

INSIDE JEB

Migrating young eagles follow adults for conservation success



Lesser spotted eagle flying with GPS transmitter. Photo credit: B.-U. Meyburg.

Although the lesser spotted eagle is not listed as endangered by the IUCN, Bernd-Ulrich Meyburg from BirdLife Germany (NABU) knows that the graceful bird of prey's future is far from assured in Germany. Meyburg explains that the German population has dwindled to just 110 breeding pairs in recent decades, largely due to habitat loss and persecution by poachers during their long migration to their overwintering sites in southern Africa. In a bid to stem the destruction of the German population, Meyburg has been relocating chicks from the more stable Latvian population in the hope of boosting the declining German numbers. However, it was not clear whether the translocated chicks would survive the gruelling migration to their overwintering sites in southern Africa. To be convinced that the conservation strategy might offer hope for the German population, Meyburg needed evidence that the translocated Latvian chicks could somehow reach South Africa and return successfully.

'I initiated the conservation project in the federal state of Brandenburg in 2004', says Meyburg, explaining that the scheme has not impacted the Latvian population, as he takes only the chicks that hatch second, which usually die within a matter of days. Meyburg and his international team of conservationists rescued the chicks – referred to as 'Abels', after the biblical story of Cain and Abel – even before they had hatched and reared them in Latvia, before relocating them to a secure hide – known as a hack – in the Schorfheide-Chorin reserve

in Brandenburg. 'The small chicks are fed using a puppet that looks like the head of an adult bird', says Meyburg, adding, 'Once they are big enough to feed on their own, the food is introduced into the hacking chamber through a small hole in one of the solid walls ... to avoid imprinting on humans'.

Then, in 2009, the team fitted lightweight GPS transmitters to 12 Latvian Abels, eight lesser spotted eagle youngsters from nearby nests and nine adults to track their departures and migrations. Meyburg recalls that the majority of the Abels embarked on their migration earlier than the other migrants, departing between 10 and 11 September, with a few remaining until 16–17 September. In contrast, most of the adults set off between 16 and 19 September, with the Brandenburg-hatched chicks departing between 14 and 16 September – although one lingered until 26 September, when the final adult departed. However, when Meyburg analysed the bird's migrations, he realised that the Abels' early departure probably spelled disaster.

Instead of following the route taken by the more experienced adults – southeast across the Bosphorus and along the Eastern Mediterranean coast before entering Africa at Suez – most of the Abels struck out west before attempting to cross the Mediterranean. Meyburg explains that as eagles are large compared with many other migrants, they cannot sustain flapping flight and depend instead on thermals generated above land to remain airborne; without the benefit of lift-generating thermals, the inexperienced birds were doomed to fail as they crossed the water. Consequently, four of the youngsters perished in the Mediterranean and two died in North Africa, with only four completing the full migration.

In contrast, just one of the eight youngsters that had hatched in Germany died on the outbound journey, following the same route as the experienced adults south across the Bosphorus. 'Juvenile lesser spotted eagles are highly dependent on adult guidance in order to survive their first migration and locate the traditional winter grounds', says Meyburg.

Although it was clear that the epic round trip took a significant toll on all of the youngsters – only two of the 12 2009 Abels returned, while just 25% of the German chicks made it home – Meyburg is excited by the potential of the Abel conservation strategy. 'The greatest success was a Latvian male, which returned at the age of 2 years to the release site and fed there a few times', recalls Meyburg, adding that the youngster eventually reared his own chick near the site 3 years later. 'A new territory had been established which did not exist before', he says triumphantly.

10.1242/jeb.166454

Meyburg, B.-U., Bergmanis, U., Langgemach, T., Graszynski, K., Hinz, A., Börner, I., Meyburg, C. and Vansteelant, W. M. G. (2017). Orientation of native versus translocated juvenile lesser spotted eagles (*Clanga pomarina*) on the first autumn migration. *J. Exp. Biol.* **220**, 2765–2776.

