Sharks

400-year-old Greenland shark is the oldest vertebrate animal

Shark, which would have reached sexual maturity at around 150 years, sets new record for longevity as biologists finally develop method to determine age

The oldest Greenland shark found by researchers was most likely around 392 years old, although the range of possible ages stretches from 272 to 512 years. Photograph: Paul Nicklen/National Geographic Creative/Getty Images

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She was born during the reign of James I, was a youngster when René Descartes set out his rules of thought and the

great fire of London raged, saw out her adolescent years as George II ascended the throne, reached adulthood around the time that the American revolution kicked off, and lived through two world wars. Living to an estimated age of nearly 400 years, a female Greenland shark has set a new record for longevity, scientists have revealed.

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The discovery places the lifespan the Greenland shark far ahead of even the oldest elephant in captivity, Lin Wang, who died aged 86. It is also far longer than the official record for humans, held by 122-year-old Frenchwoman Jeanne Louise Calment.

“It kicks off the bowhead whale as the oldest vertebrate animal,” said Julius Nielsen, lead author of the research from the University of Copenhagen, pointing out that bowhead whales have been known to live for 211 years.

But the Greenland shark doesn’t scoop all the gongs - the title of the world’s longest lived animal is held by Ming, an Icelandic clam known as an ocean quahog, that made it to 507 years before scientists bumped it off.

Grey, plump and growing to lengths of around five metres, the Greenland shark is one of the world’s largest carnivores. With a reported growth rate of less than one centimetre a year, they were already thought to be long-lived creatures, but just how long they lived for was something of a mystery.

“Fish biologists have tried to determine the age and longevity of Greenland sharks for decades, but without success.” said Steven Campana, a shark expert from the University of Iceland. “Given that this shark is the apex predator (king of the food chain) in Arctic waters, it is almost unbelievable that we didn’t know whether the shark lives for 20 years, or for 1000 years.”

A Greenland shark near the surface after its release from the research vessel Sanna in northern Greenland. Photograph: Julius Nielsen/Science

The new research, he says, is the first hard evidence of just how long these creatures can live.

“It definitely tells us that this creature is extraordinary and it should be considered among the absolute oldest animals in the world,” said Nielsen.

Writing in the journal Science, Nielsen and an international team of researchers describe how they set about

determining the age of 28 female Greenland sharks, collected as by-catch during scientific surveys between 2010 and 2013.

While the ages of many fish can be determined by counting the growth layers of calcium carbonate “stones” found their ears - in a manner somewhat similar to counting tree rings - sharks do not have such earstones. What’s more, the Greenland shark lacks other calcium-rich tissues suitable for this type of analysis.

Instead the team had to rely on a different approach: scrutiny of the lenses in their eyes.

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The lens of the eye is made of proteins that build up over time, with the proteins at the very centre of the lens laid down while the shark is developing in its mother’s womb. Work out the date of these proteins, the scientists say, and it is possible to achieve an estimate of the shark’s age.

In order to determine when the proteins were laid down, the scientists turned to radiocarbon dating - a method that relies on determining within a material the levels of a type of carbon, known as carbon-14, that undergoes radioactive decay over time.

By applying this technique to the proteins at the centre of each lens, the scientists deduced a broad range of ages for each shark.

The scientists then made use of a side-effect of atomic bomb tests which took place in the 1950s: when the bombs were detonated, they increased the levels of carbon-14 in the atmosphere. The spike, or pulse, in carbon-14 entered the marine food web across the North Atlantic no later than the early 1960s.

That provides a useful time-stamp, says Nielsen. “I want to know when I see the bomb-pulse in my sharks, what time does that mean,” he said. “Does it mean they are 50 years old, or 10 years old?”

Nielsen and the team found that the eye lens proteins of the two smallest of their 28 Greenland sharks had the highest levels of carbon-14, suggesting that they were born after the early 1960s. The third smallest shark, however, had carbon-14 levels only slightly above those of the 25 larger sharks, hinting that it was actually born in the early 1960s, just as bomb-related carbon-14 began to be incorporated in marine food webs.

A Greenland shark returning to the deep and cold waters of the Uummannaq Fjord in northwestern Greenland. The sharks were part of a tag-and- release program in Norway and Greenland. Photograph: Julius Nielsen/Science

"That indicates that most of our analysed sharks were actually older than the time mark, meaning that they were older than 50 years," said Nielsen.

The scientists then combined the carbon dating results with estimations of how Greenland sharks grow, to create a model which allowed them to probe the age of the 25 sharks born before the 1960s.

Their findings revealed that the largest shark of the group, a female measuring just over five metres in length, was most likely around 392 years old, although, as Nielsen points out, the range of possible ages stretches from 272 to 512 years.

"The Greenland shark is now the best candidate for the longest living vertebrate animal," he said.

What's more, with adult female Greenland sharks known hit sexual maturity only once they reach more than four metres in length, the scientists found that females have to clock up an age of around 150 years before they can produce young.

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But not everyone is convinced that Greenland sharks can live for four centuries. "I am convinced by the idea of there being long lifespans for these kinds of sharks, [but] I take the absolute numbers with a pinch of salt," said Clive Trueman, associate professor in marine ecology at the University of Southampton.

Trueman agrees that it is possible to get a record of the early life of a vertebrate from eye lens proteins. However, the fact that the proteins in the centre of the eye lenses, and hence the carbon-14 within them, came from nutrients taken in by the shark's mother adds a number of uncertainties to the calculations, he says.

Campana says while the approach taken by the researchers is sound, he remains unconvinced that Greenland sharks live for almost 400 years. But, he adds, "future research should be able to nail the age down with greater certainty."

Nielsen is also looking forward to further research, saying that he hopes the Greenland shark's new found fame will boost awareness of the animal, as well as conservation efforts and attempts to unravel other aspects of its

physiology. “There are other aspects of their biology which are super-interesting to know more about and to shed light upon,” he said.

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