Optic lobe of giant squid found proportionally smaller than for other cephalopods

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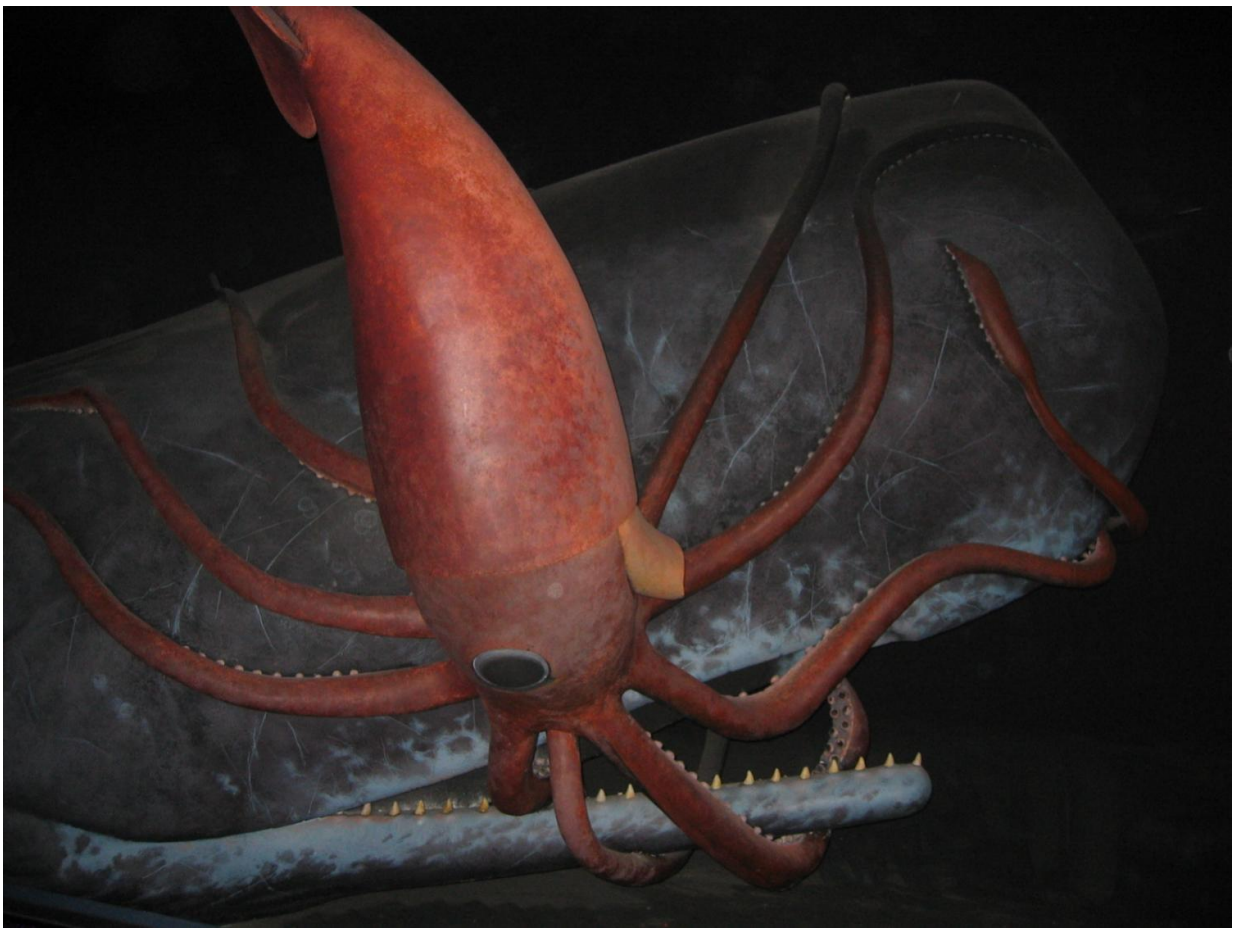

The dramatization of an underwater encounter between the sperm whale and giant squid, from a diorama in the Hall of Ocean Life at the American Museum of Natural History. Credit: Mike Goren/Wikipedia/CC BY 2.0

(Phys.org)—A team of researchers in Taiwan has found that despite having outsized eyes, giant squid do not have an overly large optic lobe to match. In their paper published in the journal *Royal Society Open Science*, the group describes carrying out a study of a giant squid captured alive by local fishermen and what they found upon examining the vision processing parts of its brain.

As the researchers note, despite their notoriety, some aspects of the giant squid have not been studied very well—this is because they are very rarely captured alive. Study of the live brain of the squid, for example, has been extremely limited. In this new effort, the researchers took advantage of a unique opportunity—local fishermen happened to catch one of the elusive sea creatures and alerted the researchers to the find.

It has often been noted that giant squid have eyes that are so large they look somewhat comical, but unfortunately, little work has been done to understand their size and thus what benefits they confer to squids. For that reason, upon finding a live specimen on their table, the researchers immediately focused on the optic lobe using MRI—they found that despite the huge eyes, the lobe was not larger proportionally than that of other cephalopods, and in fact, was actually smaller. The researchers found that the cortex, which is used by other cephalopods to process visual information, was neuron rich, while the medulla was not—it is used by other cephalopods for communicating visually with others of their kind.

The researchers note that their findings are not surprising—smaller cephalopods live in well-lit close quarters with other cephalopods in visually complex environments, and thus much more visual communication (like camouflage) is needed. The finding also confirms suspicions that the large eyes of the giant squid have evolved to capture more light in a dark underwater environment, particularly light emitted by clouds of bioluminescence that indicate a sperm whale is

nearby—one of the few sea creatures that prey on giant squid.

More information: Yung-Chieh Liu et al. Mismatch between the eye and the optic lobe in the giant squid, *Royal Society Open Science* (2017). DOI: 10.1098/rsos.170289

Abstract

Giant squids (Architeuthis) are a legendary species among the cephalopods. They live in the deep sea and are well known for their enormous body and giant eyes. It has been suggested that their giant eyes are not adapted for the detection of either mates or prey at distance, but rather are best suited for monitoring very large predators, such as sperm whales, at distances exceeding 120 m and at a depth below 600 m (Nilsson et al. 2012 Curr. Biol. 22, 683–688. (DOI: 10.1016/j.cub.2012.02.031)). However, it is not clear how the brain of giant squids processes visual information. In this study, the optic lobe of a giant squid (Architeuthis dux, male, mantle length 89 cm), which was caught by local fishermen off the northeastern coast of Taiwan, was scanned using high-resolution magnetic resonance imaging in order to examine its internal structure. It was evident that the volume ratio of the optic lobe to the eye in the giant squid is much smaller than that in the oval squid (Sepioteuthis lessoniana) and the cuttlefish (Sepia pharaonis). Furthermore, the cell density in the cortex of the optic lobe is significantly higher in the giant squid than in oval squids and cuttlefish, with the relative thickness of the cortex being much larger in Architeuthis optic lobe than in cuttlefish. This indicates that the relative size of the medulla of the optic lobe in the giant squid is disproportionally smaller compared with these two cephalopod species. This morphological study of the giant squid brain, though limited only to the optic lobe, provides the first evidence to support that the optic lobe cortex, the visual information processing area in cephalopods, is well developed in the giant squid. In comparison, the optic lobe medulla, the visuomotor integration centre in cephalopods, is much less developed in

the giant squid than other species. This finding suggests that, despite the giant eye and a full-fledged cortex within the optic lobe, the brain of giant squids has not evolved proportionally in terms of performing complex tasks compared with shallow-water cephalopod species.