

How Whales Became the Biggest Animals on the Planet

Whales are big. Really big. Enormously big. Tremendously big. **Fin whales** can be 140,000 pounds. **Bowhead whales** tip the scales at 200,000 pounds. And the big mama of them all, the blue whale, can reach a **whopping** 380,000 pounds — **making it the largest animal to have ever lived.**

已註解 [U1]: Fin whales 長鬚鯨(n.)

已註解 [U2]: Bowhead whales 北極露脊鯨(n.)

已註解 [U3]: Whopping 巨大的(a.)

已註解 [U4]: make A B to have + PP 使 A 成為曾經 PP 的 B

But for as long as whales **have awed us with their great size,** people have wondered how they became so colossal.

已註解 [U5]: have awed A with B 以 B 使 A 感到讚嘆

In a study published Tuesday in the journal Proceedings of the Royal Society B, a team of researchers investigated gigantism in baleen whales, the filter-feeding **leviathans** that include blue whales, bowhead whales and fin whales. The marine mammals became jumbo-size relatively recently, they found, only within the past 4.5 million years. The cause? A climatic change that allowed the **behemoths** to **binge-eat.**

已註解 [U6]: leviathan 海中怪獸/ 巨物(n.)

已註解 [U7]: behemoth (像河馬的)巨獸(n.)

已註解 [U8]: binge-eat 暴飲暴食(n.)

Whales have an interesting evolutionary history. They began as land-dwelling, **hoofed** mammals some 50 million years ago. Over several millions of years they developed fins and became marine creatures. Between about 20 million and 30 million years ago, some of these ancient whales developed the ability to

已註解 [U9]: hoofed 有蹄的(a.)

filter-feed, which meant they could swallow **swarms of** tiny prey in a single **gargantuan** **gulp**. But even with this feeding ability, whales remained only moderately large for **millions of** years.

已註解 [U10]: swarms of N 整群的 N

已註解 [U11]: gargantuan 巨大的(a.)

已註解 [U12]: gulp 吞下/ 吞嚥(n.)

“But then **all of a sudden** — ‘boom’ — we see them get very big, like blue whales,” said Nick Pyenson, the **curator** of fossil marine mammals at the Smithsonian Institution’s National Museum of Natural History and an author of the paper. “It’s like going from whales the size of minivans to longer than two school buses.”

已註解 [U13]: all of a sudden 突然間(adv.)

已註解 [U14]: curator 館長(n.)

Dr. Pyenson and his colleagues measured more than 140 museum specimens of fossilized whales, and then plugged that data into a statistical model. It showed that several distinct **lineages** of baleen whales became giants around the same time, independently of one another. Starting around 4.5 million years ago, giant blue whales were **popping up** in oceans across the world alongside giant bowhead whales and giant fin whales.

已註解 [U15]: lineage 血統(n.)

已註解 [U16]: pop up 出現

The researchers suspected that an environmental change happened during that time that essentially caused the **baleen whales** to **bulk up**. After some investigation, they found that this time period **coincided with** the early beginnings of when ice sheets increasingly covered the Northern Hemisphere. Runoff from the glaciers would have washed nutrients like iron into coastal waters and intense seasonal **upwelling** cycles would have caused cold water from

已註解 [U17]: baleen whale 鬚鯨(n.)

已註解 [U18]: bulk up 變大/ 長大

已註解 [U19]: coincide with N 與 N 一致

已註解 [U20]: upwelling 上湧/ 噴出(n.)

deep below to rise, bringing organic material toward the surface. Together these ecological effects brought large amounts of nutrients into the water at specific times and places, which had a cascading effect on the ocean's food web.

Throng of zooplankton and krill would gather to feast on the nutrients. They would form dense patches that could stretch many miles long and wide and be more than 65 feet thick. The oceans became the whales' giant all-you-can-eat buffets.

"Even though they had the anatomical machinery to filter-feed for a long, long time," said Jeremy Goldbogen, a comparative physiologist from Stanford University and author of the paper, "it wasn't until the ocean provided these patchy resources that it made bulk filter-feeding so efficient."

The baleen whales could now gulp down much larger amounts of prey, which allowed them to get bigger. But that was only part of the equation.

"Plentiful food everywhere isn't going to get you giant whales," said Graham Slater, an evolutionary biologist at the University of Chicago and the study's lead author. "They have to be separated by big distances."

Because the ecological cycles that fuel the explosions of krill and zooplankton occur seasonally, Dr. Slater said the whales must migrate thousands of miles from food patch to food patch. Bigger whale ancestors that had bigger fuel tanks had a better chance of surviving the long seasonal migrations to feed, while

已註解 [U21]: cascading 串聯的(a.)

已註解 [U22]: have an effect on N 對 N 有影響

已註解 [U23]: throng 群(n.)

已註解 [U24]: zooplankton 浮游動物(n.)

已註解 [U25]: krill 磷蝦(n.)

已註解 [U26]: feast on N 大快朵頤 N

已註解 [U27]: anatomical 構造上的(a.)

已註解 [U28]: it was not until N that S + V 直到 N 才 S+ V...

smaller baleen whales became extinct.

If the food patches were not far apart, Dr. Slater said, the whales would have grown to a certain body size that was comfortable for that environment, but they would not be the giants we see today.

“A blue whale is able to move so much further using so much less energy than a small-bodied whale,” Dr. Slater said. “It became really advantageous if you’ re going to move long distances if you’ re big.”

Ari S. Friedlaender, a behavioral ecologist at Oregon State University who was not involved in the study, said the research improved our understanding of how baleen whales became giants.

“What this does is it allows us to be able to say that there are crucial processes in the ocean that allowed these animals to get this big,” he said.

Richard Norris, a **paleo-biologist** at the Scripps Institution of **Oceanography**, called the study a “nice piece of work,” and said that it confirmed scientists’ current understanding of changes to the oceans over time.

已註解 [U29]: paleo-biologist 古生物學家(n.)

已註解 [U30]: oceanography 海洋學(n.)

“When we think about what the planet has been like in its long history, a whale of 10 million years ago was a very different type of **critter** than we have now,”

已註解 [U31]: critter 創造物(n.)

Dr. Norris said. “So in a sense we live in a special time where we get to enjoy the majesty of really big animals out there in the ocean.”

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<https://www.nytimes.com/2017/05/24/science/whales-evolution-oceans.html?smid=fb-nytscience&smtyp=cur&r=1>

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