Fossil has evidence of limb regeneration in 300 million year old amphibian

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Whole specimen of Micromelerpeton credneri. Credit: *Proceedings of the Royal Society B*, doi: 10.1098/rspb.2014.1550

(Phys.org) —A trio of researchers with Germany's Museum für Naturkunde, Leibniz-Institut für Evolutions und Biodiversitätsforschung, has found evidence of limb regeneration in a 300 million year old amphibian fossil, which suggests that the ability to regenerate entire limbs by such creatures is not restricted to modern salamanders. In their paper published in *Proceedings of the Royal Society B: Biological Sciences*, Nadia Fröbisch, Constanze Bickelmann and Florian Witzmann describe the fossil they've been studying and why they believe it was able to regenerate its limbs.

Scientists believe that salamanders are the only modern four-legged animals that can regenerate entire limbs throughout their lives. What's not clear, however, despite a great deal of research, is if the ability is a recent evolutionary trait or if it came about long ago and has been passed along for many years. The findings by the researchers with this latest effort suggest the latter—the fossil appears to be an ancient relative of the salamander.

The researchers note that when modern salamanders lose a limb, the replacement that grows back doesn't always look just like the original—sometimes there are odd bumps or scars or digits fused back together. This is particularly so if a salamander looses the same limb more than once. In examining the amphibian fossil, (*Micromelerpeton*, found in northwest Germany) the researchers found the same odd characteristic in the toes—there was an extra partly fused one, suggesting very strongly that the creature had lost a toe and had re-grown a replacement.

Finding regenerative ability in such an ancient creature begs the question of why more tetrapod species don't have the ability today. The researchers suggest that the ability to re-grow lost limbs was perhaps lost over time or evolved into something else entirely as it became a trait that was no longer needed, or because it took up too much resources.

Gaining an evolutionary perspective on limb regeneration might help researchers in other areas that are attempting to find out if limb replacement can be caused to come about in other animals, particularly humans, through some unknown mechanism. Learning how salamanders developed the ability might help modern researchers repeat the process.

More information: Early evolution of limb regeneration in tetrapods: evidence from a 300-million-year-old amphibian, *Proceedings of the Royal Society B*, rspb.royalsocietypublishing.or … nt/281/1794/20141550

Abstract

Salamanders are the only tetrapods capable of fully regenerating their limbs throughout their entire lives. Much data on the underlying molecular mechanisms of limb regeneration have been gathered in recent years allowing for new comparative studies between salamanders and other tetrapods that lack this unique regenerative potential. By contrast, the evolution of animal regeneration just recently shifted back into focus, despite being highly relevant for research designs aiming to unravel the factors allowing for limb regeneration. We show that the 300-million-year-old temnospondyl amphibian Micromelerpeton, a distant relative of modern amphibians, was already capable of regenerating its limbs. A number of exceptionally well-preserved specimens from fossil deposits show a unique pattern and combination of abnormalities in their limbs that is distinctive of irregular regenerative activity in modern salamanders and does not occur as variants of normal limb development. This demonstrates that the capacity to regenerate limbs is not a derived feature of modern salamanders, but may be an ancient feature of non-amniote tetrapods and possibly even shared by all bony fish. The finding provides a new framework for understanding the evolution of regenerative capacity of paired appendages in vertebrates in the search for conserved versus derived molecular mechanisms of limb regeneration.