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Cover: A male red-winged blackbird (*Agelaius phoeniceus*) perches in a Canadian marsh. Like many habitats, marshes face increasing pollution by anthropogenic noise from traffic, industry and urban centres. Noise pollution masks the birds' acoustic signals, which are crucial for defending territories and attracting mates. If the birds are unable to adapt, they may be extirpated from affected areas. A new study by Hanna et al. (pp. 3549–3556) shows that red-winged blackbirds alter the structure of their songs in response to traffic noise, a strategy that may enhance communication in a noisy environment. Photo credit: Brendan Graham.

Giurfa explains that years before, his PhD supervisor, Josué Núnez, had discovered that mildly shocked bees extend their stings, so initially he decided to see whether bees could be trained to extend their stings when they recognised an odour if the scent had been delivered with a weak electric shock.

'Some people said that would never work because when a bee stings a person the bee dies,' recalls Giurfa. However, despite the doubts, Giurfa and Sandoz proved that bees could learn that an odour was followed by a mild electric shock and extend their sting. The team also knew that the shock had to be as gentle as possible. 'We wanted the bee to respond reliably and not to be damaged by the stimulation,' he explains, so they settled on a mild 2 s long 7.5 V shock to protect the bees from injury.

Next, Giurfa and Sandoz teamed up with graduate students Theo Mota and Edith Roussel to test whether bees could be trained to extend their stings when they recognised a colour.

Gently strapping a bee to a copper stage, the team showed it a green screen and then applied the gentle shock 3 s later: the bee's sting popped out. The team also showed the bee a blue screen, without applying the mild shock. After repeatedly showing the two screens to the bee in random order (green accompanied by the shock and blue without) they showed the bee the green screen, this time without the gentle shock, to see if she would recognise it and extend her sting. She did. And she never extended the sting when she saw the blue screen. She could distinguish between the two colours.

Then the team tested to see if the bees could be trained to distinguish between two blue screens (439 nm and 440 nm) that were indistinguishable to human eyes. This time, one of the blues was associated with the shock and the other was not. Again, the bees only extended the stings when they saw the blue that had been associated with the mild shock during training. Finally, the team tested whether the bees could be trained to distinguish between colours with different intensities, and again the insects passed with flying colours.

So, restrained bees in the lab can be trained to distinguish and memorise colours if they are coupled with a gentle shock and this new training regime offers scientists the opportunity to discover how bees use their memories to avoid enemies and other risks in the environment. 'Now we have a protocol in which you can do both [visual and odour cues] so that we can study multimodal learning in the brain,' explains Giurfa.

10.1242/jeb.066290

**Mota, T., Roussel, E., Sandoz, J.-C. and Giurfa, M.** (2011). Visual conditioning of the sting extension reflex in harnessed honeybees. *J. Exp. Biol.* **214**, 3577-3587.

**Kathryn Knight**

## BLACKBIRDS ADAPT SONGS TO HUMAN NOISE


It's hard to find peace and quiet these days. No matter where you are, you can usually hear the rumble of passing cars or an aeroplane overhead. Humans tackle noisy environments by raising their voices, but how has our continual racket affected the calls of other species? This is the question that puzzled University of Ottawa honours student Dalal Hanna when she struck up a collaboration with David Wilson from the University of Windsor. 'We were both doing fieldwork at the Queen's University Biological Station. My expertise is in animal communication and her interest was in conservation biology, so we joined forces,' recalls Wilson (p. 3549).

Drawing on the experience of Gabriel Blouin-Demers and staff at the Research Station, Hanna and Wilson decided to find out how anthropogenic noise might affect the calls of red-winged blackbirds by comparing the songs of populations living in marshes adjacent to Canadian Provincial Highway no. 15 to the songs of red-winged blackbirds from pristine marshes on the biology station.

Heading into the marshes in the early morning, Hanna and Wilson recorded the calls of birds adjacent to the highway, before the traffic – and noise – levels became too high, and in the relative peace of the wilderness. 'Working in the marshes was a bit of a challenge,' admits Wilson, 'you can't walk into or through them so you are confined to the perimeter and even then it can be very soggy and difficult to move through to record different birds around the edges of the marshes.'

After successfully recording 436 songs from over 60 birds, Wilson teamed up with Daniel Mennill to analyse and compare the birds' calls. 'The challenge was separating the signal from the background noise to make very accurate measurements of the songs,' recalls Wilson. However, they eventually found that the final harsh trill of the song produced by the highway population had become deeper and more whistle-like than the wilderness birds' songs: in other words, the song had become more tonal, allowing the birds to be heard above the road noise. Also, instead of gaining low frequency components, the highway birds had lost the higher frequencies found in their rural cousin's songs, leaving the low frequency sounds that travel further for communication.

Next, Hanna and Wilson wondered how the wilderness red-winged blackbirds would respond if they suddenly encountered noise levels that the highway population endure constantly. Could they adapt and, if so, would they use the same strategy as Highway no. 15's neighbours?

Playing white noise and silence to the wilderness birds and recording their songs, Wilson and Hanna successfully extracted the noise from the recordings and compared the songs. Again, the bird's songs had become more whistle-like as they competed with the noise. So, even though the birds had never experienced traffic noise, they were able to adjust their calls in exactly the same way as birds that had been living with human noise for generations.

But how could these song changes affect the birds' lifestyles? Wilson says that it would be interesting to find out whether the alteration affects mate selection by females and how males defend their territories. 'Ultimately, we could use this information to identify the real costs of anthropogenic noise in terms of survival and reproduction in birds and use that as a model for gauging the effects on other species, as well as ones that are more endangered,' says Wilson.

10.1242/jeb.066282

**Hanna, D., Blouin-Demers, G., Wilson, D. R. and Mennill, D. J.** (2011). Anthropogenic noise affects song structure in red-winged blackbirds (*Agelaius phoeniceus*). *J. Exp. Biol.* **214**, 3549-3556.

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