Royal Veterinary College
University of London

**Strictly Embargoed Until 1800hrs, Wednesday 23 May 2012**

**Novel 3D reconstruction of fossil reveals how limb movement evolved in the first land animals**

Research published today (Wednesday 23 May) in the journal *Nature* reveals for the first time how a famous extinct animal, the early four-legged vertebrate (tetrapod) called *Ichthyostega*, moved on land.

The study, conducted by Dr. Stephanie E Pierce and Professor John R Hutchinson from the Royal Veterinary College and Professor Jennifer A Clack from the University of Cambridge, examined limb mobility in the 360 million year old fossil tetrapod by reconstructing the first ever three-dimensional computer model of its skeleton.

Lead author Dr. Pierce says: "It took almost three years of hard work on difficult fossil material, but we are finally able to see how the skeleton of *Ichthyostega* fits together and might have moved in three-dimensions. This is very exciting, as it allows us to examine how ancient vertebrates made the monumental transition from swimming to walking."

To test how the limbs of *Ichthyostega* moved, the team micro-computed tomography (CT) scanned dozens of fossil specimens and digitally separated the bones from surrounding rock. Each bone was then carefully put back together like a jigsaw puzzle in animation software and painstakingly manipulated to estimate each joint's maximal range of motion.

Professor Clack says: "Our reconstruction demonstrates that the old idea, often seen in popular books and museum displays, of *Ichthyostega* looking and walking like a large salamander, with four sturdy legs, is incorrect."

By comparing their data to five living animals (salamander, crocodile, platypus, seal, and otter), the researchers found that the shoulder and hip joints in *Ichthyostega* were unusually restricted in their motions, meaning the animal could not have used a conventional 'walking' step. In particular, the study uncovered

that the limbs in *Ichthyostega* were incapable of rotating along their long-axis - a limb motion critical to locomotion in living land animals.

Professor Hutchinson commented: “Remarkably, earlier fishes (called tetrapodomorphs) had the ability to rotate their fins, so it seems that just as vertebrates were experimenting with terrestrial movement, the limbs became confined to mainly back-and-forth and up-and-down motions. It wasn't until tetrapods became more competent on land that they recovered the ability to rotate their limbs around their long axis."

According to the study, a limited capacity to rotate the limbs implies that some of the earliest land animals could not walk well on all four legs. In particular, manipulation of the 3D model demonstrates that land locomotion in *Ichthyostega*-like animals would probably have involved synchronized motions of the front legs, with the hind legs barely being able to reach the ground and probably playing a more minor supportive role along with the tail.

Dr. Pierce adds: "These early tetrapods probably moved in a similar way to living mudskipper fishes in which the front fins/legs are used like crutches to haul the body up and forward. As early tetrapods were still mostly aquatic, this type of movement may have helped to stabilize the body during their first tentative forays onto land."

The next step, the researchers say, is to combine their models of limb motion with similar models of the rest of the skeleton as well as muscles, to make much more sophisticated biomechanical analyses of just how these animals did or did not move, and how well they were able to do it. When did the ability to run, for example, first evolve? The approach used in this study, combining modern 3D imaging tools and computer modelling along with knowledge of the rules of animal movement, may answer such big questions.

Additional images and videos are available. An explanatory webpage has been set up by the researchers; please contact us for details on access to that page.

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**Notes for editors**

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- The **Natural Environment Research Council (NERC)** funds world-class science, in universities and its own research centres, that increases knowledge and understanding of the natural world. It is tackling major environmental issues such as climate change, biodiversity and natural hazards. NERC receives around £400m a year from the government's science budget, which is used to provide independent research and training in the environmental sciences. http://www.nerc.ac.uk/

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