Inside JEB highlights the key developments in *The Journal of Experimental Biology*. Written by science journalists, the short reports give the inside view of the science in JEB.

Inside JEB

RULES OF ATTRACTION: CATCHING A PEAHEN'S EYE

Getting the undivided attention of a female is tough at the best of times but it's even harder when surrounded by other male suitors. It's no wonder males often resort to ostentatious displays to distinguish themselves from the crowd, and nowhere is this clearer than in peacocks. Sexual selection has driven the evolution of their showy iridescent trains, whose main purpose is to attract females. But what is it about this train of colourful feathers that attracts peahens? Is it the characteristic eyespots or perhaps the green scale-like feathers? Researchers have tried to answer this question by manipulating the trains, for example by removing feathers, but Jessica Yorzinski thought, why not just ask the females what they found attractive? So, during her PhD in Gail Patricelli's lab at the University of California Davis, USA, and Michael Platt's lab at Duke University, USA, Yorzinski decided to investigate using an eye-tracking technique to get a peahen's perspective (p. 3035).

Yorzinski began the project by gradually introducing captive peahens to the eye-tracking equipment, training them to carry the small backpack and a helmet carrying two cameras. Of these two cameras, one filmed the field of view in front of the peahen while the other tracked the movement of the eye's pupil. Afterwards, Yorzinski could use the movements of the pupil to work out exactly where the peahens had been looking. After testing the equipment by throwing a tasty mealworm into the peahens' enclosures or placing a potential predator in the enclosure in the form of a taxidermy raccoon, Yorzinski was satisfied that the eye tracker was successfully identifying the object of their gaze.

Next, Yorzinski, put the peahens to the test and introduced two males to each female. As the males began their elaborate displays, the peahens performed their characteristic courtship steps, first inspecting the peacocks from behind and then evaluating them from the front. Despite all the peacocks' tiring efforts, the peahens spent merely 21–27% of their time gazing at the peacock. The rest of the time they spent surveying their environment, on the look out for predators or food. By rattling his feathers, the peacock could engage her attention longer, but it was where the peahens were focusing that surprised Yorzinski most: 'The female spent most of her time gazing at the lower portion of the train, going back and forth along the bottom of the train. Almost all of her gaze was directed below the head and very little on the upper part of the train.'

So, is the upper train defunct? 'I wondered why females primarily looked at the lower portion of a peacock's train', recalls Yorzinski. 'It became clearer to me after travelling to India to observe the birds in their native habitat. I saw that only the upper train of a peacock was visible at a distance because of the dense vegetation.' Yorzinski thought that perhaps peahens used the upper train to locate the peacocks in the first place. To test this idea, she crafted a train out of peacock feathers and obscured the lower portion behind a barrier. When peahens were presented with these partial trains, they gazed more at the upper train than when the lower train was also visible. What's more when they were far away they tended move in towards the train to get a better close-up view. It seems that while a nice upper train may initially lure a peahen in, it's the bottom feathers that really intrigues her close-up. Although quite what it is about this region that interests a female remains to be seen.

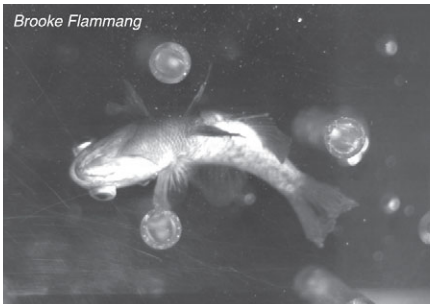
10.1242/jeb.090977

Yorzinski, J. L., Patricelli, G. L., Babcock, J. S., Pearson, J. M. and Platt, M. L. (2013). Through their eyes: selective attention in peahens during courtship. *J. Exp. Biol.* **216**, 3035-3046.