Kathryn Knight

Spear-nosed bats train echolocation beam



A pale spear-nosed bat (*Phyllostomus discolor*). Photo credit: Kathrin Kugler.

Visual information streaming through our peripheral vision is essential for keeping us on the straight and narrow. 'When you move past an object, you expect the object to move sideways and if it does not, you know you are going to crash into it', says Lutz Wiegrebe from the Ludwig-Maximilians-Universität Munich, Germany. Animals that use vision to negotiate their surroundings rely on rapid eye movements, known as saccades, which briefly track individual background objects as they appear to fly past, before flicking to the next: 'You need landmarks for orientation', says Wiegrebe. However, imagine negotiating a complex forest in

the dark without visual guidance: ‘It would be dangerous if you did this on your bike’, says Wiegrebe. Yet, this is the situation faced by echolocating bats whenever they venture out. Wondering whether leaf-nosed bats use the acoustic equivalent of visual saccades – briefly training their sonar beam and ears on objects as they flit past – Wiegrebe and Kathrin Kugler investigated the possibility that one member of the family, the pale spear-nosed bat (*Phyllostomus discolor*), coordinates its ear movements and the movements of the noseleaf through which it emits sonar to scan its environment while moving.

As filming each agile aeronaut’s facial movements while recording their echolocation cries during flight would be impossible, Wiegrebe and Kugler designed a custom-built cart in which a bat could sit as it went for a joyride past a wooden wall covered in vertical ridges that would produce a train of acoustic reflections. Having accustomed a bat to its fairground ride and ensured that it was content to echolocate naturally as it swooped past the wall in its Batmobile, Wiegrebe and Kugler filmed the animal’s facial movements and recorded their echolocation cries with seven minute microphones mounted in a semi-circle around the animal’s head. ‘The video analysis was the hardest thing to do’, says Wiegrebe, admitting that the painstaking job of reconstructing the bats’ facial movements in 3D was extremely intensive.

Despite the challenge of handling the massive data set, it eventually became clear that the bats flexed and twitched their noseleaves every time they emitted a sonar beam. ‘We assume that they do that to adjust the elevation of the emitted call, like, “do I point my call further up or down?”’, says Wiegrebe. However, instead of moving and training their ears on the returning acoustic reflection, the bats always swivelled their ears forward: ‘It is really a very short transient movement’, says Wiegrebe. And when the duo moved the vertically ridged wall further away from the bat’s cart-ride, the animals delayed moving their ears forwards by a fraction of a second (3 ms): ‘This very fast behaviour is not stereotyped’, says Wiegrebe, ‘it is adjusted according to what the animals hear; namely, to the echo delay’. In contrast, between echolocation calls the bats twisted their ears to the side. Wiegrebe admits that he was surprised to

see the movement, as it is unnecessary for the bats to move their ears to determine their distance from objects. He suspects that, instead, ‘They are listening everywhere like a cat does’.

So, pale spear-nosed bats transiently train their echolocation sonar beams on passing static obstacles and Wiegrebe is now keen to learn more about how the bats track moving objects as they manoeuvre through their nocturnal world.

10.1242/jeb.166439

Kugler, K. and Wiegrebe, L. (2017). Echo-acoustic scanning with noseleaf and ears in phyllostomid bats. *J. Exp. Biol.* **220**, 2816–2824.

Kathryn Knight

Some insect larvae tolerate high temperatures better during winter



Fire-coloured beetle, *Dendroides canadensis*, larva. Photo credit: Shaun Lee and Stefan Freed.

Snowy winters seem to be becoming a thing of the past. As rising temperatures take an ever stronger hold, the insulating blankets of snow that kept overwintering populations of bugs and mini-beasts in various states of suspended animation through the long dark months are receding. ‘We were interested in how insects would respond to increased temperatures in the winter’, says Henry Vu from the University of Notre Dame, USA, who was curious to find out how vulnerable exposed insects might respond to relatively sultry winters when their insulating winter blanket dwindles. Specifically, Vu and his colleagues wanted to find out whether high temperatures during thaws could be close to the insects’ lethal temperatures. As many insects pass the winter buried as larvae deep in logs, Vu and PI John Duman decided to test the tolerance of the fire-coloured beetle, *Dendroides canadensis*, throughout the seasons to find out whether losing their winter muffler is risky.

