FAUNA

MATING SYSTEMS IN AUSTRALIAN FROGS: THE QUACKING FROG

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Mating quacking frogs. Photo: Michael Smith

What do we have in this photo? Look closely and you can clearly see there are frogs and eggs. Look more closely and you will see there are four frogs: one female and three males. Why so many males? Good question and one where we have a few but not all the answers.

We all know about the life cycle of a frog: male frog calls in a pond, attracts female, frogs mate, eggs deposited in water, neat black and white eggs that hatch into tadpoles then metamorphose into a miniature version of the adult frog. Yes, but let's look a little more carefully at that third bit: frogs mate.

In most frogs, eggs are released by a female then the male deposits sperm directly onto the eggs – external fertilisation. Sounds simple and in most frogs it is: one male and one female and all sorts of tricks used by males to be that one male. Males who call faster, who have deeper croaks, longer calls, call before other males, have call sites where eggs will develop better, in different frog species, all do better. But in almost every frog species there is also another set of males who adopt different tactics to get a mating: sneaks and satellites!

In the north American bullfrog, large males defend calling sites where eggs are less likely to be eaten by leeches but from time to time, small, young males sit by silently and intercept females attracted to larger males. Satellite males are common in many frog species and get exclusive access to a female's eggs. They are often, but not always, smaller or younger males who cannot defend a calling site either because their calls are too wimpy or, they themselves are too wimpy! Satellite males sit close to calling males and intercept incoming females. In some studies satellites males do almost as well as callers in mating successfully. But what about sneaks?

Sneak males have been observed in many fish species. A large male builds and defends a nesting site and attracts a female - and may also attract a set of sneak males. Sneaks slip in and deposit sperm onto eggs a female is releasing at the same time as the large male is releasing sperm. A behaviour comparable to sneaks but not quite as stealthy is now also known in frogs: in the quacking frog, *Crinia georgiana*.

The picture alongside is a fairly typical mating in the quacking frog, which occurs in the forested areas of southern WA and across the south coast east of Esperance. It breeds in winter with males calling from shallow water. Eggs are deposited at the sites where males call and tadpoles metamorphose in spring. But that is about where conventional behaviour stops!

The average number of males per mating is two – for most frogs it is one. Who mates? That depends on circumstances. If frog numbers are low, large males call, small males take on a "sneak" role. Calling males attract females and the pair mate then one or more sneaks join in. The calling male mates in the conventional frog position – on the back of the female. The first sneak male joins the pair underneath then other males hang on almost anywhere. Only the first two males mated actually fertilise eggs – hangers on are missing out! When there are more frogs out, bigger males dominate matings often finding females by searching rather than attracting females with their call. Up to 9 males may try to mate with a single female.

Outcomes? The first two males to mate share paternity, but, as more males join a mating, less eggs are fertilised dropping to about 70% of eggs developing. One in 50 females are killed in the chaos! So there are big potential costs to females and to

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individual males in getting involved in multiple male matings. So, why do it? There may also be benefits to females:

- males might be sperm depleted so mating with more than one may be an insurance policy
- not all sperm-egg combinations work – incompatibility – so again more than one might guarantee at least one male who is a match
- the improved genetic variability might give developing eggs an edge in unpredictable future environments
- if some males are super quality their sperm might improve quality of the offspring

Why share your eggs? Not good for males as we would expect natural selection to have led to the evolution of mating systems that maximise individual reproductive success. We know that in the quacking frogs, sex ratios at the breeding site are heavily skewed towards males and on high density nights that skew is even more extreme. We do not know why that skew occurs but we think the overall sex ratio is about one to one so the skew at breeding sites presumably reflects simple things like males stay around longer and try to mate again and again (because they can) while females may take several weeks or a whole summer to take in enough energy to develop a second clutch of eggs. So males might tolerate extra males, not because they are benevolent but the costs of displacing extra males might be even higher – e.g. reducing the number of eggs fertilised even lower.

Is the quacking frog unique? No. There are a number of frog species around the world where several males may fertilise eggs from a single female including one of the commonest frogs in Europe, *Rana temporaria* and even the cane toad, *Bufo marinus*. But most people, including me the first time I saw it, have either ignored this phenomenon or at least not reported it. We know that in Australian frogs, if there is a greater risk that several males will be involved in a mating, then males have evolved much larger testes leading to more sperm per ejaculate so in a competitive mating situation they may win out. If you "buy" more tickets in the lottery the better the chance to win where the tickets are sperm and winning means more eggs fertilised. We know of a lot of Australian frogs with relatively large testes and for several of those there are some hints that they might also engage in matings involving more than one male: polyandrous matings. Many *Neobatrachus* species found in south-western Australia often form groups involving one female and more than one male but we have not followed them right through the egg deposition process. The motorbike frog, *Litoria moorei* has also been reported with several males associated with a single female. Some *Cyclorana* and *Litoria* species in northern Australia often have single males sitting next to mated pairs or females depositing eggs – maybe waiting for an opportunity.

Can you contribute to our knowledge of frog natural history? Yes! If you know your local pond and its frogs you may well have seen things that fly-by night scientists like me have missed. What species have you seen where more than one male tries to mate with a single female? Pictures or recordings of calls would make those identifications easier. Or, go to http://www.frogsaustralia.net.au/ for help with sorting what frogs you have. So get out and start looking – that frog pond might be a little more interesting than you ever imagined! You might also wake biologists up to thinking a little more carefully about mating systems where we thought we knew it all!

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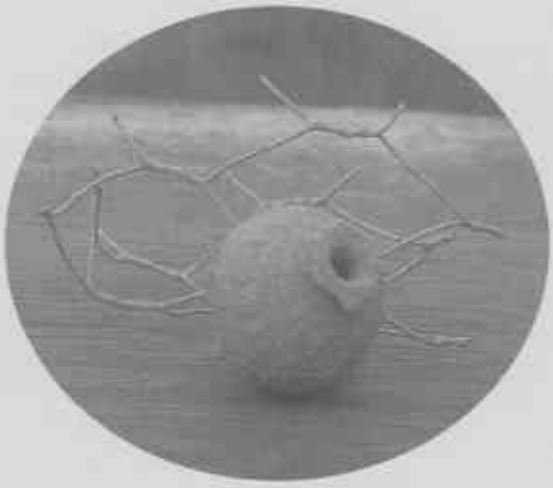
Bush Detective

Nature's Potter!



Avril Baxter photographed this at "Knotwood" near Williams. The 13mm-hole aviary wire to which it is attached gives the scale. She asked, "Who made it?" (Answer on page 16)