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

COLUGOS GLIDE TO SAVE TIME, NOT ENERGY

Gripping tightly to a tree trunk, at first sight a colugo might be mistaken for a lemur. However, when this animal leaps it launches into a graceful glide, spreading wide the enormous membrane that spans its legs and tail to cover distances of up to 150 m. So, when Greg Byrnes and his colleague Andrew Spence from the University of California, Berkeley, USA, were looking around for a mammal to carry the accelerometer/radio transmitter backpacks that the duo designed to track animals in the field, the colugo was an obvious choice. 'They are a large glider and it was an opportunity to learn about an animal that we didn't know much about,' says Byrnes. Admitting that they were initially interested in the natural history of these charismatic creatures, Byrnes realised that they could use the information gathered to find out about the cost of the colugo's gliding lifestyle. Flying to Singapore, Byrnes teamed up with Norman Lim to track the gliding mammals (p. 2690).

Describing how some of the nocturnal colugos roost low in the forest, Byrnes was able to capture six of the mammals and glue the accelerometer packs to their backs before allowing them to scurry back up their trees for the first glide of the night. Explaining that the data loggers were able to collect data for 3–9 days, Byrnes and Lim tracked the animals until the data loggers eventually fell off and they were able to retrieve them several weeks later.

Back in Berkeley, Byrnes, Spence and Thomas Libby had the unenviable task of managing the colossal amount of data collected: 'We were sampling at 100 Hz for days,' explains Byrnes. According to Byrnes, there is a distinctive acceleration profile when they glide. 'What you see is the leap and the landing when there is this sweeping acceleration, so it's easy to pick out their glides,' he says. Eventually, the trio converted each animal's acceleration traces into velocities – as they scaled trees and glided – and then they calculated the distances that the animals covered.

Analysing the glide trajectories, the team realised that the colugos only climb a relatively small height to achieve their lengthy shallow glides. 'The average was 8 m for an animal that is gliding 30–50 m,' says Byrnes. But how much energy were they using to cover that distance?

Basing their calculations on the amount of energy used by small climbing primates – close relatives of the colugo – the trio calculated the energy used by a colugo ascending a tree to initiate a glide. Then they calculated the amount of energy that the animals would use if they had clambered through the canopy to cover the glide distance and were amazed to see that instead of saving energy, the colugos were using 1.5 times more energy. 'This was a surprise, as the dogma has always been that gliding is cheaper,' says Byrnes.

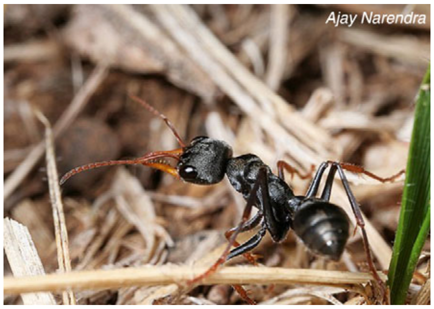
However, one thing was clear: gliding was faster. 'If you watch the animals move through the trees they move pretty slowly,' says Byrnes, 'But they can go 10 times as fast and cover long distances gliding so they can spend more time foraging,' he explains. Gliding could also protect colugos from dangerous predators and reduce the risks of climbing on spindly branches, so it could be more of a long-term benefit than simply saving energy.

10.1242/jeb.062687

Byrnes, G., Libby, T., Lim, N. T.-L. and Spence, A. J. (2011). Gliding saves time but not energy in Malayan colugos. *J. Exp. Biol.* **214**, 2690-2696.

