Evolution of marine mammals to water life converges in some genes

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Credit: Wkipedia

When marine mammals such as whales, dolphins, manatees and walruses moved from land to water, a series of physical abilities —— limbs adapted for swimming, less dense bones that make them more buoyant and a large store of oxygen relative to their body size – made it possible. Yet these animals made the transition from land to water millions of years apart.

In a report that appears online in the journal *Nature Genetics*, an international consortium of researchers that includes those at Baylor College of Medicine looked at the genomes of these four marine mammals and compared them to their closest land kin. The genomes of the whale and dolphin were compared to that of the cow, the walrus to the dog and the manatee to the elephant.

"The Baylor College of Medicine Human Genome Sequencing Center had already done some sequencing of the dolphin and then refined the genome sequence further," said Dr. Kim Worley, professor in the Baylor Human Genome Sequencing Center and an author of the project. The Baylor Center did the sequencing of the killer whale, dolphin and walrus and The Broad Institute of MIT and Harvard in Cambridge, Mass., sequenced the genome of the manatee. The phenomena of moving from land to water happened in the subclades (subgrouping) called Cetariodactyla (which includes whales, dolphins and cows) and Carnivora (which includes walruses and dogs) and Afrotheria (which includes manatees and elephants).

The marine mammals shared the traits needed to live in a marine environment, but they developed their traits separately – a process called convergent evolution.

"We were wondering what the genetic evidence for this convergent evolution was," said Worley.

In their work, they found 191 genes likely to be associated with the move from land to sea that were selected during evolution across the four species, eight of these had undergone identical changes in the different lineages. Another seven genes had undergone identical changes but were believed to be involved in the land-sea shift in only a couple of the mammals.

The comparison of the genomes of the marine mammals has highlighted "parallel molecular changes in genes evolving under positive selections and putatively associated with independently evolved, adaptive phenotypic convergence," the authors wrote. They also found widespread molecular convergence in the land animals.

"Our data therefore indicate that, although convergent phenotypic evolution can result from conver gent molecular evolution, these cases are rare, and evolution more frequently makes use of different molecular pathways to reach the same phenotypic outcome," the authors wrote.

"We found some positively selected genes that were selected on all lineages," said Worley. "We found that there were parallel, non-synonymous changes in coding genes that occurred at the same amino acid site on more than one lineage. We also found similar history in the terrestrial animals."

More information: "Convergent evolution of the genomes of marine mammals." *Nature Genetics* (2015) DOI: 10.1038/ng.3198

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