Nicola Stead

TOUCH AND FEEL: FINS' ROLE IN NAVIGATION

Stubbing your toe on a table leg is not an enjoyable experience. Although we can all be clumsy at times, for most of us this is not a frequent occurrence as we're usually pretty good at navigating our way through complex environments. However, we're not the only ones living in cluttered environments; fish also face obstacles in their habitats, be it a coral reef or a reedy lake bottom. So, how do they manoeuvre their way around these hurdles? It's a question that interested Brooke Flammang, a post-doc in George Lauder's group at Harvard University, USA: 'Up until now, the majority of studies of fish swimming have looked at them just swimming in a completely open environment in a tank without anything around them, to just really



understand the fish itself. But we wanted to put the fish into the context of its environment, to understand how it was moving in a more natural setting.' So, with the help of several students, Flammang began her investigation (p. 3084).

To begin, Flammang created an obstacle course by placing several posts in a flow tank – essentially a treadmill for fish – taking care that there was a route that the fish could take without ever having to bump into the posts. She then put some bluegill sunfish to the test and filmed the outcome. Flammang suspected that these fish would use vision and/or their lateral line (a sense organ that enables them to detect water flow) to aid their quest. To test this, she deprived some of the fish of one or both of these senses during their time in the flow tank by keeping them in the dark and/or treating them with cobalt chloride to temporarily disable their lateral lines.

The results were surprising. Even when the fish were able to both see and use their lateral lines, they were actively tapping the posts with their pectoral fins, wrapping their fins around the obstacles, and they never took the direct route through the poles. As fish use their pectoral fins to swim at slow speeds, Flammang was surprised: 'If you have animals swimming using their pectoral fins and you put them into an environment where they're going to be potentially contacting things around them with their fins, then you would think that that contact would hinder their locomotion.' But perhaps they were just using the posts to push themselves forward? Flammang doesn't think so: 'If they had been pushing off they would have had to have had a flat fin ray pressed against the obstacle; they wouldn't have been able to generate that pushing force and maintain that nice flexible bend around the tube.' In addition, when the fish were coaxed to swim faster and use their body and tail fins to swim against the flow, the pectoral fins were still touching the obstacles.

So what information are they getting from these touches? Flammang doesn't know, but suspects 'it is important to the fish to have an idea of where it is peripheral to obstacles, and potentially the size and shape of the obstacles.' In support of a role in feeling their way around obstacles, when the fish were deprived of both vision and the lateral line, fin taps became more frequent. In short, they depended on the only sense left to them – touching. It seems that, for a fish, touching, feeling and seeing are all useful when navigating your way through a complicated habitat.

10.1242/jeb.091066

Flammang, B. E. and Lauder, G. V. (2013). Pectoral fins aid in navigation of a complex environment by bluegill sunfish under sensory deprivation conditions. *J. Exp. Biol.* **216**, 3084-3089.

Nicola Stead

LIFE AT HIGH pH: MANAGING AMMONIA

At the southernmost point of the Kenyan Rift Valley lies the inhospitable, alkaline Lake Magadi. With a pH of 10, the only fish that can survive here are *Alcolapia grahami* cichlids. For over two decades, Chris Wood, from McMaster University, Canada, has been intrigued by how these fish cope in their hostile habitat, and has made five expeditions to this lake to investigate. During his first expedition in 1987, Wood recalls the exciting discovery that these fish are 100% ureotelic – they only excrete their nitrogenous waste as urea. This was in stark contrast to other ammonotelic teleosts, who only excrete ammonia. But with such a high external pH, making it almost impossible to excrete ammonia, excreting urea seemed to be the only viable option for *A. grahami*. In more recent years, following the discovery that Rhesus (Rh) proteins facilitate ammonia transport across the gills in most fish, Wood wondered whether, in becoming ureotelic, these fish no longer had a need for Rh proteins. To find out, Wood assembled an international team of scientists and returned to Lake Magadi once more (p. 2998).

