In southern Africa, our team members from Sea Search / Namibian Dolphin Project – associated with Stellenbosch University but hosting postgraduates from other local and foreign universities too – have been studying the behaviour of wild dolphins for over a decade.

In Namibia, we have recorded bottlenose dolphins (*Tursiops truncatus*) under different behavioural settings and catalogued over 50 signature whistles from a population of around 100 individuals. In research published in the *Journal of Mammalogy* in 2020, we were able to calculate a population abundance estimate using signature whistles by applying a statistical method called mark-recapture. The resulting estimate was very similar to that calculated using the standard method, which relies on photo-identification of the dolphins' dorsal fin.

Further research using this passive acoustic monitoring (PAM) technique is planned in both Namibian and South African coastal waters. By recording the signature whistles produced by dolphins as they move around in their natural habitat, the team will document individual dolphins in space and time. This will allow the number of



Sea Search

A spectrogram (sometimes called a sonogram) of bottlenose dolphin whistles.

Clicks and acoustic crypsis

Simon Elwen

Heaviside's dolphins don't whistle, but probably use clicks for communication.

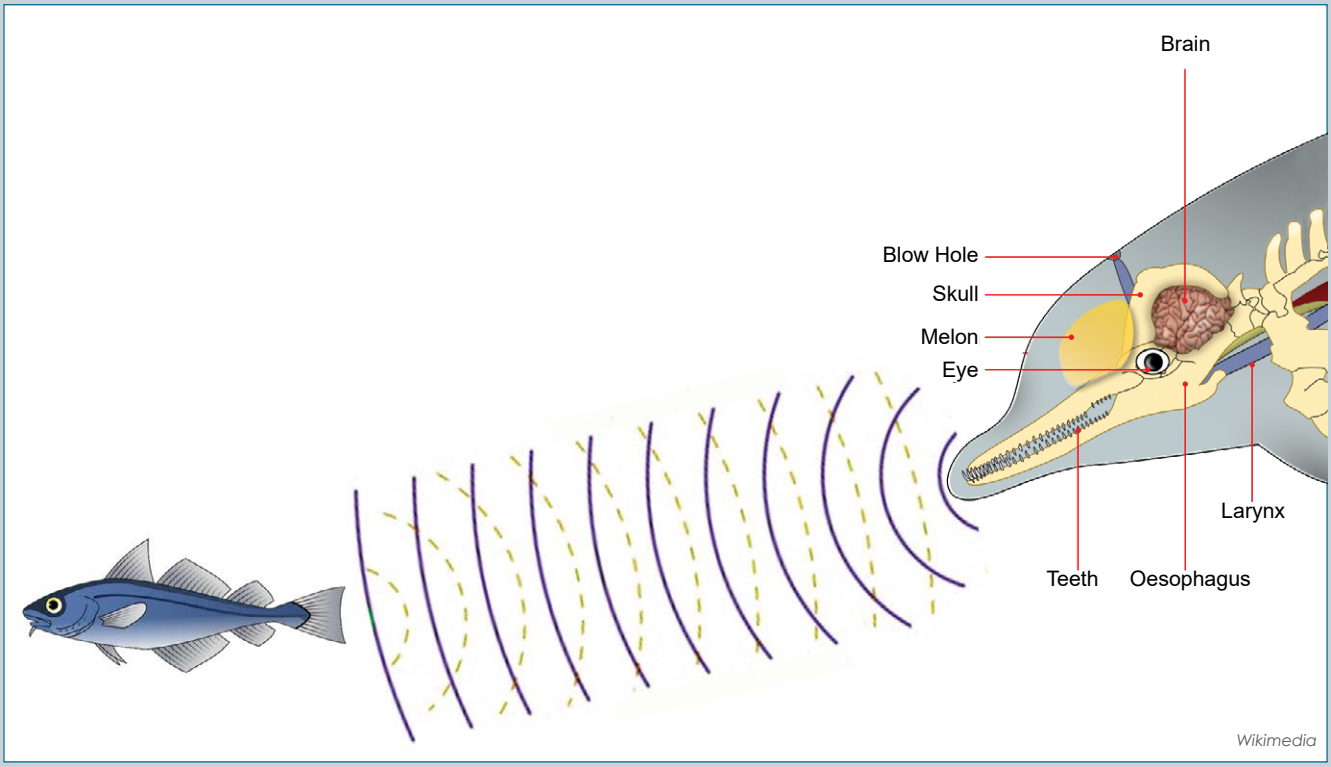
All dolphin species use echolocation to help 'see' the underwater world around them. By producing loud clicks and then processing the returning echo, dolphins can avoid obstacles and detect prey, for example. When they find a prey item, they tend to speed up the clicking so that they can home in on it. As the clicks are produced at faster rates, the interval between individual clicks is shortened, turning the sound into a feeding buzz that allows the dolphin to track and capture its target.

Heaviside's dolphins (*Cephalorhynchus heavisidii*) are small dolphins found only in the Benguela Current ecosystem along the south-western coast of Africa. Together with other members of the genus, these dolphins do not whistle, and have long been thought to produce clicks only for echolocation, but we suspect they use clicks to communicate too.

When foraging, Heaviside's dolphins produce very high-frequency echolocation clicks at 125 kHz. These ultrasonic clicks are beyond the range of human hearing, which at its best extends up to 20 kHz. Killer whales, also called orcas (*Orcinus orca*), can't hear these clicks either, and we think this is a great advantage for the dolphins as they can forage without being detected by the predators, sometimes referred to as the 'wolves of the sea' because they hunt in groups like wolf packs. The behavioural adaptation of modifying the structure of calls to avoid detection by eavesdropping predators, such as changing the volume or pitch, is known as acoustic crypsis, and is practised by many whales and dolphins.

