Microwavenews.com – 19/10/2011: Cornell biologists may have made a breakthrough in understanding why some people are electrosensitive. They report in *Nature Communications* that humans as well as many other species descended from a type of fish that lived some 500 million years ago which had a "well developed electroreceptive system." A possible implication is that some of us, like sharks and rays, may be able to detect very weak electric fields and perhaps a subset has an electroreceptive system that has gone awry. We concede that this is speculation on our part; for a more direct interpretation of the new paper, read the Cornell University press release.

CORNELL UNIVERSITY PRESS RELEASE

FOR RELEASE: Tuesday, Oct. 11, 2011

http://www.pressoffice.cornell.edu/releases/release.cfm?r=61663

Contact: Joe Schwartz
Phone: (607) 254-6235
Joe.Schwartz@cornell.edu

Most vertebrates — including humans — descended from ancestor with 'sixth sense'

ITHACA, N.Y. — People experience the world through five senses but **sharks, paddlefishes and certain other aquatic vertebrates have a sixth sense: They can detect weak electrical fields in the water and use this information to detect prey, communicate and orient themselves.**

A study in the Oct. 11 issue of Nature Communications that caps more than 25 years of work finds that the vast majority of vertebrates – **some 30,000 species of land animals (including humans)** and a roughly equal number of ray-finned fishes **– descended from a common ancestor that had a well-developed electroreceptive system.**

This ancestor was probably a predatory marine fish with good eyesight, jaws and teeth and a lateral line system for detecting water movements, visible as a stripe along the flank of most fishes. It lived around 500 million years ago. The vast majority of the approximately 65,000 living vertebrate species are its descendants.

"This study caps questions in developmental and evolutionary biology, popularly called 'evo-devo,' that I've been interested in for 35 years," said Willy Bemis, Cornell professor of ecology and evolutionary biology and a senior author of the paper. Melinda Modrell, a neuroscientist at the University of Cambridge who did the molecular analysis, is the paper's lead author.

Hundreds of millions of years ago, there was a major split in the evolutionary tree of vertebrates. One lineage led to the ray-finned fishes, or actinopterygians, and the other to lobe-finned fishes, or sarcopterygians; the latter gave rise to land vertebrates, Bemis explained. Some land vertebrates, including such salamanders as the Mexican axolotl, have electroreception and, until now, offered the best-studied model for early development of this sensory system. As part of changes related to terrestrial life, the lineage leading to reptiles, birds and mammals lost electrosense as well as the lateral line.

Some ray-finned fishes – including paddlefishes and sturgeons – retained these receptors in the skin of their heads. With as many as 70,000 electroreceptors in its paddle-shaped snout and skin of the head, the North American paddlefish has the most extensive electrosensory array of any living animal, Bemis said.

Until now, it was unclear whether these organs in different groups were evolutionarily and developmentally the same.

Using the Mexican axolotl as a model to represent the evolutionary lineage leading to land animals, and paddlefish as a model for the branch leading to ray-finned fishes, the researchers found that electrosensors develop in precisely the same pattern from the same embryonic tissue in the developing skin, confirming that this is an ancient sensory system.

The researchers also found that the electrosensory organs develop immediately adjacent to the lateral line, providing compelling evidence "that these two sensory systems share a common evolutionary heritage," said Bemis.

Researchers can now build a picture of what the common ancestor of these two lineages looked like and better link the sensory worlds of living and fossil animals, Bemis said.

Co-authors include Glenn Northcutt, a world expert on vertebrate neuroanatomy based at the Scripps Institution of Oceanography; and Claire Baker at the University of Cambridge, whose lab contributed molecular analyses.

The study was funded by the Biotechnology and Biological Sciences Research Council in the United Kingdom, National Institutes of Health, National Science Foundation, Whitehall Foundation and Tontogany Creek Fund.

Contact Joe Schwartz for information about Cornell's TV and radio studios.

Nature Communications | Article

http://www.nature.com/ncomms/journal/v2/n10/full/ncomms1502.html

Electrosensory ampullary organs are derived from lateral line placodes in bony fishes

- Melinda S. Modrell,
- William E. Bemis,
- R. Glenn Northcutt,
- Marcus C. Davis
- & Clare V.H. Baker
- Affiliations
- Contributions
- Corresponding author

Nature Communications
2,
Article number:
496
doi:10.1038/ncomms1502

Received
02 June 2011

Accepted
07 September 2011
Published
11 October 2011

Abstract

Electroreception is an ancient subdivision of the lateral line sensory system, found in all major vertebrate groups (though lost in frogs, amniotes and most ray-finned fishes). Electroreception is mediated by 'hair cells' in ampullary organs, distributed in fields flanking lines of mechanosensory hair cell-containing neuromasts that detect local water movement. Neuromasts, and afferent neurons for both neuromasts and ampullary organs, develop from lateral line placodes. Although ampullary organs in the axolotl (a representative of the lobe-finned clade of bony fishes) are lateral line placode-derived, non-placodal origins have been proposed for electroreceptors in other taxa. Here we show morphological and molecular data describing lateral line system development in the basal ray-finned fish *Polyodon spathula*, and present fate-mapping data that conclusively demonstrate a lateral line placode origin for ampullary organs and neuromasts. Together with the axolotl data, this confirms that ampullary organs are ancestrally lateral line placode-derived in bony fishes.