TEMPERATURE DOES NOT RESTRICT BULL ANT ACTIVITIES

Myrmecia aren't known as bull ants for nothing. 'They are very ferocious, they have good eyes and a very painful sting,' explains Jochen Zeil from the Australian National University. However, despite their aggressive nature, two of these closely related species have achieved an arrangement that allows them to live in close proximity: *Myrmecia croslandi* forage by day while *Myrmecia pyriformis* only forage after sunset. Zeil explains that this partitioning of time could be explained by a number of factors such as competition and avoiding predators. However, Zeil points out that another factor could be responsible for the ants' lifestyles. 'It could be that the night-active animals avoid the heat of the day and the day-active animals avoid the cool of the night,' he says. Intrigued by this possibility, Zeil and his colleagues Piyankarie Jayatilaka, Ajay Narendra and Paul Cooper decided to monitor the ants' activity patterns over a year and to measure their thermal tolerances to find out whether the insects' thermal tolerances influenced their lifestyle choices (p. 2730).



Finding *M. croslandi* and *M. pyriformis* nests on the university campus, Jayatilaka, Narendra and Samuel Reid monitored the ants as they set off foraging in the surrounding trees. Over a year, the team saw that the day-active *M. croslandi* were active at temperatures ranging from 10 to 35°C and their foraging pattern varied across the year. On hot summer days, the insects emerged from the nest at about 8 am and returned to the nest for a midday siesta before heading out a second time and finally turning in at 5 pm. However, in the cooler spring and autumn the ants stayed out foraging all day and as the temperatures dropped further in winter the ants closed the nest and hibernated. *M. croslandi* were extremely temperature sensitive and Zeil says, 'There was a clear correlation with temperature at sunrise and the onset of foraging.'

However, the nocturnal *M. pyriformis*'s behaviour was much less variable and they seemed completely unaffected by temperature as the year progressed. 'They always came out about 20 minutes after sunset and they were active throughout the winter,' says Zeil, who adds, 'Their foraging is determined by the light level at sunset time.'

Next, the team decided to find out whether the insects' foraging patterns were influenced by their thermal tolerance, so they measured the temperature at which the insects lose the ability to move. Filming *M. croslandi* as the temperature rose gradually, Jayatilaka, Cooper and Zeil were surprised to see that the ants suddenly began rushing around at about 35°C before collapsing later at 48.5°C. The ants seemed to be trying to escape the heat and Zeil says, 'The increase in walking speed when they encounter an uncomfortable temperature is a much better predictor of the temperatures they stop being active outdoors.' After allowing the ants to recover from the high temperature, the team reversed the experiment and found that the ants were incapacitated at 10.4°C.

The team also repeated the same experiments with the nocturnal *M. pyriformis*, and the ants functioned well from 41.6°C down to 8.2°C. 'It is very clear to us that the physiology of these animals does not limit them to their activity schedules,' says Zeil: *M. pyriformis* could handle the heat of the day and *M. croslandi* could cope with cooler nights. The team suspects that the ants are restricted by their visual system instead, with the bright light of day sending *M. pyriformis* back to the nest and dim night conditions keeping *M. croslandi* out of *M. pyriformis*'s way.

10.1242/jeb.062695

Jayatilaka, P., Narendra, A., Reid, S. F., Cooper, P. and Zeil, J. (2011). Different effects of temperature on foraging activity schedules in sympatric *Myrmecia* ants. *J. Exp. Biol.* **214**, 2730-2738.

Kathryn Knight

RED CROSSBILLS COPE WITH MOULTING AND STRESS

No matter how much effort a bird puts into preening, there is always a time when its feathers need replacing. However, feather regrowth is a costly process. Jamie Cornelius from the University of California Davis, USA, is intrigued by the metabolic trade-offs that animals make between competing physiological processes. 'Trade-offs are a very potent evolutionary force in forming the behaviour and physiology of animals,' she says. Knowing that animals divert resources from non-essential to critical processes, Cornelius and her colleagues wondered how resource-intense moulting impacts on the ability of some songbirds to deal with stress. She explains that most songbirds only moult after the breeding season and they free up resources for feather regrowth by suppressing their stress response. But how do nomadic songbirds that moult over a longer period and depend on unreliable food sources juggle the competing demands of their stressful lives *versus* feather regrowth? Knowing that corticosterone is the key hormone triggering a stress response in birds, Cornelius and her supervisor, Thomas Hahn, decided to measure levels of the hormone in red crossbills and zebra finches to find out how well they prepare for stressful encounters while replacing their plumage (p. 2768).

