A WHALE OF A FIND

UC RIVERSIDE:
Research finds evolutionary link in genes of sea creatures.

BY MARK MUCKENFUSS

Baleen whales, such as the gray and blue whales, do not have teeth. But their distant ancestors did; at least, that has been the belief based on the fossil record.

Now UC Riverside researchers say they have shown that modern baleen whales still carry the gene for making enamel, the building material for teeth. However, the gene has changed over millions of years and is no longer functional.

Confirming the gene's existence, the researchers say, further cements the concepts behind Darwin's Theory of Evolution, showing a strong connection between the molecular and the larger physiological changes that take place in animals over time.

Eventually, the scientists want to construct an evolutionary tree showing the place and time where various species diverged from one another.

Biology professor Mark Springer led the whale study.

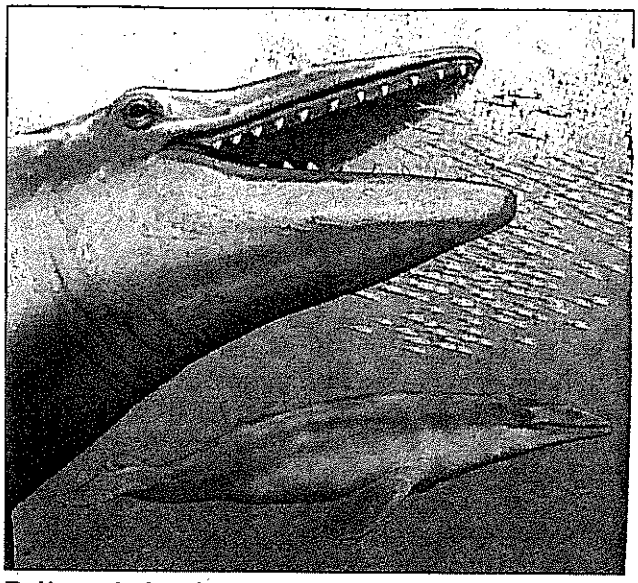
"We view this as sort of very important in the context of the work that we're doing," Springer said. "Not only do we find evidence that the enamelin gene is (changed) ... but we can make some predictions about when enamel was lost and tie that into the fossil record."

Using genetic information from other vertebrates, the researchers were able to identify the enamelin gene in the whales. What they discovered was that the gene had damaged sections that left it useless.

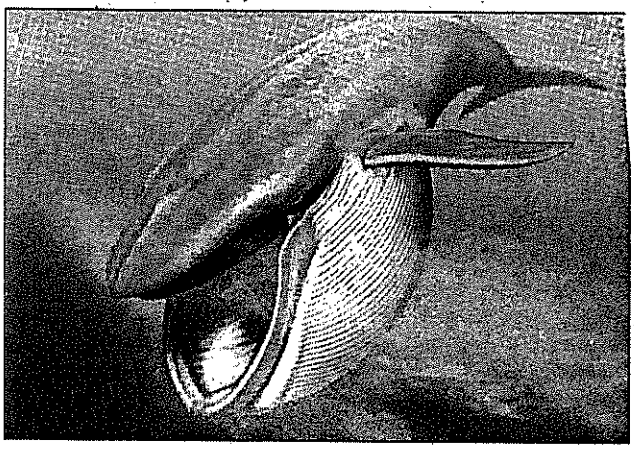
Instead of teeth, baleen whales have a thick, fibrous material in their mouths that strains from sea water the small organisms on which they feed, such as krill and plankton. Study of fossils indicates that the whales lost their teeth about 20 million years ago.

Springer said that Darwin used diminished or vestigial organs as evidence of evolution, such as sightless cave-dwelling fish that still have eyes. The UCR study, he said, uses the same idea but connects the gene with a physiological feature, or morphology, that is no longer present.

"What makes this unique is it's one of the few opportunities to actually look at the molecular decay of a gene, coupled with the loss of a morphological feature in the fossil record," he said.



Baleen whales then, with teeth.



Baleen whales now, without teeth.

Eventually, he said, the gene will most likely disappear completely.

"We know that modern birds that do not have teeth are descended from animals with teeth," Springer said. "But the loss of teeth in birds was much earlier" than in whales.

While evidence exists of

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genes that code for tooth enamel in some birds, the genes are so degraded that the evidence is not definitive.

Charles Marshall, Harvard University professor of biology and geology, called the UCR study clever.

"It's sort of not really a surprise," Marshall said of the findings, "which is sort of why it's important. As Mark Springer and his colleagues argue, we know a lot about the genes and we know a lot about morphology, but we're not able to connect them very often."

The fact that the enamel gene has decayed is also important, Marshall said. "There are relatively few examples where you can see the consequences of decay within the gene."

Louise Mead, education project director for the National Center for Science Education in Oakland, has a doctorate in evolutionary biology. She said the study is important in showing how researchers can predict the evidence for evolution.

"They made the prediction and when they actually looked for the gene they actually found the gene," Mead said. "I think it's a novel find. What's really nice, in addition to the predictive value, it actually adds more support again that whales have this common ancestor."

Springer said whales are not alone when it comes to inactive or pseudogenes. Humans, for example, have a nonfunctioning vitamin C gene, he said. "We can't make our own vitamin C, where some mammals can."

The team chose to study the enamel gene in whales because of the distinct contrast between ancient whales with teeth and modern whales without.

"There are different systems where one can look at this," Springer said. "There are mammals that are blind and have vestigial eyes such as golden moles. The enamelin gene is just one of the ones we're looking at.

"It becomes interesting to look at certain evolutionary changes on certain branches of the tree," he said. "We're interested in morphologies evolving on different branches of the tree and to be able to tie that into key genes. We're sort of anxious to be able to use that approach to other gene sequences."

The UCR study appears in the Sept. 4 issue of PLoS Genetics. It can be found online at www.plosgenetics.org/article/info%3Adoi%2F10.1371%2Fjournal.pgen.1000634

EVIDENCE OF EVOLUTION: Researchers at UC Riverside have discovered nonfunctioning genes in toothless whales that indicate they once had teeth, bolstering the belief that they descended from the toothed whales found in fossils.

Baleen: Thick, brush-like material strains sea water for food such as plankton and krill.

Examples of baleen whales: Blue, gray and humpback

Ancestors: Extinct ancestors of baleen whales such as Aetiocetus weltoni, which lived 25 million years ago, had teeth.

Now: Modern baleen whales lack teeth but carry a nonfunctional gene for tooth enamel.

SOURCE: UC RIVERSIDE

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