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

PARAKEETS ARTICULATE SOUNDS WITH TONGUE

Speech almost defines the human race. But we are not the only animals with a versatile vocal repertoire; birds are also renowned for learning and producing intricate trains of sound. Verena Ohms and her colleagues from The Netherlands, Germany and USA explain that speech scientists are particularly interested in bird sound production because of the parallels between bird and human vocal learning. However, there are significant differences too. For example, humans use the tongue extensively to articulate sounds while most birds do not use the tongue; instead, they expand the oesophagus and adjust how wide they open their beaks. Yet, there are several groups of birds that may buck this trend. Ohms explains that speech-imitating parrots have a prominent tongue that they may use to modulate sounds produced by their simple syrinxes. But, there was no direct evidence that parrots use their tongues while calling, so Ohms and her colleagues, Gabriel Beckers, Carel ten Cate and Roderick Suthers, decided to make X-ray movies of four squawking monk parakeets to find out whether or not they articulate sounds with their tongues (p. 85).

Placing minute metal markers in the birds' tongues and at two locations on the tracheae near the top of the throat, the team filmed the parakeets with 10 ms bursts of X-rays as they chattered and made contact and greeting calls. Analysing the markers' movements, the team saw that the birds use their tongues extensively as they squawk and chatter. Having lowered the tongue and opened their beaks before initiating a call, the parakeets then further lowered their tongues by as much as 6.7 mm as they began calling. They also varied the strength of their calls using two strategies: opening the beak wider and varying the height of the tongue to alter the distance between it and the beak's upper mandible.

Analysing the birds' throat, beak and tongue movements during contact and greeting calls, the team found that the parrots prepared for a call by lowering the larynx, opening the beak and lowering the tongue before uttering a sound. They also shortened the distance between the two markers on the tracheae by as much as 44%. Then, as the birds began squawking, they continued depressing their tongues and pulling their larynxes down. Comparing the greeting and contact calls, Ohms and her colleagues found that the throat structure movements were slower in the longer greeting calls. However, when the birds were chattering – rattling out a train of alternating notes – the team noticed that the birds produced two distinct tones by changing the relative timing of their beak, tongue and tracheal movements.

So monk parakeets modulate their calls by adjusting their tongue height, beak opening and tracheal length and the team points out that this is the first observation that a bird contracts the trachea to articulate distinct sounds. However, the parakeets did not perform one tongue movement that is particularly important in human speech. Explaining that humans extend the tongue back and forth, the team noticed that the parakeets appeared not to move the tongue horizontally. However, knowing that the parakeets produce a repertoire of nine calls when communicating naturally, they say, 'It cannot be ruled out that in some of the other call types these birds use the front–back dimension more heavily.' They are also keen to analyse the beak, tongue and throat movements of birds mimicking human speech to discover more about the mechanisms of speech production.

10.1242/jeb.068551

Ohms, V. R., Beckers, G. J. L., ten Cate, C. and Suthers, R. A. (2012). Vocal tract articulation revisited: the case of the monk parakeet. *J. Exp. Biol.* **215**, 85-92.

