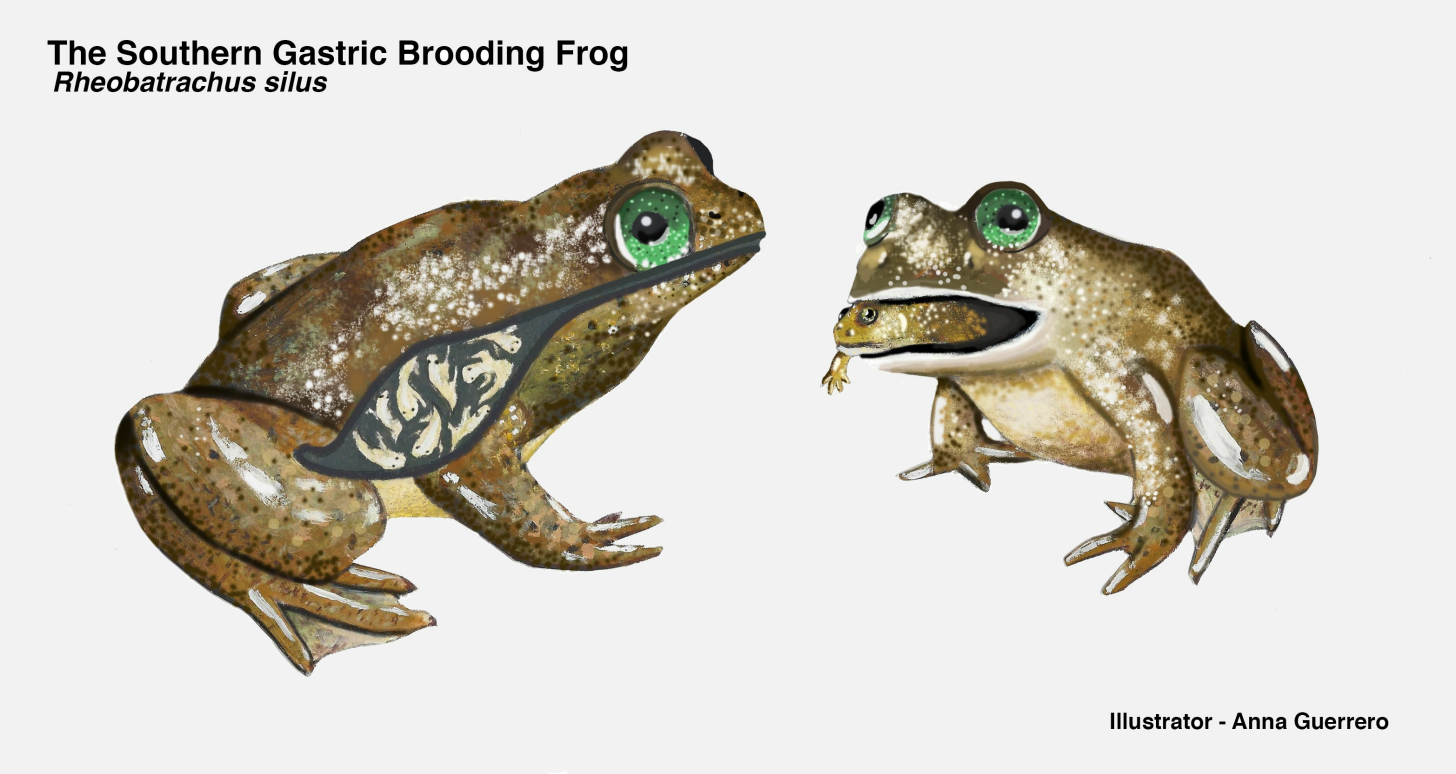
The Southern Gastric-Brooding Frog [1]

By: Rojas, Christopher Keywords: Michael Archer [2] de-extinction [3] gastric brooding frog [4] Somatic cell nuclear transfer [5]



Editor's note: Anna Guerrero created the above image for this article. You can find the full image and all relevant information here [6].

