Primitive frogs do a belly flop: Study shows frogs evolved jumping before they refined landing (w/ Video)

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Sometimes divers, to their own painful dismay, do belly flops. But did you ever see a frog belly flop? That's just what primitive living frogs do, according to a new study1 by Dr. Richard Essner, from Southern Illinois University Edwardsville in the US, and colleagues, looking at the evolution of frog jumping and landing. They found that frogs became proficient at jumping before they perfected landing.

This evolutionary split, characterized by an inability to rapidly rotate the limbs forward during flight in order to land front legs first, might also explain why primitive frogs' back legs are out-of-phase with one another when they swim. Essner's work is published in Springer's journal *Naturwissenschaften*.

Prior to this research, it had generally been assumed that all frogs jumped in a similar manner by rapidly extending their back legs during the propulsive phase and rotating the limbs forward during flight so that they could land front legs first. However, no studies had looked at the jumping behavior of the most primitive living frogs of the family *Leiopelmatidae*, which uniquely among frogs use a trot-like rather than a frog-kick swimming gait.

Essner and team compared the jumping behavior of leiopelmatids with that of more advanced frogs. They analyzed video footage from 5 species - 3 primitive (*Ascaphus montanus*, *Leiopelma pakeka*, and *L.*

hochstetteri) and 2 advanced (*Bombina orientalis* and *Lithobates pipiens*).

They found that although launch movements were similar among the species, primitive frogs maintained extended back legs throughout their flight and landing phases and did not land on their front legs. These belly flop landings limited their ability to jump again quickly.

According to Essner, this unique behavior of leiopelmatids shows that the evolution of jumping in frogs was a two-step process with symmetrical back leg extension jumping appearing first and mid-flight back leg recovery and landing on forelimbs appearing later. The frogs' inability to rapidly cycle the limbs may also provide a functional explanation for the absence of synchronous swimming in leiopelmatids. It is also plausible that the reason these primitive frogs have unusual anatomical features such as large, shield-shaped pelvic cartilage and abdominal ribs is to prevent damage to their internal soft tissues and organs during uncontrolled landing.

The authors conclude: "The simple shift to early hind limb recovery may have been a key feature in the evolutionary history of frogs, facilitating controlled terrestrial landings and enabling rapid repetition of jumping and swimming cycles. These changes may have offered advantages for longer distance locomotion, better landing postures and improved predator avoidance and foraging."

More information: Essner RL et al (2010). Landing in basal frogs: evidence of saltational patterns in the evolution of anuran locomotion. Naturwissenschaften. DOI:10.1007/s00114-010-0697-4

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