Unfortunately, capturing moulting red crossbills was far from easy. 'The tricky thing is that red crossbills are nomadic so you don't know where they are going to be in a given year,' explains Cornelius. However, by tracking the bird's favourite food source – pine cones – as they ripened, Cornelius eventually located flocks of the elusive birds and was able to trap them by luring them into mist nets with captive red crossbill decoys. Then Cornelius had to work fast. Knowing that being trapped was stressful for the birds, she had to collect the first tiny blood sample from each bird within 3 min: before its corticosterone levels began rising. Next, she gently placed the bird in a cloth bag and collected three more blood samples over the course of an hour as the bird coped with the stressful situation. Finally, she assessed how far each individual's moult had progressed before releasing it back into the wild.

Meanwhile, down in Australia, Nicole Perfito was also trapping zebra finches, collecting blood samples and checking how may feathers they had replaced. 'Zebra finches show a very slow moult that takes nearly a whole year,' explains Cornelius, who adds that the birds living in the deserts around Alice Springs are also dealing with very unpredictable conditions, so a strong stress response would be very beneficial.

Next, Cornelius travelled to Creagh Breuner's lab at the University of Montana to find out how the birds had handled the stress. Measuring the concentration of corticosterone in the trapped birds' blood, Cornelius found that the level of the stress hormone had rocketed and she also found that the zebra finches from the harsh desert around Alice Springs produced the highest corticosterone levels.

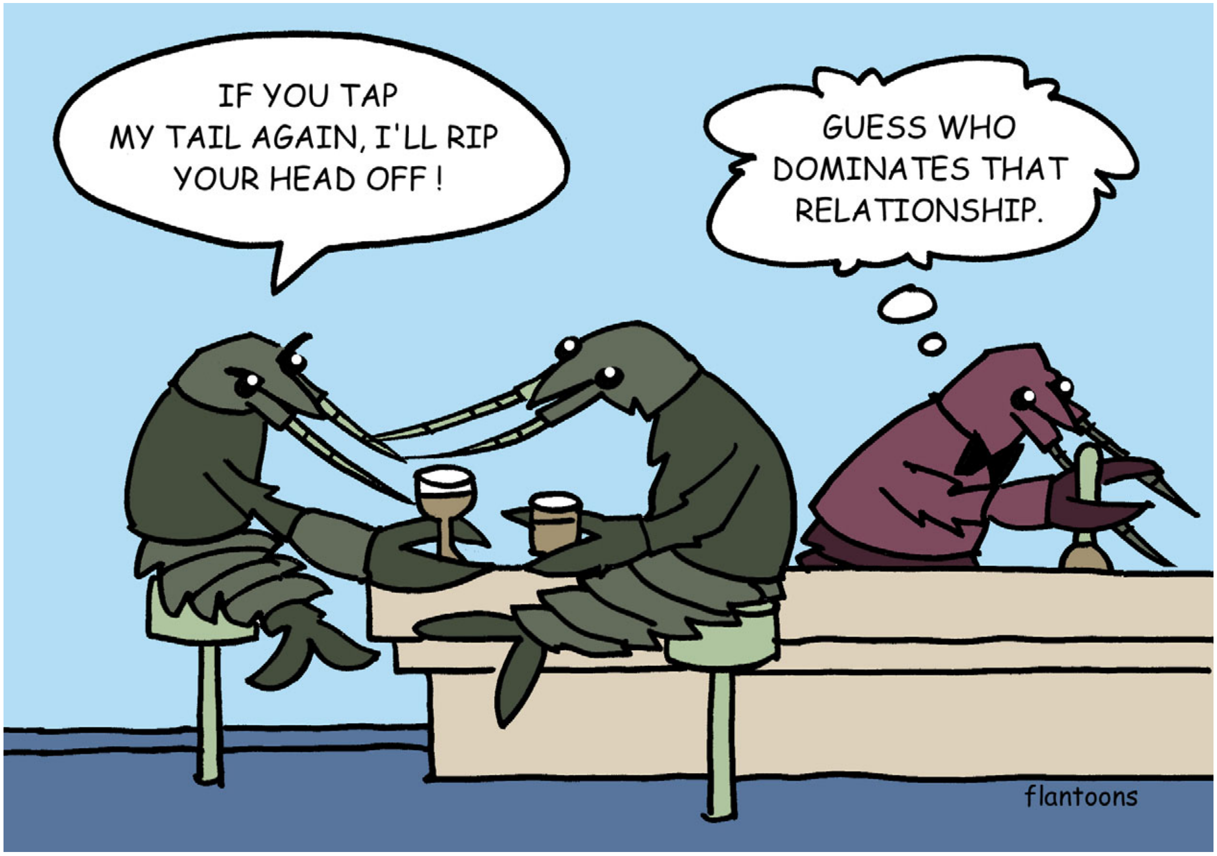
The nomadic birds with extended moults were able to maintain their costly stress responses for protection from their stressful lifestyle, unlike other songbirds that suppress the response while replacing their plumage rapidly. Having found that some songbirds do make the trade-off while others don't, Cornelius and her colleagues suggest that instead of being hardwired, songbirds may be able to adjust their moult/stress response trade-off to match their circumstances.