Vu ventured out into local woods to retrieve the beetle larvae from decaying logs throughout the year, even braving the elements during the polar vortex that gripped the US in January 2014: ‘We used a chisel and hammer to peel back the frozen bark of trees and chip away at the decaying wood to find our insects during the winter’, he recalls. Back in the lab, Vu placed the larvae in incubators ranging from 33 to 41°C for up to 2 days to find out how well they survived the high temperatures. In addition, he chilled some of the larvae during each of the seasons, while recording the temperatures at which they died, to find out how their low temperature tolerance varied.

Fire-coloured beetles avoid freezing during the colder months by producing antifreeze compounds and Vu and Duman recorded that the insects could survive temperatures as low as –25°C during the winter, although they only survived temperatures that were a few degrees below freezing during spring and summer. However, when Vu recorded the insects’ survival rates at high temperatures, he found they were able to survive temperatures around 40.9°C during the winter but could only cope with temperatures around 36.7°C during the summer. ‘These insects can survive over a 60°C range in the winter while only surviving over approximately a 40°C range in summer’, says Vu. And when he tested the survival of the larvae of two other species – a member of the flat bark beetle family, *Cucujus clavipes clavipes* (which also produces antifreeze to avoid freezing), and the crane fly, *Tipula trivittata* (which can survive the freezing of some of their body fluids) – their high temperature resilience also seemed to increase during the winter.

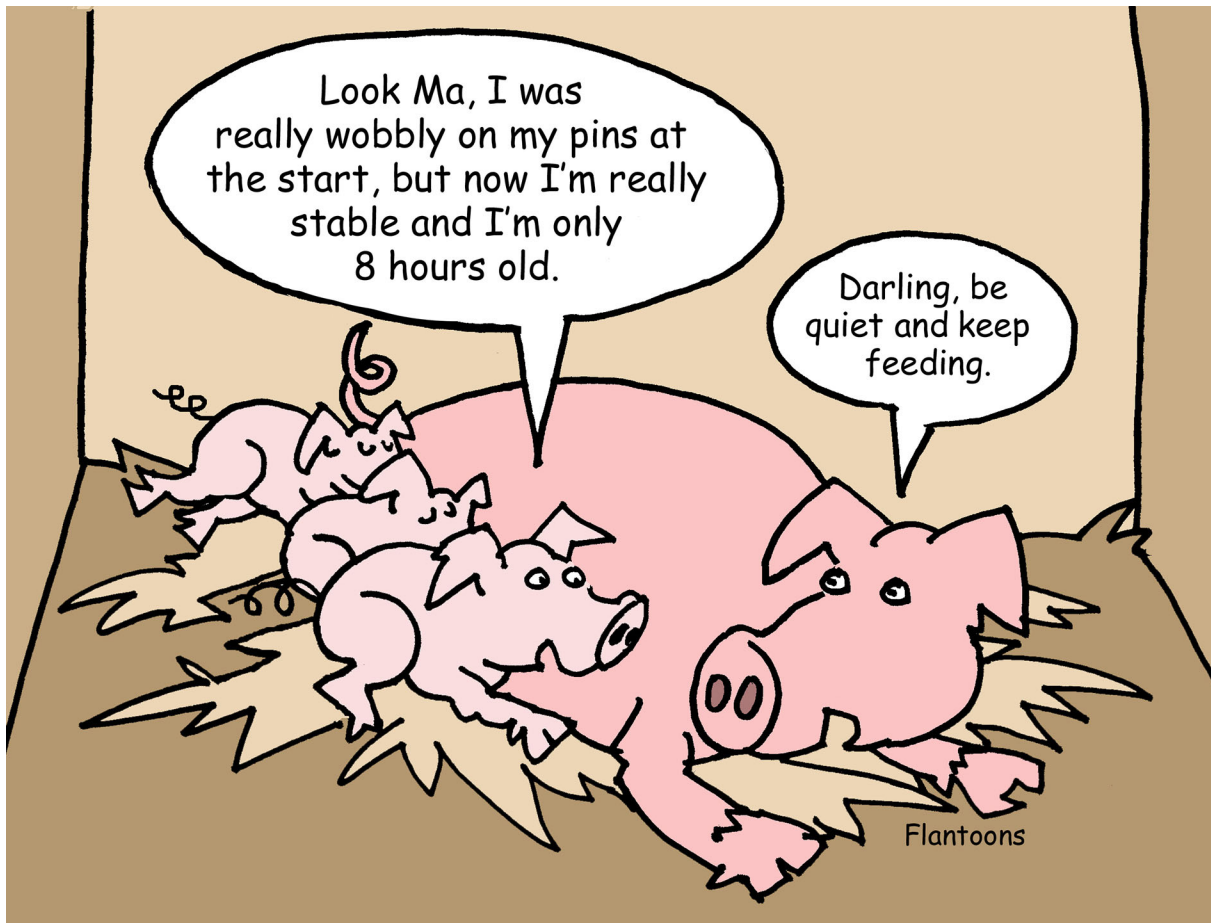
‘Logically, we were expecting the insects to survive higher temperatures in the summer because that’s when the highest temperatures are’, says Vu. He suspects that the larvae are most at risk from overheating during the spring, when they are becoming less heat tolerant and the logs are warming as the air temperatures rise and there are fewer leaves for shade from the increasing strength of the sun.