From their makeshift laboratory in a nearby house, the team made early morning trips down to the lake, taking it in turns to wade into the caustic waters to capture the fish for their investigation. Upon return to the lab, Wood says: 'We would let the fish settle down for a couple of hours and then we would put them into small chambers with an oxygen electrode so we could measure their oxygen consumption and also their urea excretion'. After a while, the team loaded the water with ammonia, and monitored the fish for 24 h. In parallel experiments, fish were regularly euthanized and the team collected blood, gill and other tissues samples for analysis back in Canada.

While still in the field, the team saw that ammonia loading caused urea excretion levels to go up, but it was when they got back to Canada that the surprising results came to light. In the lab the team found that two Rh proteins, Rhbg and Rhcg2, were expressed in most tissues. Wood explains that this in itself was not entirely unexpected – the Rh proteins might be used to shuttle ammonia to other regions of the body to be converted to urea. However, he admits he was surprised to find Rh proteins in the gills. What's more, the team also found that the expression of these two Rh proteins and an ATPase essential for ammonia excretion increased after exposure to ammonia. Wood explains that increased expression of Rh proteins is a standard response in ammonotelic fish after ammonia loading; it is initiated by high cortisol levels, and sure enough, cortisol levels in the *A. grahami* exposed to ammonia were also raised.

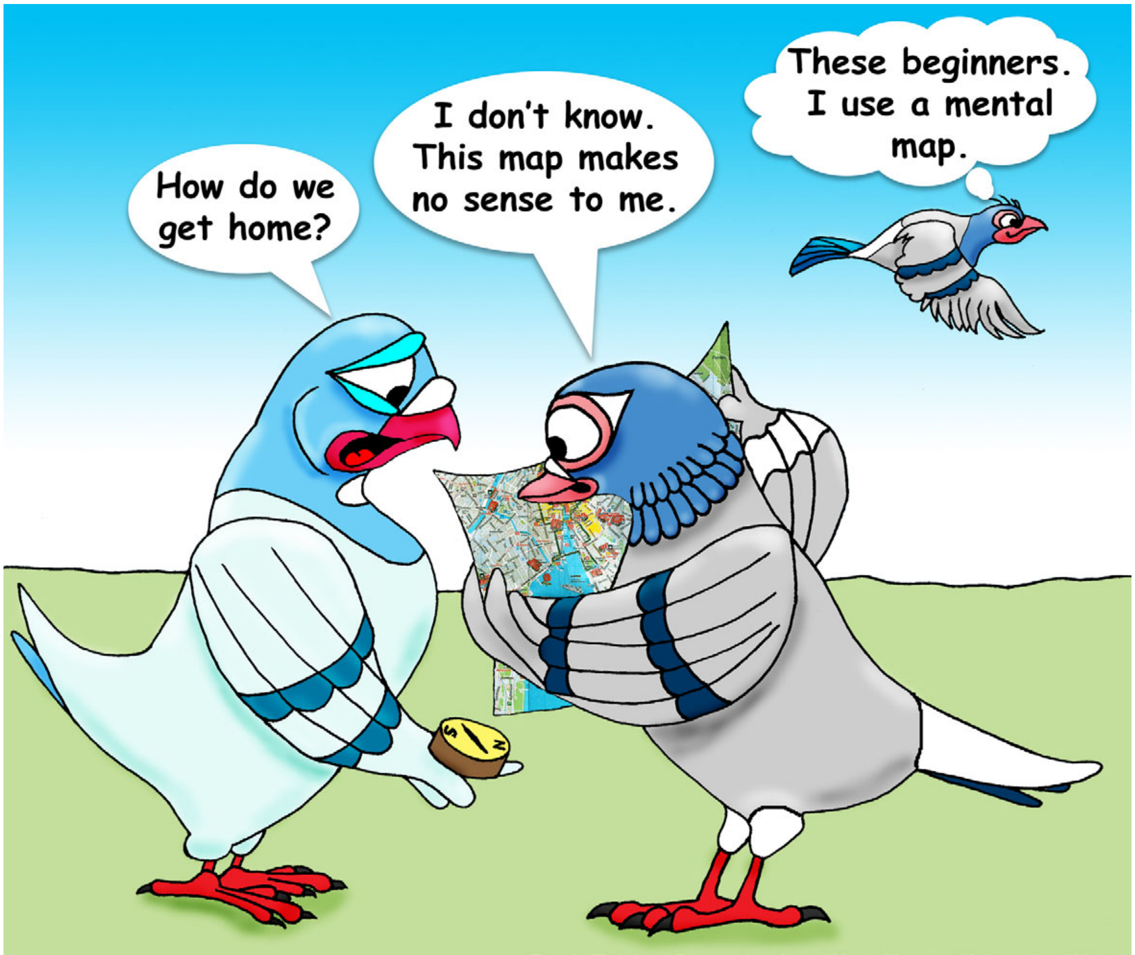
All the evidence suggests that even though these fish usually secrete urea, they've held onto the ammonia-sensitive ammonia excretion system. 'Maybe when they're really challenged by high ammonia the urea mechanism is not sufficient and they might have to start pumping out ammonia as well', speculates Wood. He adds, 'This is quite relevant because there are areas of this lake where there are a lot of flamingos and they produce guano, and bacteria degrade the uric acid to produce a lot of ammonia in the water.' However, quite how *A. grahami* does this against an ammonia gradient remains to be seen, although Wood suspects that the Rh proteins might pump ammonia into the gill cells to such an extent that it's at a higher concentration internally than externally. Wood is currently awaiting permission to return to the alkaline lake to find the answer.

