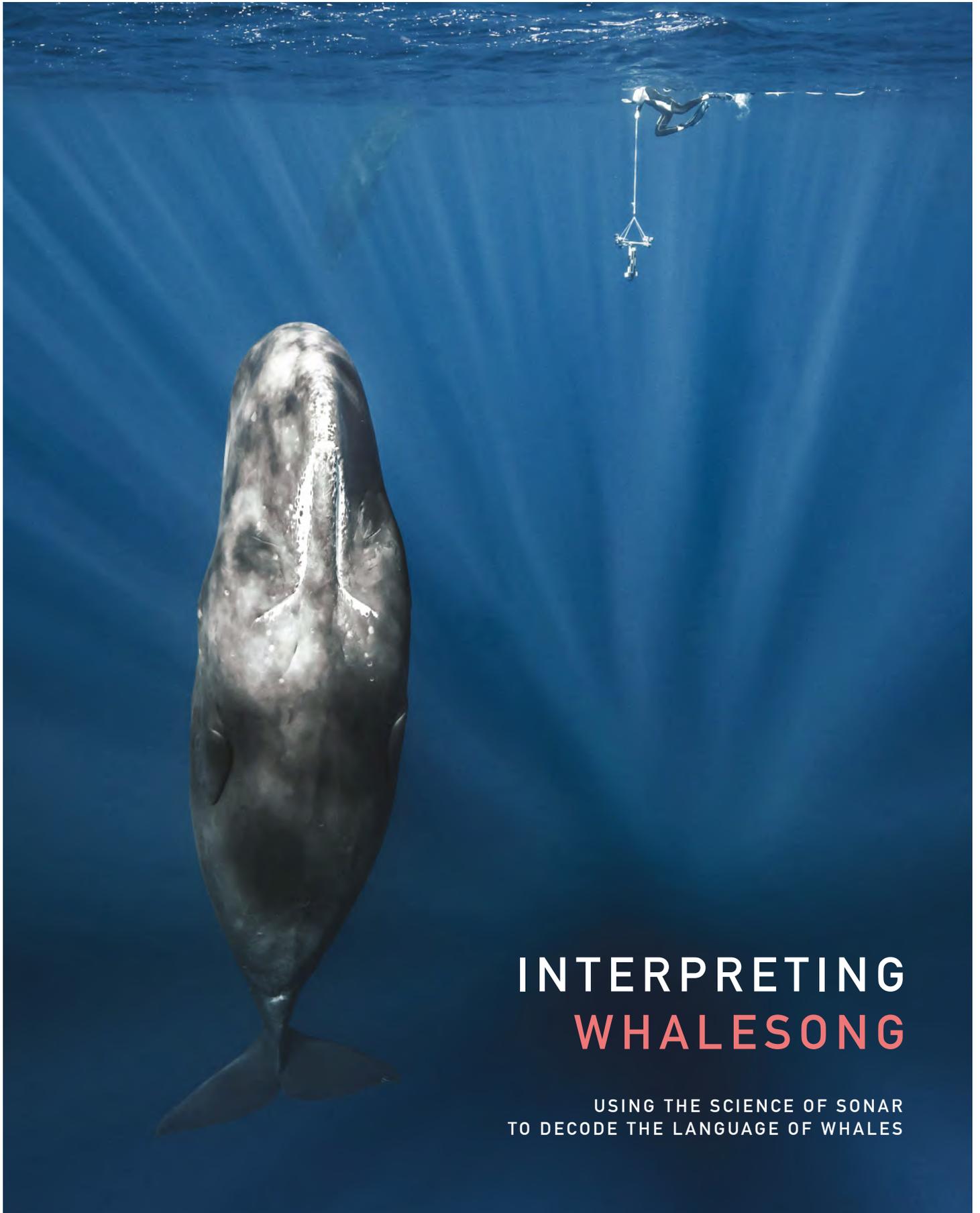


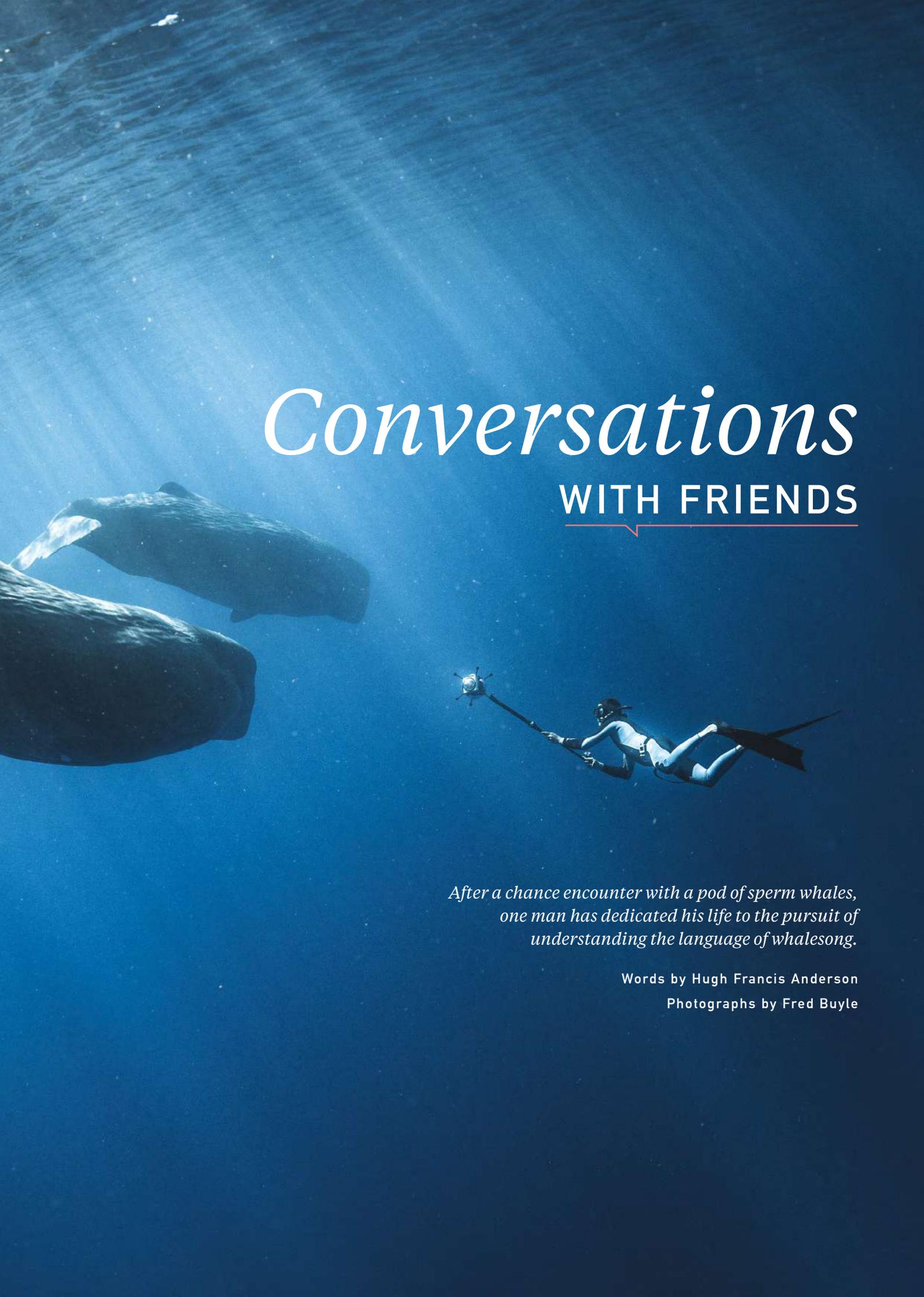
oceanographic™



INTERPRETING WHALESONG

USING THE SCIENCE OF SONAR
TO DECODE THE LANGUAGE OF WHALES



An underwater photograph showing two large sperm whales on the left and a diver on the right. The diver is holding a long pole with a camera at the end, pointing it towards the whales. Sunlight rays filter through the water from the top left.