The Southern Gastric-Brooding Frog (*Rheobatrachus silus* [7]) was an aquatic frog [8] that lived in south-east Australia. In 2002, the International Union for Conservation of Nature Red List declared the frog [8] extinct, although no wild specimens had been reported since 1981. As the common name alludes to, the *R. silus* was a gastric-brooder, meaning that the female's eggs developed inside of her stomach. Weeks after ingestion, juvenile frogs escape through the mother's mouth. Because no other observed species performs this reproductive behavior, in the early twenty-first century *R. silus* became a target of the de-extinction movement that aims to resurrect extinct species. Researchers studied this frog [8]'s reproductive behavior and how the eggs and embryos escape digestion. Some scientists claimed that resurrecting this frog [8] could result in future medical applications related to digestion and to reprogramming organ function, as during pregnancy [9], *R. silus*'s stomach physiologically functioned as a uterus [10].

R. silus was first described in 1973 by David Liem in Australia, but its reproductive behavior was not discovered until the following year. In 1983, the International Union for Conservation of Nature (IUCN) headquartered in Gland, Switzerland, designated the species as vulnerable, meaning that it was at high risk of becoming endangered in the wild. Three years later in 1986, the IUCN officially listed *R. silus* as an endangered species, which meant that the species was at high risk of becoming extinct in the wild. However, scientists claimed that the frog [8] was already extinct in the wild since 1979, while tissue samples and remaining live frogs existed only in laboratories for a few years. All of the lab specimens had died by 1983. Although Liem described the species, Michael J. Tyler, an animal and veterinary scientist from the University of Adelaide in Adelaide, Australia, researched and described the reproductive behavior of the species in his 1983 book *The Gastric Brooding Frog*.

The physical features of the frog [8]'s reproductive system were similar to those in other frog [8] species, and therefore scientists initially did not predict the brooding behavior. The frog [8] was oval-shaped with grey skin and darker blotches. Its skin color camouflaged it in its environment of streams and rocks. Males grew to about 37 millimeters long, while females could reach 55 millimeters in length. The female frogs lived for three to four years and matured around twenty-two to twenty-four months of age. During the second year of life, the frogs became sexually dimorphic and females grew at twice the rate as males.

The range of the *R. silus* covered approximately 1,400 square kilometers in Australia, about 100 kilometers to the north of Adelaide, and 30 kilometers west of Sunshine Coast. The frog [8] was found only in four water systems located within the Blackall and the Conondale Mountain Ranges, namely Mary River catchment, Mooloolah River catchment, Stanley River catchment, and Kilcoy creek. Inside these systems, 89 percent of sightings took place in rock pools, which are holes or cavities in rocks filled with water. *R. silus* favored deeper rock pools containing foliage or plant litter. In fast flowing areas of the streams there were few frogs, if any at all. Likewise, few flogs if any inhabited areas without rock coverage. Researchers observed that the frogs rarely left water because they were slow and had limited leaping abilities on dry land, and those that did leave water began visibly dehydrating in less than five minutes. Due to scarcity of specimens, little is recorded about the frog [8]'s hibernation habits. Scientists assumed that those frogs found locales of hibernation in recluse, wet, crevices of rock pools.

In few frog [8] species to parents care for their eggs after laying them. In contrast, *R. silus* mothers cared for their eggs after they were laid and fertilized. Researchers did not observe *R. silus* mothers ingesting their eggs, but they inferred that the mother ingested her eggs, as there was no other physiological pathway for them to enter the stomach. Thus, the precise stage of development at which the eggs were ingested is unrecorded. After the mother ingested her eggs, development continued normally, similar to other frog [8] species. The frog [8]'s gestation [11] period was estimated to be six to seven weeks. During this time, the mother fasted and was inactive, and her lungs collapse to allow room for the embryos to develop.

In 1973, scientists observed female frogs give oral birth. The mother vomited six tadpoles. Eighteen days later, the frog [8] regurgitated a fully developed young. More births occurred in the following days, totaling sixteen progeny before the mother was euthanized to examine her stomach. Examinations of *R. silus*'s stomach showed that physical and chemical alterations had taken place when compared to a non-gestating *R. silus*. The stomach functioned as a uterus [10], as the musculature and blood vessels altered their form in addition to a regress in secreting acids.