10.1242/jeb.062661

Cornelius, J. M., Perfito, N., Zann, R., Breuner, C. W. and Hahn, T. P. (2011). Physiological trade-offs in self-maintenance: plumage molt and stress physiology in birds. *J. Exp. Biol.* **214**, 2768-2777.

Kathryn Knight

CRAYFISH STATUS AFFECTS STEREOTYPICAL BEHAVIOUR



It's a cut-throat world in crayfish society. When two unacquainted crustaceans meet, they battle it out to establish their social status and their resulting rank can affect other subsequent behaviours. Sawako Fujimoto, Bunpei Hirata and Toshiki Nagayama from Hokkaido University and Yamagata University, Japan, explain that stereotypical responses can be altered by a wide range of factors. The team were curious to find out how a crayfish's social status might affect one of its stereotypical responses: the avoidance reaction, when they respond to a perceived attack on their tail (p. 2718)

Fujimoto and her colleagues explain that crayfish react in one of two ways to a tap on the last segment of the tailfin. They either flee from the perceived attack or turn to take it on. The level of their response also depends on their social status, with dominant animals more likely to attack and subordinates more likely to escape. Starting out with isolated crayfish, the team tested the crustaceans' responses to the simulated attack and found that 90% of the animals fled. Then they paired crayfish together and allowed them to fight before retesting the animals' reactions. The winners switched their response from flight to fight, with 90% of the dominant crayfish aggressively curling their bodies and turning toward the tail. Next, the team pitted winners against winners to switch the loser's status and the newly subordinate crayfish changed their tail-tap response too, becoming more timid. Finally, when the team measured the spike pattern in the neurones that control the position of appendages on the tail tip, the spike pattern reversed when the crayfish's behaviour switched.

Having shown that the crayfish's avoidance reaction is changeable and dependent on the crustacean's social status, the team says, 'The neural mechanisms for this change in aggressiveness and behavioural choice in response to a stimulus are unclear and further neuroethological studies are necessary to clarify this point.'

10.1242/jeb.062679

Fujimoto, S., Hirata, B. and Nagayama, T. (2011). Dominance hierarchy-dependent behavioural plasticity of crayfish avoidance reactions. *J. Exp. Biol.* **214**, 2718-2723.

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