

Tilapias use urine to attract females

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How many of us have seen, much to its owner consternation, a misguided pet urinating at the corner of a room marking its territory to repel rivals and attract females? Well, apparently fish do the same.

Scientists in Portugal and Germany have just identified in the urine of male Mozambique Tilapia fish a sex pheromone used to attract and

prepare females to spawn (pheromones are chemicals that affect the behaviour - in this case sexual - of other individuals of the species). The work, by Tina Keller-Costa at the Centre for Marine Science, University of the Algarve, Portugal and colleagues from the Max Planck Institute in Jena, Germany, has important economically implications as tilapias are now one of the most farmed fish for food in the world.

In fact, with high nutritional content and pleasant taste, tilapias are also cheap and so easy to breed that in China they can be grown in rice fields and picked up at harvest time. Their farming is also much less toxic to the environment than raising salmon or trout. All this makes them an increasingly favoured fish for aquaculture. The study now published will help to understand better how these fish reproduce and interact, contributing to optimise their farming while helping to keep under control their invasive behaviour (the downside of their easiness to survive and breed). In a planet trapped in a vicious cycle of an ever-increasing human population and non-stop diminishing food resources, these are nothing less than good news.

But Keller-Costa and colleagues' study will also contribute for a better understanding of fish chemical communication, which although known to be widespread in the group remains far from understood. In fact, the largest vertebrate group uses many forms of communication; they rely on visual cues, sound and electrical fields, as well as chemicals. Much on fish communication and social interaction needs yet to be understood though – for example, [sex pheromones](#) (which are crucial to improve aquaculture) so far have only been identified in females, and only in a couple of species (goldfish and Atlantic salmon).

Tilapias were the perfect subject for this research because of their growing economical importance and easiness to keep (surrealistically they can even be fed on a cereal-based diet), but also because of their complex social interactions, which are maintained in captivity. And in

the study now published, the team led by Adelino Canario looked at Mozambique tilapia.

Mozambique tilapia live in a strict male hierarchy with [dominant males](#) fertilising most of the females, and ranks being disputed in "arenas or leks", where the winners also dig their nests to attract females. It has also been shown that males urinate when acting aggressively towards each other, with those that are more dominant urinating more often and in larger quantities. Dominant males also urinate in the presence of ovulating (but not post-spawned) females, and have thicker and larger bladders than subordinated ones. All these results were suggesting that tilapia male urine contained pheromones responsible for male dominance and female attraction

With this in mind Tina Keller-Costa and colleagues compared the urine of males with different ranks in the group – according to their aggressiveness, courtship towards females, etc – and discovered two molecules with a potential "[pheromone](#) profile". Both molecules were detected by tilapias' olfactory cells (in fish, pheromones are sensed as odours), and their concentration in the urine increased as the males ranked higher in the group (so dominant males had the highest concentration). Further research identified the molecules discovered as steroid hormones of the progesterone family, which is known for its role in female reproduction.

The next step was to synthesize the two steroids to better test their biological role, with this leading to the discovery that while both male and the female tilapias could smell/respond to the compounds this only occurred above a certain concentration.

Female tilapias are known to be attracted to the vicinity of dominant males where they produce $17,20\beta$ –P – a molecule, also derived from progesterone (P), that stimulates eggs' maturation, preparing them to be

fertilized. Keller-Costa and colleagues next discovered that the two steroids could mimic this "dominant male effect" prompting $17,20\beta$ –P production by females, what supported the idea that the compounds now identified were the pheromones produced by dominant male tilapias responsible for attracting and preparing females for reproduction.

But how can females distinguish between dominant and subordinate males? This was, most probably, due to the fact that dominant males urine had a much higher concentration of pheromones (than that of subordinated males), what would mean that when diluted in water only theirs would retain pheromones levels high enough to be detected by [females](#).

Although males also use more frequent urination to signal dominance towards other males, Keller-Costa and colleagues' study could not find a link between the pheromones now identified and male dominance suggesting that some other molecule(s) in the urine is responsible.

Tilapias role as an increasingly important food resource, but also a banned species in some places due to their invasive behaviour, makes the discovery of these new pheromones especially important if they can contribute for a better management of its populations.

Farmed tilapia production is already in the range of a million and half tons per year (an estimated value of 1.8 billion dollars), about the same as salmon and trout. But tilapias are not only easier and cheaper to maintain than salmon and trout, but can also be, contrary to these two species, "vegetarian" which means less pressure on other fish and less toxic waste, making their farming a much more environmental choice and an option to promote.

More information: Tina Keller-Costa, Peter C. Hubbard, Christian Paetz, Yoko Nakamura, José P. da Silva, Ana Rato, Eduardo N. Barata,

Bernd Schneider, Adelino V.M. Canario, "Identity of a Tilapia Pheromone Released by Dominant Males that Primes Females for Reproduction," *Current Biology*, Volume 24, Issue 18, 22 September 2014, Pages 2130-2135, ISSN 0960-9822, [dx.doi.org/10.1016/j.cub.2014.07.049](https://doi.org/10.1016/j.cub.2014.07.049).

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