10.1242/jeb.166447

Vu, H. M. and Duman, J. G. (2017). Upper lethal temperatures in three cold-tolerant insects are higher in winter than in summer. *J. Exp. Biol.* **220**, 2726–2732.

Kathryn Knight

Newborn piglets develop coordination within 8 h



Within minutes of birth, tiny piglets must be up on their trotters, competing with their siblings for a place at mum's dining table. But Charlotte Vanden Hole, Peter Aerts, Chris Van Ginneken and colleagues from the University of Antwerp, Belgium, were curious to find out how much control newborn piglets have over their legs at birth and whether their control improves within the first few hours of life.

Being on hand at the birth of seven litters, Vanden Hole, Van Ginneken and Sara Prims intercepted the youngsters immediately after delivery and filmed their first faltering steps as they stumbled along a checkerboard tunnel. However, an hour later, all of the piglets seemed to have better control of their limbs and the team continued filming the piglets' progress for the first 96 h of their lives.

Rescaling their observations – as if all of the piglets were the same age and size, for comparison – and then analysing how the piglets' walk developed during the first hours after birth, Vanden Hole, with the help of Jana Goyens and Erik Fransen, found that the piglets' coordination improved dramatically during the first 4 h, although their movements were not completely coordinated until the age of 8 h. 'Intralimb coordination does not seem to be fully innate [at birth]', says Vanden Hole. However, the synchronisation of the footfall pattern did not change from the piglets' initial steps – it was essentially the same as the adults'. The team also noticed that the youngest piglets kept their feet in contact with the ground for a longer proportion of each stride, while swinging their legs for a shorter period, and Van Ginneken and Aerts say, 'We propose that during the

first hours after birth, the piglet would adopt a means of locomotion that is as energy efficient as possible, because of the limited amount of available energy. One way of accomplishing this is by limiting the swing duration'.

While piglets are remarkably mobile, the circuits that control their movements are not fully developed at birth, although they mature rapidly within the first 4 h of life, allowing newborns to snuffle around their mother in search of milk.

10.1242/jeb.166462

Vanden Hole, C., Goyens, J., Prims, S., Fransen, E., Ayuso Hernando, M., Van Cruichten, S., Aerts, P. and Van Ginneken, C. (2017). How innate is locomotion in precocial animals? A study on the early development of spatio-temporal gait variables and gait symmetry in piglets. *J. Exp. Biol.* **220**, 2706-2716.

Kathryn Knight
kathryn.knight@biologists.com