

## INSIDE JEB

## Developing ears key for red-eyed treefrog embryo survival



Once the parents have sauntered off, many developing eggs are as defenceless as sitting ducks, at risk from passing voracious predators. But the embryos developing in red-eyed treefrog frogspawn have an escape strategy to evade the jaws of death. When attacked by a ravenous snake, they rupture the membrane within which they are encased and fall into the pond below in a bid for freedom. But how do the mini escapologists know when they are under attack? Realising that the tiny youngsters are incapable of escape before reaching a specific stage in development, Karen Warkentin from Boston University, USA, wondered whether the treefrog embryos

depend on their developing ears, which pick up vibrations, to warn them of an impending attack. But to check this, Warkentin's graduate student Julie Jung and undergraduates Su Jin Kim and Sonia Pérez Arias had to show that the tadpoles' sensitivity to vibrations kicks in around the same time that they develop the ability to save their skins.

Knowing that unhatched treefrog tadpoles swivel their eyes in response to motions sensed by their developing ears – otoconial organs – in a response known as the vestibulo-ocular reflex, Warkentin and J. Gregory McDaniel, also from Boston University, built a piece of equipment for

Pérez Arias to gradually rotate the tiny embryos to find out when their otoconial organs began detecting movements. Prior to 4 days of age, the youngsters didn't respond to the rotations at all, but over the next 0.75 days their eyes began reacting as they were rotated and their otoconial organs began responding to the motion. But would the development of the embryos' eye-swivelling reflex correlate with their ability to evade a snake attack?

Simulating snake attacks by shaking clumps of frogspawn ranging in age from 3.7 to 4.9 days, Jung and Kim found that embryos aged 4.3 days and older escaped from the shaken frogspawn. The pair then quickly checked the eye movements of all of the embryos, whether they had stayed put or made a break for it; their eyes only began swivelling around the age when they could liberate themselves while under attack. Finally, Jung and Kim agitated the embryos inside their eggs every 3 h from the age of 81 h (~3.4 days), to find out when they were able to burst free, then tested their eye rolling, and found that the youngsters that could effect an escape were also adept at swivelling their eyes. In other words, the embryos' otoconial organs were picking up the warning vibrations.

'The onset of [the] vestibulo-ocular reflex and hatching responses was largely concurrent', says Jung. So, development of the frog embryos' ears seems to coordinate with their ability to evade feasting serpents, suggesting that the vibration-sensitive otoconial organ is key for the youngsters' survival.

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