Were our tetrapod ancestors deaf?

November 8 2010

This is an African lungfish. Credit: Christian Brandt

A research group led by Jakob Christensen-Dalsgaard, University of Southern Denmark, have shown that the closest living relatives of the tetrapods, the lungfish, are insensitive to sound pressure, but sensitive to vibrations. The discovery was published online in *Biology Letters* on Sept. 8.

Many changes in the sensory systems of tetrapods are associated with the water-to-land transition. In hearing, one of the crucial elements in detecting airborne sound is the tympanic ear. Surprisingly, the tympanic ear originated independently in the major tetrapod lineages and relatively late after the terrestrial tetrapods emerged – in the Triassic, more than 100 million years after the origin of tetrapods.

The major question raised by the researchers Jakob Christensen-Dalsgaard, Christian Brandt and Magnus Wahlberg, University of Southern Denmark, and Maria Wilson and Peter T. Madsen, Aarhus University was what hearing was like in the early tetrapods before the origin of the tympanic ear. To answer that question the research group measured hearing in the closest living relative of tetrapods, the lungfish.

The scientists measured evoked potentials in the brain of lightly anesthetized African lungfish in response to airborne and underwater sound and to vibrations of the head. The vibration sensitivity of lungfish is comparable to the exquisite sensitivity of frogs, but their ear does not respond to airborne sound. Most likely a large otoconial mass generates the high vibration sensitivity, but also limits hearing to very low frequencies. If the lungfish inner ear is similar to the ears of the first tetrapods, the conclusion is that they were insensitive to sound.

Sensitivity to airborne sound entailed three major changes of the ear between the age of Carbon and the Triassic: a changed sensitivity in the inner ear, a change in the articulation of the middle ear bone and finally coupling of the middle ear bone to skin covering the spiracle, creating a tympanic ear.

More information: Christensen-Dalsgaard J, Brandt C, Wilson M, Wahlberg M, Madsen PT (2010) Hearing in the African Lungfish, Protopterus Annectens. Preadaptations for pressure hearing in tetrapods? *Biology Letters* online: Doi:10.1098/rsbl.2010.0636

Provided by University of Southern Denmark