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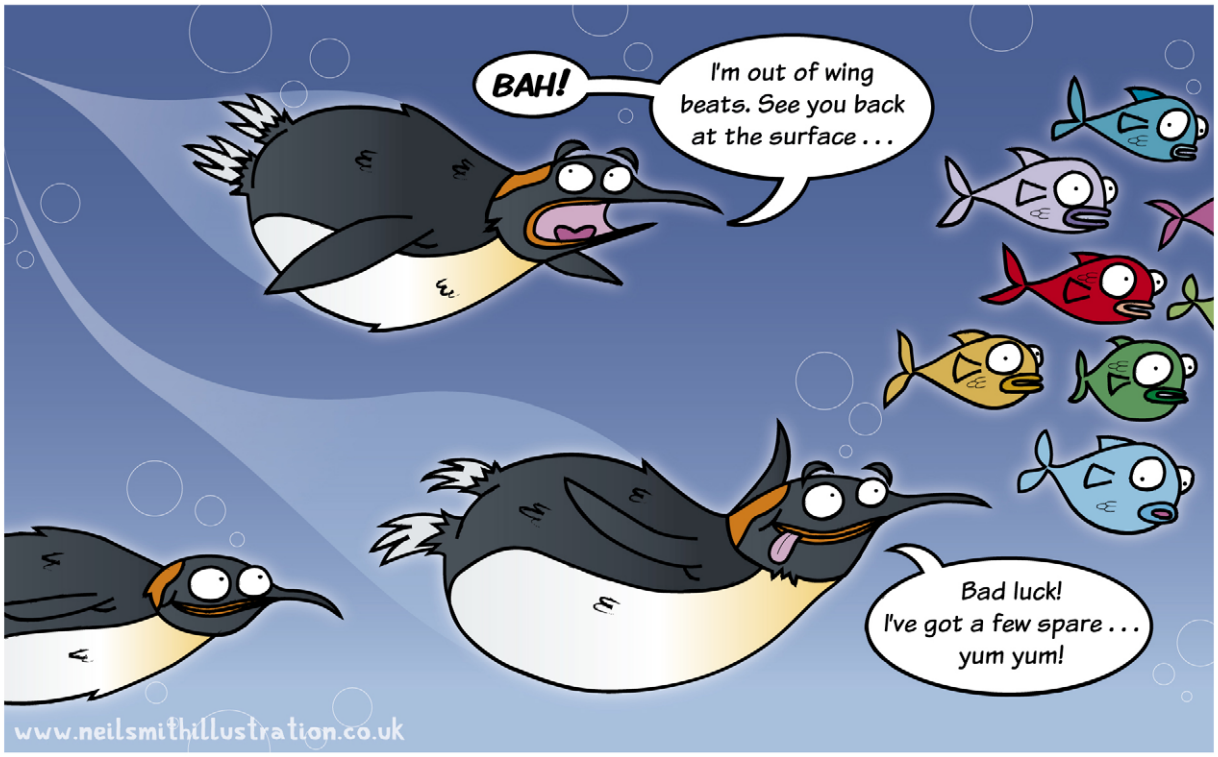
CORRECTION: PREGNANCY IS A DRAG FOR BOTTLENOSE DOLPHINS

The image of a pregnant dolphin that was used to illustrate this article was incorrectly attributed to Shawn Noren. The credit should have read Dolphin Quest.

PENGUINS TIME DIVES BY WING BEAT



Breath-hold divers face a dilemma: remain submerged to exploit rich hunting opportunities or return to the surface to replenish the air supply. 'When to end a dive may not be a straightforward decision', say Kozue Shiomi and colleagues from The University of Tokyo, Japan, and Scripps Institution of Oceanography, USA. Deep-diving animals, such as emperor penguins, decide to terminate a dive long before they make it back to the top, so what factors determine when a diving animal decides to begin ascending? Suspecting that the muscle work expended until they decide to return to the surface rather than submergence time might trigger an emperor penguin's return journey Shiomi, Katsufumi Sato and Paul Ponganis decided to analyse the dive profiles of emperor penguins diving freely in open sea and from an ice hole to find out what triggers the birds' decision to end a dive (p. 135).

Using data collected from diving penguins on previous field trips, the trio analysed 15,978 dive profiles from 10 free-ranging birds and 495 dives from 3 birds foraging through an ice hole. Calculating the time when each penguin began its final ascent to the surface, the team realised that almost all free-ranging birds began their final ascent around 5.7 min into the dive. However, penguins diving through the ice hole often dived for longer before performing an U-turn and returning to the ice hole, so some other factor must be sending them back to the surface.

Analysing the birds' acceleration patterns to calculate the number of wing beats taken before turning to return to the ice hole, the team realised that the birds used on average 237 wing beats before embarking on their return. 'We suggest the decision [to return to the surface] was constrained not by elapsed time, but by the number of strokes, and thus, perhaps cumulative muscle work', say Shiomi and colleagues.

10.1242/jeb.068569

Shiomi, K., Sato, K. and Ponganis, P. J. (2012). Point of no return in diving emperor penguins: is decision to return time limited by the number of strokes? *J. Exp. Biol.* **215**, 135-140.

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