Conversations

WITH FRIENDS

*After a chance encounter with a pod of sperm whales,
one man has dedicated his life to the pursuit of
understanding the language of whalesong.*

Words by Hugh Francis Anderson

Photographs by Fred Buyle

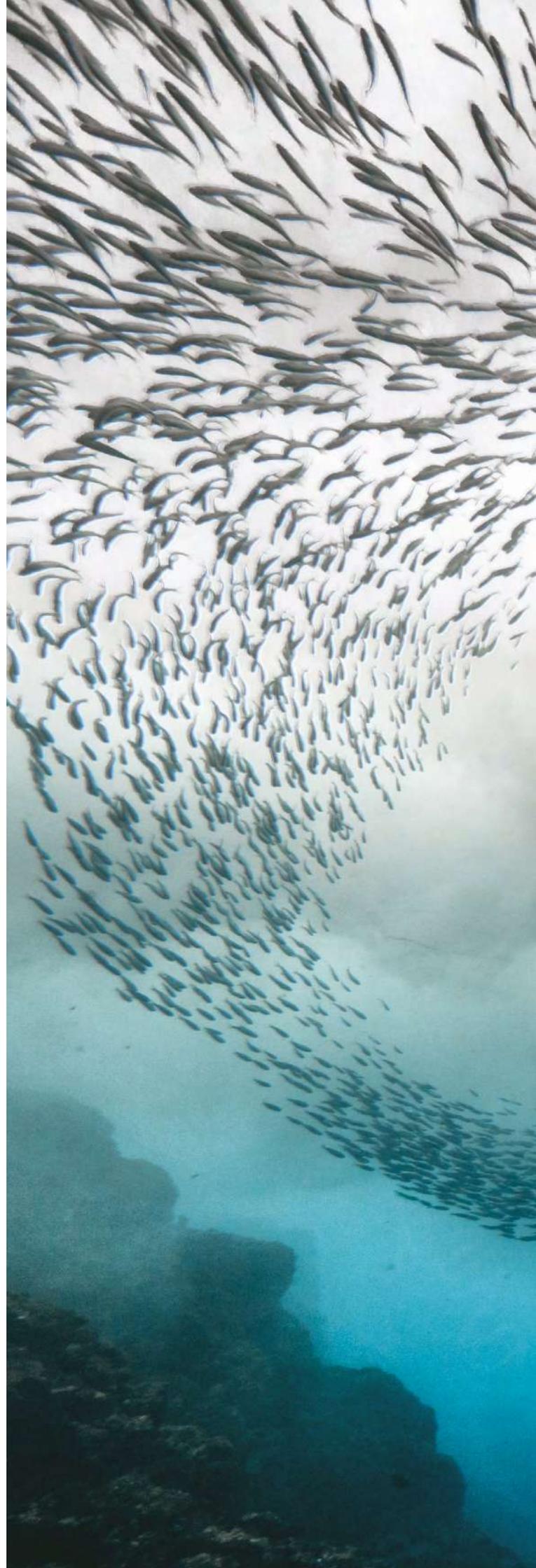
I first met Frenchman Fabrice Schnöller aboard the expedition yacht *Barba* earlier this year when we took part in the Arctic Whale project, a story featured in Issue 08 of *Oceanographic*. As we sailed across the North Atlantic, Schnöller explained the pioneering research he has dedicated much of the past decade to – Darewin, a company he founded in 2012 with one simple aim: to gain a greater understanding of cetacean click communication.

Born in Tahiti, Polynesia, the ocean has always been part of Schnöller's life. "The first years of my life were spent on the beach and in the water. I have always been connected to the ocean. It's my universe." And while this may be the root, Schnöller notes one poignant encounter that led him to found Darewin. In 2006, on a short sailing journey from the Réunion Islands to Mauritius, Schnöller and a friend found themselves surrounded by a pod of sperm whales. Hypnotised by their presence, an urge to enter the water overcame him. "[It was a] crazy experience – 20 big animals coming towards me, making sounds, wanting to touch me, studying me," he says. "It was like being on another planet, and it was the start of everything." Schnöller, who at the time was the CEO of an engineering company, was so compelled by his encounter that he sold his company, embarked on a postgraduate degree in biology and began his innovative research into cetacean communication. "I discovered that there was no one really working on communication, so I said, 'let's collect evidence of it so that people can see it, maybe then they will be interested'"

The primary objective of Darewin is to collate data, and lots of it – the pursuit of a critical mass of information that, it is hoped, will encourage the broader scientific community to invest additional resources into whale communication research. It's a get-the-ball-rolling exercise of sorts. To aid this process, Darewin uploads its ever-expanding findings to an open-source platform, available for all to access.