Researchers hypothesized about how both the mother and embryos survived the gestation [11] process. One hypothesis in regards to the mother's survival was that her thin-walled stomach contained stretch receptors that satiated hunger. Because the young continued to grow, the mother did not feel the need to feed. At least one other frog [8] species had gastric stretch receptors. That mechanism of *R. silus*'s worked in conjunction with the young secreting a substance called prostaglandin E2 (PGE2), which inhibited the mother's gastric acid secretion. A second hypothesis said that in the absence of PGE2, the young would be dissolved like food. Researchers noted that the evidence for the hypothesis was circumstantial, as they retrieved PGE2 in aquarium water, on tadpole's skin, and in the mother's stomach. In addition, no researchers observed PGE2 inhibiting gastric acid secretion in any other species.

In 2013, Michael Archer at the University of New South Wales in Sydney, Australia, formed a research group focused on restoring *R. silus*. This group became called the Lazarus Project, after a biblical tale of resurrection. Archer garnered a lot of publicity for the lazarus project when he delivered a Ted Talk in Washington, D.C. Tyler, a colleague of Archer's, studied the frog [8] in the mid-1980s before it went extinct, and he kept a tissue sample in his lab's deep freezer. Researchers in the Lazarus Project extracted cell nuclei from the thawed *R. silus* tissue and implanted the material into egg [12] cells from a similar amphibian, the Great Barred Frog (*Mixophyes fasciolatus* [13]). With this process, called somatic cell [14] nuclear transplantation [15] or cloning [16], by 2014 scientists had caused an embryo with genetic material from *R. silus* to reach early embryonic stages.

Sources

1. Archer, Michael. "How We'll resurrect the Gastric Brooding Frog, the Tasmanian Tiger." TedxDeExtinction. Washington, D.C., March 2013. http://www.ted.com/talks/michael_archer_how_we_ll_resurrect_the_gastric_brooding_frog_the_tasmanian_tiger [17] (Accessed January 19, 2014).
2. Dankosky, John. "Project Seeks to Bring Extinct Species Back. *National Public Radio*, March 22, 2013. http://www.npr.org/2013/03/22/175054279/project-seeks-to-bring-extinct-species-back-to-life [18] (Accessed May 23, 2014).
3. Corben, Christopher J., Glen J. Ingram, and Michael J. Tyler. "Gastric Brooding: Unique Form of Parental Care in an Australian Frog." *Science* 186 (1974): 946–7.
4. Meyer, Ed., David Newell, Harry Hines, Sarah May, Jean-Marc Hero, John Clarke, Frank Lemckert.*Rheobatrachus silus*. The International Union for Conservation of Nature and Natural Resources Red List of Threatened Species, 2004. Version 2014.3 http://www.iucnredlist.org/details/19475/0 [19] (Accessed January 20, 2015).
5. Liem, Davis S. "A new genus offrog [8] of the family Leptodactylidae from S.E. Queensland, Australia." *Memoirs of the Queensland Museum* 16 (1973): 459–70.
6. Tyler, Michael J., and David B. Carter. "Oral Birth of the Young of the Gastric Brooding Frog Rheobatrachus silus." *Animal Behavior* 29 (1981): 280–2.
7. Tyler, Michael J., ed. *The Gastric Brooding Frog*. London: Croon Helm, 1983.
8. Tyler, Michael J., David J.C. Shearman, Rony Franco, Paul O'Brien, R. F. Seamark, and R. Kelly. "Inhibition of Gastric Acid Secretion in the Gastric Brooding Frog, Rheobatrachus silus." *Science* 220 (1983): 609–10.

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Subject

Breeding behavior [20] Reproductive behavior [21] Extinction (Biology) [22] Extinct animals [23] Cloning [24] Frogs [25] Embryos [26] Australia [27] University of New South Wales [28] Tyler, Michael J. [29] Liem, David S. [30]

Topic

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