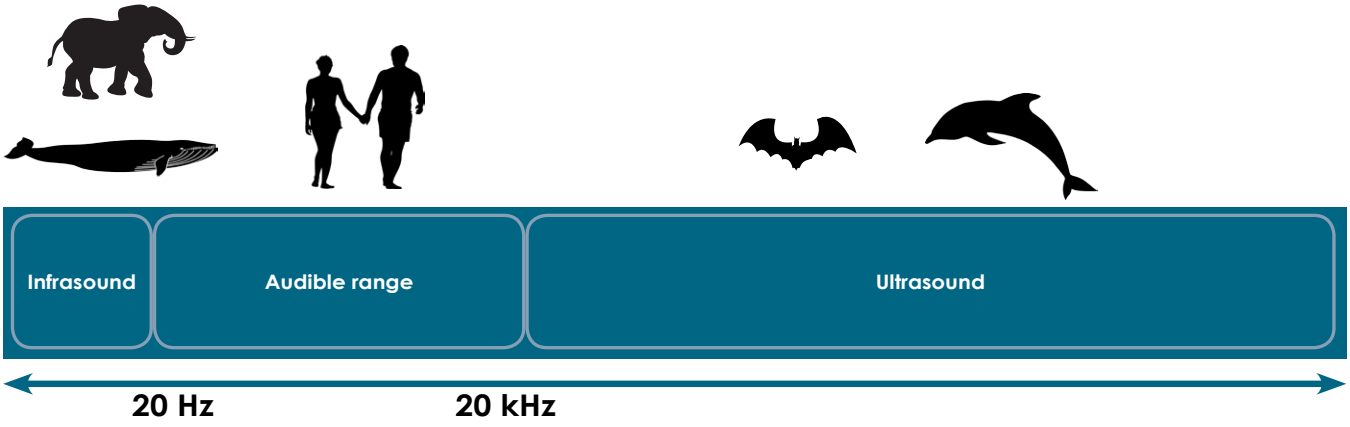
When communicating with each other, though, Heaviside's dolphins produce lower-frequency sounds that apparently overlap with the hearing range of killer whales. The dolphins arrange the clicks at these times in a different way, producing them very quickly, with different sound properties, and also in patterns, like a sort of Morse code, which all helps to communicate different information.

In this instance, they appear to have relaxed the acoustic crypsis in order to communicate with other animals in the area – but this can be costly as predators can overhear the 'dolphin chatter'.



Wikimedia

Dolphins use echolocation clicks to detect underwater objects, including prey items. The outgoing sound waves from these clicks – produced by air movements in the nasal passages – are focused into a beam by the melon, a mass of fatty tissue in the forehead.



Whistles produced by humpback dolphins have a frequency of about 35 kHz, while echolocation clicks produced by Heaviside's dolphins during foraging are in the region of 125 kHz. These sounds are in the ultrasonic range, and cannot be heard by humans.

Chantel Elston

The Indian Ocean humpback dolphin is considered South Africa's most endangered marine mammal.

Sea Search

Sea Search team members study the behaviour of wild dolphins, record their sounds and estimate their numbers.

dolphins in a population as well as dolphin density (the number per unit of area) to be determined, and provide information on the size of an individual's home range.

The South Africa-based project focuses on the locally endangered Indian Ocean humpback dolphin (*Sousa plumbea*), which has an estimated population size of 250 to 500 individuals in our waters. The population is threatened by human activities including noise pollution, overfishing, boat interactions, shark nets and coastal construction. Data collection will therefore be invaluable to inform conservation action and management options for the species, allowing for improved protection.

Although signature whistle use is well documented in bottlenose dolphins, much less is known about humpback dolphin vocalisations, so a first step is to record and document the vocal repertoire of the South African population. Since 2019 we have been collecting recordings at multiple locations around the coast. This has revealed that humpback dolphins make very high-pitched whistles, with frequencies up to 35 kHz (much higher than bottlenose dolphins), as well as lots of interesting clicks, grunts and burst-pulse sounds.

Preliminary analysis of existing data suggests that humpback dolphins also use signature whistles. These will be identified using SIGID, a signature identification technique developed by Janick and co-authors in 2013. It analyses the timing of whistles in the acoustic recordings and if very similar whistles are produced close together – repeated every 10 seconds of raster – it's very likely the individual is calling its signature whistle. These calls are then catalogued and matched over time so that we can create 'capture histories' of when different individuals were in an area. The SIGID technique offers a cost-effective and low-impact method for studying dolphins.

Although several studies have documented signature whistle use in humpback dolphin species, there are no published reports of the acoustic behaviour of our study species, *S. plumbea*, so this is an exciting project that will provide important information on the whereabouts of this endangered species.

- For more information, see the Sea Search Research and Conservation website http://seasearch.co.za or YouTube channel.
- Report your sightings of humpback dolphins and other marine mammals on the SeafariApp or via the website http://www.seafariapp.org/

Dr Tess Gridley is Co-Director of Sea Search and the Namibian Dolphin Project. In March 2018 she initiated the African Bioacoustics Community, which convened its second international conference in November 2020, held online. She was awarded her PhD by the University of St Andrews, Scotland, in 2011.

CURRICULUM CORNER

PHYSICAL SCIENCE: GRADE 10
Sound: pitch, frequency, ultrasound