Darewin's data collection methodology hinges on two things: freediving and revolutionary technology. Freediving is important because it enables Schnöller and his team (including record-breaking freediver and underwater photographer Fred Buyle) to interact with the whales unencumbered – a non-invasive approach without the noise and complications that arise with scuba gear.

Regarding the technology, Schnöller wanted to create something that allowed his team to capture the magic of the interactions as well as collect visual and acoustic information that would afford them the opportunity to learn from the encounters, in turn improving the quality of subsequent interactions. "It's not every day that you meet 20 sperm whales, [and I wanted] everyone to see it. So I developed these 360° cameras. My goal was to



| PREVIOUS PAGE: Fabrice Schnöller filming a group of sperm whales in Dominica with a 360 camera.

| THIS PAGE: Schnöller and a school of bait fish off Reunion island.



“Darewin's data collection methodology hinges on two things: freediving and revolutionary technology.”

“Darewin is also exposing our own species' naivety when it comes to how we interpret communication.”

capture everything, to gather data, to share it with people – and to interpret [whale behaviour] so we can interact with them [more effectively].” The tool he created was a combination of cameras and hydrophones, and it worked.

With the onset of VR, his timing was perfect. His captures allowed people to totally immerse themselves in particular encounters. It tacked on an emotional element to what started as a scientific pursuit. “When you get into the water with them, you can feel the love a mother has for her calf,” says Schnöller. “By using VR, others can feel that too.” In 2015, Darewin partnered with the New York Times to produce the Emmy-nominated 360° underwater VR movie, *The Click Effect*, and was also invited to present at the 2016 UN Solution Summit. By capturing all the information available, Darewin offers scientists the necessary data to make better connections between communication and behavioural habits.

So, we know that whales communicate, but what are they saying? And how complex is that communication? Here, Darewin has collated significant data surrounding the whistle-ID of both captive and wild dolphins. It is known that dolphins in captivity use whistles as a form of ID, so Schnöller set about collecting the signatures of a wild pod off the coast of Réunion Island.

His results showed that each dolphin used a unique whistle when approaching him in the water, as if they were presenting themselves. “Scientists have said that yes, dolphins use their whistle when they come to you, but it can't be proven that they are introducing themselves, and they are right. But when you are in the water, you know they are doing that.”

The same can be said for sperm whales, of which Darewin has amassed the largest collection of behavioural and vocalisation data ever recorded. When Buyle was freediving with a pod of sperm whales, he witnessed an incredibly rare sight – a live birth. But it is what the mother did next that most surprised the team. “The mother took the baby in her mouth and she brought it to Fred. He felt like the mother was presenting him her baby.” There is, of course, no way of scientifically proving that this was what the mother was doing, even though they felt it when underwater.

This is where Darewin's VR technology aims to shed further light. By capturing every element, scientists will be better equipped to understand the intricate

details of what is happening underwater, from both a communication and a behavioural perspective.

Darewin is also exposing our own species' naivety when it comes to how we interpret communication. Schnöller notes that we project our own way of communicating onto cetaceans and try to make determinations from this perspective, but the truth is that they communicate in their own unique way, using a sensory system we do not possess. “They have sonar,” he says. “Sonar can convey more information than just sound. We don't have the sensory system for this, so we don't ‘get it.’” Anthropomorphism – the attribution of human traits, emotions, or intentions to non-human entities – extends, it would seem, to communication.

Using the jawbone as an antenna, and teeth as receivers, sonar enables whales to create a 3D map of everything around them. So when Schnöller and the Darewin team enter the water, the cetaceans around them can physically see through them too, in much the same way as an x-ray machine. In addition, Schnöller notes that sperm whales can collectively communicate through a term he calls overlapping. “I have to stop talking and listen when you talk,” he says. “We cannot talk and listen at the same time, but sperm whales can.” It is our Umwelt, the term coined by the early 20th century biologist Jakob von Uexküll, that proposes our objective reality to be absolute. Schnöller sums this up perfectly: “Just try to explain to someone who has been blind all of their life what it's like to see.”

