



In *The Tragedy of the Commons*, artists Robin Meier and Ali Momeni recorded the sounds of foraging ants.

Q&A Robin Meier

Maestro of the swarm

Swiss acoustic artist Robin Meier manipulates the sounds of insects and birds to create ethereal soundscapes. As his mosquito-inspired musical installation *Truce* is aired in the French city of Nantes, he talks about firefly synchrony and setting up feedback loops in nature.

Why did you choose to work with mosquitoes?

Male mosquitoes serenade potential mates with a 'love song' by vibrating their wings. They synchronize their wingbeats with those of the females to mate in mid-air. I first read about this in a 2006 paper by entomologist Gabriella Gibson and neurobiologist Ian Russell (*Curr. Biol.* **16**, 1311–1316; 2006). The constant *glissandi* — gliding from one pitch to another — and 'tuning in' of mosquito wingbeats reminded me of *dhrupad*, an ancient form of Indian classical music often sung by brothers in unison. My collaborator Ali Momeni and I played male mosquitoes some *dhrupad* and, sure enough, they tuned in. We call the piece *Truce: Strategies for Post-Apocalyptic Computation* because we see it as one way that computation could evolve. In the future, the environment could become an extension of our cognitive processes.

How did you become interested in this area?

I'm a musician but studied cognitive philosophy, and am very interested in artificial intelligence. One of my first installations, with French experimental musician Frédéric Voisin in 2004, involved manipulating



artificial neural networks to make music. The idea of collective intelligence is a theme that is common to all my work. Intelligence isn't just an intrinsic property; it lies in the interaction between organisms and environment. It is all around us, and I want to harness it to make music.

How did that lead you to work with ants?

With the help of scientists at the Laboratory of Experimental and Comparative Ethology at the University of Paris 13, I conditioned leafcutter ants to associate quinine — which they dislike — with different smells and foods. We built a star-shaped installation called *The Tragedy of the Commons*, which provides a choice of six foods, each in one arm of the star [see go.nature.com/mvbswm]. Here we manipulate the ants' foraging decisions through smell. Once they associate quinine with a certain food, we take the quinine away and the smell of that food alone will put them off. They communicate this to other ants, partly through sound signals called stridulation, when they rub body parts together. Using strategically placed microphones and loudspeakers, we have created a soundscape of their foraging decisions on two levels: an amplification of the stridulation, and an amplification of the sounds of ants eating at the positions they choose.

The sound therefore varies spatially across the installation.

And what about your firefly work?

My virtual firefly project hinges on synchrony. Fireflies synchronize their flashing for courtship purposes. Groups of males of the same species seem to do this so that the passing females can see them better — the flashing pattern is species-specific. When it happens, you see distributed pockets of synchronous flashing appear before they join up and an overall synchrony emerges. Although the behaviour itself is complex, all you need to generate it virtually is a number of identical 'organisms', each equipped with some basic perceptual apparatus and an internal mechanism for adjusting the flashing speed. We have simulated this on a computer.

How do you turn virtual firefly synchrony into music?

You could think of the fireflies as a sort of amateur orchestra and me as their conductor, only I go further by tinkering with their virtual brains. We manipulate their flashing by altering those underlying parameters — the ones that determine how they perceive and generate flashes — and so change the rhythm or even break up the synchrony completely. My collaborator on this project, Canadian artist Yan Breuleux, is interested in the visual effects that this allows him to create. I transform the flashes into sound and create audio effects using standard music-sampling software.

What other projects are in the pipeline?

I've long been interested in the neurobiology of songbirds. Starlings are fascinating because they're such good learners. They imitate car alarms, mobile phones, anything. This year, we intend to build birdhouses in the Camargue nature park in the south of France, and we hope that starlings will nest in them. We'll install speakers and play melodies to them. Because starlings are migratory, the fledglings could carry the tunes far and wide.

Are you 'playing God' with animals?

No: God is top-down, we're bottom-up. I think of what we do as more like hacking. We may end up manipulating a few starlings, for example, and our manipulation may be transmitted, but probably only in a small way before it fades like a ripple on a pond. It's not just us manipulating the organism. The organism reacts to our manipulation, we react to its reaction, and so on. We set up feedback loops. ■

INTERVIEW BY LAURA SPINNEY