Genetic mutation in whale eyes may increase mortality risks

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A mother and calf right whale surfacing at Sebastian Inlet, Florida. New research led by Florida Institute of Technology links difficulty seeing in bright light with baleen whales' susceptibility to fatal entanglements in fishing gear. Credit: Richard Aronson/Florida Institute of Technology

Scientists have found that a genetic mutation in the eyes of right whales that hampers their ability to see in bright light may make them more susceptible to fatal entanglements in fishing gear, one of the major causes of death for this critically endangered mammal.

The study of this whale species, which numbers less than 500 individuals remaining in the Western Atlantic Ocean, may also help scientists better understand how vision works in other mammals, including people.

Florida Institute of Technology doctoral student Lorian Schweikert and her adviser, Michael Grace, professor of neuroscience and senior associate dean of science, worked with Jeffry Fasick, an assistant professor of biology at the University of Tampa, to characterize this newly discovered mutation in Northern right whales and Bowhead whales. Their results suggest that this mutation may seriously harm the whales' ability to visually avoid entanglement.

According to their new study, "Evolutionary Loss of Cone Photoreception in Balaenid Whales Reveals Circuit Stability in the Mammalian Retina," published this month in the *Journal of Comparative Neurology*, the normal light-detecting proteins in cone photoreceptor cells are missing in these whales, demonstrating for the first time the complete loss of cone-based light detection in any mammal.

In light of the findings, the Florida Tech and University of Tampa team cloned and sequenced the gene that encodes a cone opsin protein. Humans possess several different opsin genes that provide excellent color vision, but whales and their relatives were thought to only possess one. Now researchers are finding some whale species in which that single gene is fundamentally broken.

Working in Florida Tech's Behavioral Neuroscience Laboratory and the Center for High Resolution Microscopy, the scientists went on to study how this mutation affects the wiring of the whale retina by studying the bowhead whale, a resident of the Arctic. Schweikert and Grace found that rod cells—light-detectors that operate in dim-light conditions—remain, while functional cone cells are completely absent in the bowhead whale retina.

Said Schweikert, "Cone cells are normally required for vision in bright light. With only rods, right whales may have very poor vision when they surface to breathe. This may make it difficult for them to avoid entanglement in fishing gear - one of the leading causes of death of these critically endangered animals."

Unexpectedly, however, the cone opsin mutation thought by scientists to hinder operation of the retina may actually enhance dim-light vision in these whales—a finding that provides insight into the effects of mutations on the health and function of the human retina.

"Understanding sensory systems in critically endangered species opens a window that may help us better understand how to protect them," Grace said. "It's a fantastic bonus that analyzing whale vision eyes may help us better understand how our own eyes operate."

More information: Lorian E. Schweikert et al, Evolutionary loss of cone photoreception in balaenid whales reveals circuit stability in the mammalian retina, *Journal of Comparative Neurology* (2016). DOI: 10.1002/cne.23996

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