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We learned a lot about whales this year

By Nick Pyenson

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Some of the largest skeletons in places such as the Smithsonian's National Museum of Natural History — those of mammoths, mastodons, sauropod dinosaurs and the *Tyrannosaurus rex* — belong to long-extinct species. They are totems of the deep past, but it is important to remember that we are living in a time of giants. Those giants are whales, creatures that have been evolving for 4 billion or so years. And our fate is tied to theirs.

As a whale scientist at the Smithsonian, I can tell you that 2019 was an unusual year for learning about whales. This year, scientists discovered that blue whales have a better memory than anyone suspected: They remember where they have been, and they know where they are going. That may seem obvious, but consider how hard it is to study anything about a 300,000-pound mammal that lives as long as we do and travels across thousands of miles of ocean. My colleagues attached satellite tags to the backs of blue whales and found that their migrations targeted feeding patches that

were consistently reliable over decades, rather than the latest (and potentially ephemeral) hot spots. In other words, blue whales seek the most dependably open lunch spots, rather than the newest food truck, because the risk of not finding food is too great when you're moving a hundred tons of warm-blooded tissue across an ocean. (But how exactly they find these places that they remember remains a mystery.)

It is worth remembering that blue whales nearly didn't make it out of the 20th century because of industrial whaling: 99 percent of the blue whale population from 1900 was gone by 1970. The slaughter killed as many as 3 million of the giants among us, including the fin, sei, humpback, right and sperm whales.

The surviving whales have inherited a lonelier and more perilous ocean. Whaling has largely stopped thanks to an international moratorium, but 200,000 or so whales die each year from ship strikes, being entangled in abandoned fishing nets or ingesting enough plastic pollution to fatally clog their digestive tracts. Some threats are diffused and hidden, making them hard to manage; others, such as being struck by cargo and cruise ships, happen because whales swim and feed in the waters near our densest cities. Their fates — and how much they suffer — are directly tied to our ability to manage our urbanization of the world's coastlines.

The number of whales living on the planet matters for an unexpectedly practical reason: There is a value for all of the carbon locked in their bodies. With their extreme size, whales incorporate a vast amount of carbon from the atmosphere

throughout their lives by feeding on krill and other zooplankton at the base of the food web. When whales die, their carcasses fall to the ocean floor, burying that carbon and preventing it from contributing to climate change — for a geologically long period of time. This year, economists calculated the value of all this carbon sequestration at more than $1 trillion. Imagine a world full of whales, as it was a century ago, with hundreds of thousands of blue whales keeping our planet habitable for the foreseeable future.

The most striking thing to me, however, is that, after centuries of investigation, we still don't really know that much about whales — and new discoveries are always in the offing. Last month, several of my colleagues reported that blue whales drop their heart rate to an astounding two beats per minute on a dive. The researchers achieved this hard-earned insight by attaching a removable tag loaded with FitBit-like sensors to a whale's back. For this study, they deftly placed the electrode-housing tag just below the left pectoral fin. Two beats per minute was a number scientists had not anticipated, setting a new limit for what heart tissue can do in mammals.

Whales teach us a lot about the limits of biology because they are so big. But why haven't they gotten bigger? After all, they have had more than 50 million years to do so, starting with dog-size land ancestors. This month, my colleagues and I published a paper addressing this question. After collecting tag data from every size of whale we could find, we calculated the feeding efficiency from each species, effectively asking: From porpoise to blue whales, what' is the return on the

investment for pursuing food? We found limits governing whale size based on the kind of food that they eat. It turns out that echolocating sperm whales are energetically maxed out for catching single prey at depth, while a filter-feeding blue whale has maximized its ability to gulp swarms of krill near the surface. They are each larger than any of their ancient relatives, a strong hint that evolution has maximized size to these ends. The giants among us are that way because they have hacked how to hunt the Earth's oceans unlike any species before them.

As much as we have pulled back some mysteries about whales this year — knowing their minds, their hearts and what limits them — we are still far from knowing everything about them. For instance, we still don't know how many *kinds* of whales there are on the planet: This year, scientists described a new species of whale, *Berardius minimus*, that is so poorly known that we have more details about its biology from Japanese whaling carcasses and museum drawers than from the wild.

There were other surprises not on my bingo card for 2019: A people-friendly beluga bearing a Russian-made harness appeared in northern Norway, and a viral video showed it playing catch with boaters who tossed it an inflatable ball. It may well have been an escapee from the Russian navy, serving as a reminder that our militaries (U.S. and Russian) have long conscripted whales for warfare. A brave public servant fought a terrorist on the London Bridge using a narwhal tusk, an object whose actual function scientists still

don’t fully understand.

Some of these stories seem pulled from fiction; facts about whales sometimes feel that way, whether they are about their inscrutable inner lives or the size of their outer ones. Because of their place in ocean ecosystems, whales tell us about things we can’t see or phenomena that are otherwise hard to measure. A careful inspection of them reveals the outlines of our own imprint on the farthest reaches of this planet, whether it’s plastics in their bodies or the deep grooves of fishing lines lodged in their skin. Self-knowledge can be challenging, but I think we need these stories of discovery to remind us that the world is still full of wonder and mysteries to plumb.

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