10.1242/jeb.091207

Wood, C. M., Nawata, C. M., Wilson, J. M., Laurent, P., Chevalier, C., Bergman, H. L., Bianchini, A., Maina, J. N., Johannsson, O. E., Bianchini, L. F. et al. (2013). Rh proteins and NH^{4+}-activated Na^+-ATPase in the Magadi tilapia (*Alcolapia grahami*), a 100% ureotelic teleost fish. *J. Exp. Biol.* **216**, 2998-3007.

Nicola Stead

HOME LOFT OR FOOD LOFT? PIGEONS USE COGNITIVE MAP TO DECIDE



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Homing pigeons don't have the luxury of GPS or sat navs for guidance as they fly, yet release them far away from their home loft and they will quickly and efficiently find their way home. Their astonishing navigation skills have long intrigued scientists, who believe that they use a map-and-compass approach when homing. This involves the pigeons first determining their geographical location using a cognitive map and then using compasses, such as landmarks or celestial cues, to keep them on the right bearing on their way home. While most people assume that pigeons have these cognitive maps, Nicole Blaser, a PhD student from the University of Zürich, Switzerland, realised no one had really tested the idea, so with help from her colleagues and supervisor Hans-Peter Lipp, Blaser began her study (p. 3123).

To test their cognitive map skills, the pigeons were given the option of homing to either home or food loft. However, Blaser had to first train the birds to recognise the food loft. She began ferrying them by car to be fed only at the food loft. After they had adjusted to the food loft, she started releasing them along the beeline between the home and food lofts. Slowly, she incrementally increased the distance from the food loft until the birds could efficiently fly to the food loft from their home loft.

After training her pigeons, Blaser then took them to a novel release site equidistant from the two lofts. Half the pigeons were fed at the release site while the other half remained hungry. Once released, all the satiated pigeons flew off in the direction of their home lofts and all famished birds hungrily headed off towards the food loft. When the team repeated the experiment at new site in Italy, using GPS trackers to map the pigeons' aeronautical journeys, they found that all those heading towards their food loft never detoured *via* the home loft, which indicates that the cognitive map isn't centred around their home loft and the pigeons can head directly to their goals. The pigeons know their geographical position in relation to targets and will use this map to choose the appropriate bearing for their needs.

10.1242/jeb.090563

Blaser, N., Dell'Omo, G., Dell'Ariccia, G., Wolfer, D. P. and Lipp, H.-P. (2013). Testing cognitive navigation in unknown territories: homing pigeons choose different targets. *J. Exp. Biol.* **216**, 3123-3131.

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