# The care and captive breeding of the caecilian *Typhlonectes natans*

RICHARD PARKINSON

*Ecology UK, 317 Ormskirk Road, Upholland, Skelmersdale, Lancashire, UK.* E-mail: *notonnecta@aol.com*

CAECILIANS (Apoda) are the often overlooked third order of amphibians and are not thought to be closely-related to either Anurans or Urodelans. Despite the existence of over 160 species occurring throughout the tropics (excluding Australasia and Madagascar), relatively little is known about them. The earliest known fossil caecilian is *Eocaecilia micropodia*, which is dated to the early Jurassic Period approximately 240 million years ago. *Eocaecilia micropodia* still possessed small but well developed legs like modern amphiumas and sirens. The worm-like appearance and generally subterranean habits of caecilians has often led to their dismissal as primitive and uninteresting. This view-point is erroneous. Far from being primitive, caecilians are highly adapted to their lifestyle. *Typhlonectes natans* are minimalist organisms having dispensed with tail, limbs, one lung and functioning eyes. Animals which live in underground burrows or the turbid depths of South American rivers, however, have no use for these organs.

Instead of sight, caecilians have a pair of organs known as the tentacles situated in pits between the eye and nostril. The tentacles are connected to both the optic nerves (and muscles) and the olfactory system. How this hybrid sense (sight, taste and smell combined) functions is unknown. That this sense does function is undeniable. I can testify from personal observation how rapidly caecilians locate and consume food. The research of Himstedt & Simon (1995) clearly demonstrates how efficient caecilians are at foraging for food using the tentacle organ by locating food items faster than newts in experiments. They are the only vertebrate animals known to possess motile sub-ocular tentacles. Caecilians have poor hearing but, like other amphibians and fish, have a well developed lateral line system.

Many caecilians have no larval stage and, while some lay eggs, many including *Typhlonectes natans* give birth to live young after a long pregnancy. Unlike any other amphibian (or reptile) this is a true pregnancy in which the membranous gills of the embryo functions like the placenta in mammals, so that the mother can supply the embryo with oxygen. The embryo consumes nutrients secreted by the uterine walls using specialized teeth for the purpose.

### Captive Care

In March 1995 I acquired ten specimens of the aquatic caecilian *Typhlonectes natans* (identified by cloacae denticulation after Wilkinson, 1996) which had been imported from Guyana. I immediately lost two as a result of an ill-fitting aquarium lid. Another died after only six days as a result of a severe bacterial infection which did not respond to antibiotic treatment. The remaining seven, however, thrived. They ranged from 25 cm to 35 cm in length and were on average 1–2 cm in diameter.

I established them in a 180 cm x 61 cm x 46 cm (6 ft x 2 ft x 1.5 ft) tank with a substrate of river sand (from a local unpolluted stream) 10 cm deep, and a water depth of 30 cm (later raised to 40 cm) of soft acid water (pH 5–6 & dH 3), at 74°C with external filtration. The tank was furnished with plenty of bogwood and extensive non-rooting plants (Java Fern, Java Moss and Rigid Hornwort) as I anticipated extensive burrowing.

The caecilians do burrow but not as much as I expected. They are active equally by day and night and appear oblivious to bright light even when shone directly on them. Their tastes are catholic and they seem to do well on frozen bloodworm, chopped mussels, prawns and chopped sprats (later I stopped using sprats because of the mess and potential for fouling of the water; as a codicil, if feeding with non-live food remember to feed freshwater animals with marine fish/prawns – this reduces the risk of disease transmission). They grew well and by 1997 the largest individual measured 3 cm in diameter and approximately 55 cm in length.

Initially, I was reluctant to introduce fish to the aquarium, fearing that they would be eaten or even attack the caecilians. I experimented with small tetras and, when these remained unscathed, gradually introduced a full community of Amazonian fish. To this date no living fish has ever been harmed – even small loaches resting amongst the inactive caecilians under the bogwood. Similarly, the large cichlids ignore the caecilians even when their breeding territories are violated. When a fish dies, however, it is consumed immediately leading me to speculate that carrion forms a significant part of wild caecilians diets. This is backed up by the relative abundance of *Typhlonectes* sp. near riverside fishing villages in northern South America, where they have been observed eating the entrails of gutted fish (Hofer, 2000).

## Breeding

In July 1997 I lowered the water level in the tank to 18 cm and allowed the pH to drop well below 5 and the organic content of the water (especially nitrates) to rise considerably. This was a deliberate attempt to simulate dry season conditions when the flooded river basins of the Amazon shrink to shallow pools. To my surprise, on 13th July the caecilians began to mate. The smaller males entwined themselves around the two much larger females. With their lower bodies entwined and positioned vent to vent, the males inseminated the females (the sexual organ – phallodeum – was large and obvious). This process often lasted for several hours, with initial frenzied activity subsiding into stillness so profound that on more than one occasion I believed that both animals had drowned. Periodic mating continued until 18th July 1997.