Sperm whale communications are extremely diverse. Their clicks can be as short as 1/1000 of a second, and their range goes all the way up to their ‘gunshot’, one of the most powerful sounds on the planet – as loud as 230 decibels. To put this into perspective, a jet taking off registers at around 150 decibels from 25 metres, enough to rupture an eardrum. Scientists claim that anything between 180-200 is enough to kill. These powerful sounds enable whales to communicate over truly enormous distances – thousands of miles.

Regarding the huge distances over which whales are able to communicate, we must consider the larger questions surrounding the impact human activity in the oceans plays on the health of cetaceans. Offshore oil drilling, fracking and seismic surveys, for example, emit such significant underwater sounds that, according to a report published in the *Journal of Experimental*



| TOP: Schnöller using a 360° camera mounted on a ray-bio-inspired device with multiple hydrophones built to record whales and dolphins clicks.
| BOTTOM: Schnöller filming spotted dolphins in Bimini, Bahamas



“What started as an inquiry into whale communication has developed into a broader consideration of whale consciousness, and our duty to their welfare.”



*The first 360° camera/
sound recording proto-
type being deployed in
Mauritius, 2011.*



*Inquisitive sperm whales
come in for a closer look at
the prototype.*

“Sperm whale brains possess spindle cell neurones, which are most commonly associated with empathy.”

Biology, whales avoid otherwise populated areas and even change their migratory patterns. Worse still, underwater sound is also directly related to cetacean death. The well-publicised mass stranding of Curvier’s beaked whales, Blainville’s beaked whales and northern minke whales in the Bahamas in 2000, for example, has been acknowledged by the US Government as a direct result of mid-frequency military sonar use.

What started as an inquiry into whale communication has developed into a broader consideration of whale consciousness, and our duty to their welfare. People often recall the moment they make eye contact with a whale – they feel connected in some unknown way to another sentient being, a trans-species communication that supersedes objective thought. Schnöller explains regarding sperm whales, for example, the evidence of consciousness is alarmingly clear. “They educate their calves for 15 years,” he says. “Why do they do this? What do they need 15 years for? To catch some squid? I don’t think so.” Indeed, sperm whales possess the largest brain in the animal kingdom, and their neocortex, the part of the brain that controls higher-level function, including cognitive behaviour, perception and language, is six times larger than a human’s, and far denser. They also possess spindle cell neurones, which are most commonly associated with empathy. This evidence suggests that sperm whales, among other cetaceans, have brains that allow them to feel emotion, intuition and goes some way to explain just how diverse their communications truly are. “Firstly, we have to ask, what is consciousness? And then we have to ask, how can we say that we are more conscious than them?” says Schnöller. “We are not so different. These animals are very social, they have empathy, and you can feel it when you meet them, but you can also take it from the scientific, biological angle too.”

What it fundamentally comes down to is an emotional response, and it is this emotional response that Schnöller believes is the way to create a more harmonious existence with whales and the wider marine population. “When I’m in the water, I know they are communicating with me,” says Schnöller. “So I think if we really want to raise awareness of animals among people, we have to create something emotional. For me, raising the idea of consciousness in animals is about targeting one very simple thing, to say that they deserve the same rights as us. They are sentient beings with emotions like us. So the last wall between us and the animal, for me, is language.”

Darwin continues to bridge the gap. As of this moment, Schnöller is in arctic Norway trialling a new invention with orcas, something he jokingly calls the Orca Talker, to further glean information about the complexities of cetacean communication. We know their communications are multifaceted, but is there anything else we can learn? “The basic idea was to capture the orcas’ acoustic signatures, to see what they’re saying.” For this, Schnöller invented a special tool to bounce the clicks back at the animal to see how they reacted. He says: “The tool [has] three acoustic lenses that create rebounds in the sound and make a hologram to see if they receive it, how they react and whether they’ll be interested.” Only after this winter season will their results be revealed – another step in data collection. By mapping signatures in this way, the team will also be able to match cetacean dialect with other recordings, thus making it possible to determine where the whales have come from. As Schnöller says, “Maybe there’s a possibility for us to find out what sounds are used and from where, like humans with different languages.”

With all research that is at the frontier of discovery, the process is a long and arduous one, but it is only by staunchly pursuing this knowledge that we will be able to understand in greater detail. Darwin is asking the right questions at the right time. The better we understand the language of cetaceans, the more likely we are to instil positive change within our oceans.