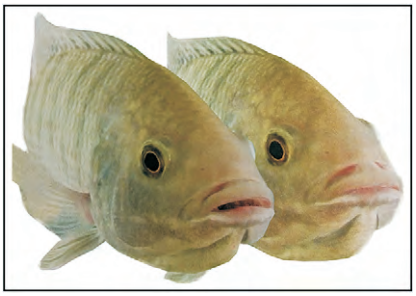
Tilapia parents churn to cough kids clear



Mouthbrooding tilapia mother performing churning. Photo credit: Sam Van Wassenbergh.

Many egg-layers go to great lengths to produce cosy incubators for their families; they range from the sandy nests of ocean-going turtles to the immense leaf-litter compost heaps of Australian brush turkeys. But other species have opted for a less costly approach: some tilapia simply slurp up their eggs and hold them in their mouths until the larvae are ready to emerge. However, while the next generation is snuggled up safe and secure, their parents have to continue breathing through their heavily congested mouths. Sam Van Wassenbergh, from the University of Antwerp, Belgium, says,'During mouthbrooding, cichlid fishes [tilapia] alternate the normal ventilation of their gills (breathing) with bouts of a sequence of movements of several head parts that is called"churning"'. But the jury was out as to why these parents appeared to chew on their charges: were they churning the eggs around to ensure that their offspring had sufficient access to oxygen or to ensure that they didn't choke on the kids? Intrigued by the bizarre parenting technique, Van Wassenbergh and Dominique Adriens, from Ghent University, decided to take a closer look inside the mouths of tilapia parents stuffed with eggs.

Fortunately, Nile tilapia are content to breed in captivity, and can cram more than 1500 eggs in their mouths where the youngsters develop, so Gudrun De Boeck, Mathieu Desclée and Jung Liew filmed the expectant mums 'head movements for 9 days to find out exactly how they moved their jaws as they churned their eggs. Comparing the jaw motions when the fish were 'churning' and breathing, Iris Joris, Van Wassenbergh and Peter Aerts saw that the churning parents'upper jaw always protruded several millimetres beyond the lower jaw; meanwhile, the mouth remained relatively static when the fish breathed normally. In addition, the churning fish expanded their mouth cavity significantly and the expansion rippled forwards from the back of the head as they depressed the mouth floor down, having pushed the gill covers (opercula) outwards. In addition, Joris and Van Wassenbergh realised that water was pulled into the mouth strongly through the gill slit during the first 100 ms of the churning action before jetting out of the gill slit behind the headI was surprised to see such a strong inflow of water entering through the gill slits',says Van Wassenbergh, who adds,'during breathing or suction feeding, this is normally the place where water exits…it is markedly different in churning'.

However, the team was none the wiser about whether the eggs were moving inside the fish's heads until Van Wassenbergh cautiously popped a dummy egg carrying a steel pellet inside the mouth of an incubating mum.'The X-ray video experiment to track the motion of a dummy egg was very challenging,' he says, recalling that four of the mothers spat out their own eggs when he attempted to insert the ball into their mouths. However, Van Wassenbergh eventually succeeded, and saw the dummy egg pushed forward away from the gills as the water flowed into the mouth and the wave of expansion surged forward.

So, churning parents prevent themselves from asphyxiating on eggs that could clog their gills while mouth brooding by sucking water in through the gill slits and washing the eggs around in their mouths. 'In fact, churning can be regarded as a closed-mouth cough to avoid the parent choking', chuckles Van Wassenbergh.

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Van Wassenbergh, S., Joris, I., Desclée, M., Liew, H. J., De Boeck, G., Adriaen, D. and Aerts, P. (2016). Kinematics of mouthbrooding in Oreochromis niloticus (Cichlidae). J. Exp. Biol. 216, 1535-1541.

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