After mating had clearly finished, I returned the water conditions to their original state (pH 5/6, dH 3 and 40 cm deep). After that things went on as they had before and it was many months before I realized that one of the females was indeed pregnant. This was the largest of the females approximately 55 cm long (22 inches). Her girth gradually increased, over the months the diameter of her body reaching more than 6 cm at its greatest. The birth finally took place on the night of 10/11th June 1998, ten months and three weeks after mating had ceased. Unfortunately, the births took place during the hours of darkness so I didn't observe the process. Six young were born. One was unfortunately stillborn but the rest are alive at the time of writing (March 2004). The young varied from 10–15 cm in length and approximately 5 mm in diameter. Some still retained external gills which were lost within hours. The young were weak and feeble initially and I immediately dropped the water level to help them get to the surface to breath. The mother did appear to push some of the youngsters towards the surface on occasion although this may have been coincidental rather than a deliberate act. The young began to feed after a few days, initially on frozen bloodworm and later on finely-chopped adult food. They quickly gained strength and were able to swim rapidly within a week but grew very slowly. At two years old, most of the five young had not quite reached 30 cm in length and had a body diameter of about 1 cm. Currently (March 2004), aged more than five years, they are about 45 cm in length with a body diameter of 1.5–2.5 cm.

All but one of the original adults gradually died between 1998 and 2000. The surviving adult remains active and healthy. I had originally supposed that this was a small male but, in the intervening years, it has matured into a large 60 cm long) female much larger than any of the younger animals. I have had this animal for nine years now and, judging by the growth rate of the others, it was at least two years old when I obtained it. The five-year old young have only now achieved the size and maturity exhibited by the original animals when they bred. This implies that *Typhlonectes natans* is a long lived species which reaches maturity at a fairly advanced age.

## Conclusions

My hypothesis is that *Typhlonectes natans* is a dry season breeder mating mid-dry season one year and giving birth early in the dry season in the following year. This would confer a number of advantages. The first being that the feeble new-born young would be less liable to drown as would almost certainly happen in the flooded forests during the wet season. The second advantage is that food is plentiful and concentrated into small areas during the dry season, particularly for scavengers. The disadvantage is that the stress on the mother of such a long pregnancy (the mother in this case died four months after giving birth despite extensive care and treatment) makes it improbable that breeding would take place every year in the wild. Every second year seems more likely (it may be possible that a well fed captive female caecilian might regain breeding condition faster). Females of a relative of *T. natans*, *Dermophis mexicanus* are known to have a biennial sexual cycle while the males breed annually (Jared et al., 1999). This would mean that the reproductive rate of *Typhlonectes natans* is very low. It therefore follows that the mortality rate of wild caecilians must also be low or they would long-since have become extinct (rather than persisting as a group for over 200 million years).

Why then, since *Typhlonectes natans* appears to take no steps whatever to avoid predation, does it not get decimated by the wide array of predators present in its habitat (fish, turtles, otters, snakes, cormorants, freshwater dolphins, herons & egrets to name a few)? There is good evidence for the toxicity of many caecilians, particularly members of the genera *Ichthyophis* and *Dermophis*, although the extent of toxicity in *Typhlonetes* species is less clear. References have been made to the toxic effects of *Typhlonectes compressicauda* on the predatory Wolf Fish, *Hoplias malabaricus* (Miller, 2003). My supposition is that, in common with many other amphibians, *Typhlonectes natans* is either unpalatable or positively toxic. I have, however, kept my caecilians with fish for eight years now and none have suffered any ill effects. I would therefore assume that, in common with bufonid toads, it is necessary to either eat the caecilian or agitate it very severely before any toxins are exuded. I have not tried this and advise others not to do so, on both safety and humanitarian grounds. This supposition would be best proved/disproved at autopsy by a pathologist.

The majority of amphibians have rapid reproductive rates, laying large numbers of eggs with little or no parental care (there are of course exceptions such as Darwin's Frog, midwife toads, *Pipa* spp. and others) these are essentially 'r' selected species. It would appear that *Typhlonectes natans* represents the opposite extreme: a 'K' selected species, characterized by a long life span, late maturity, and a very low rate of reproduction with extensive parental care (in this case a pregnancy lasting approximately 11 months). This is more commonly associated with animals like whales and elephants. For an amphibian this extreme example of 'k' selection is exceptional. In general 'K' selected species require stable habitats with constant environmental conditions in order to thrive. They are very vulnerable to sudden environmental changes and recover very slowly, if at all, from population declines. A further complication is that the long life spans and low reproductive rates of such organisms make it very difficult to detect long-term breeding failures which may lead to population crashes. Concerns have been expressed because of large-scale global declines in amphibian populations. This led to the establishment of the Declining Amphibian Population Task Force (DAPTF) by the IUCN in order to monitor amphibian populations, and to use such declines as an environmental and ecological barometer. The unusual life history of *Typhlonectes* species makes them even more vulnerable to environmental change than the majority of amphibians and, although current populations do not appear to be undergoing significant declines, this should be carefully monitored.

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