Sonic nets viewed as a safe, humane way to shoo hungry birds

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Collaborators Mark Hinders (left) and John Swaddle are developing Sonic Nets, technology designed to disrupt bird communication and drive them from fields of ripening crops and other places where birds are not welcome, such as airfield runways.

Scarecrows have never worked, and history shows that advancements in technology haven't worked much better when it comes to shooing birds away from ripening crops.

"You set out propane cannons, they'll habituate. You broadcast predator calls, they'll learn to ignore them. They'll even get used to packs of angry wiener dogs," said Mark Hinders. "About the only things that work to exclude birds are nets, guns and poison. But those are expensive and/or bad manners."

Hinders, professor of applied science, and John Swaddle, professor of biology, are the core members of the Sonic Nets collaboration at William & Mary. The idea is to produce an effective, non-lethal bird deterrent, a solution to an age-old problem that is affordable, polite and does not rely on a steady supply of irritable dachshunds.

Instead of scaring or even alarming the birds, Sonic Nets works on the annoyance principle. As they dine in a farmer's field, birds keep up a constant chatter. A device called a parametric array projects a narrow beam of sound to disrupt the birds' field chatter, which seems to be mainly about the quality of the hors d'oeuvres and the immediate predator situation.

"It's like the cocktail party problem," Hinders explained. "You're in a room and a lot of people are talking and it can be difficult to follow an individual conversation. It doesn't even have to be especially loud. It's just that all those other people's words fill in the empty spaces. And so you go to a quiet room so that you can hear."

The Sonic Nets collaboration has attracted considerable interest over the years, beginning in 2012, when the Bill and Melinda Gates Foundation named the project a Grand Challenges Explorations winner. Additional support from the Andrew W. Mellon Foundation allowed birdsong expert Dana Moseley to join the collaboration in fall, 2014 as a Mellon postdoctoral fellow.

There also has been considerable movement toward eventual commercialization of Sonic Nets, as well. The collaborators have been discussing options with a group of M.B.A. students at William & Mary's

Raymond A. Mason School of Business under the leadership of Richard Ash, executive director of the Mason School's Alan B. Miller Center for Entrepreneurship. A patent application for the parametric array system is under consideration, and Sonic Nets has entered into a partnership with Midstream Technology, a Williamsburg firm, to pursue commercial opportunities.

The technology was first tested with starlings in William & Mary's aviary. Those encouraging results led to a summer of field tests at Fort Eustis. Swaddle explained that the Fort Eustis tests included an examination of a completely different use for the parametric array—minimizing bird-aircraft collisions by chasing birds away from runways. The airfield work is funded by the Virginia Center for Innovative Technology.

"We surveyed bird activity at three places at the airfield four times a week for eight weeks," Swaddle said. "The first four weeks gave us a baseline of bird activity. During the second four weeks, we deployed our Sonic Net at one of the sites—and recorded an approximate 85 percent reduction in the presence of birds in that area."

They also field-tested the devices in an open field, with the action recorded on video. The video footage from the open-field tests is still being processed, but Swaddle said the airfield data exceeded their expectations. The aviary tests showed that the Sonic Nets reduced the presence of starlings at food by 50 percent. He suggested that the higher success rate at the airfield is probably due to the difference between wariness of wild birds versus captive starlings.

"After our aviary testing, we thought that we would see a stronger effect in the field, but not as strong as we recorded," Swaddle said. "We think the Sonic Net works because birds can't hear alarm calls or predators. In the aviary, there isn't much threat. In the wild, there are plenty of threats and so there is greater need for birds to hear these calls."

Bird vocalization is much more rich and diverse than calls to alert the flock to the presence of predators or food. Moseley's Ph.D. research centered on how males use songs to attract potential mates as well as ward off rivals. The breeding-related vocalizations are yet another aspect of the deep aural avian experience.

"It's interesting to think about how the world of birds is such an acoustic world," Moseley said. "It can be hard for us to see some little brown bird in a bush. And it's hard for them to see each other too in a bush or in a forest, or even in a field. The way that they are able to interact with their environment is especially through sound."

She explained that there is some evidence that "soundscape" is a factor in habitat choice—that birds show a preference for a place where their songs and calls will best resonate. Moseley noted that the Sonic Nets apparatus could be used as research tool to test the soundscape-preference hypothesis, using its wide-frequency range to select sound that would alter the acoustic landscape of a test plot to observe if sound changes the bird's perception of a habitat.

The wide-frequency capabilities of the apparatus open up the potential for "tuning" the Sonic Nets sound to target particular species. Nonlinear acoustics principles incorporated into design of the speakers also allow the operator to "focus" the sound right at the birds, and only the birds.

"If you do it just right you can get that narrow beam of sound to cancel itself out after it propagates a certain distance," Hinders explained. "This control over where the sound goes allows us to cover a particular region with a blanket of sound. Inside that area the birds can't communicate, so they leave. Outside that area, nothing—so we don't generate any noise pollution."

Elizabeth Skinner, a Ph.D. student in applied science, is working on simulations of how the sound beams interact with air. Her aim is to fine-tune the controls of the sound, setting the stage for Sonic Nets arrays tailored for specific situations.

"There are some applications where we're going to want to cover a huge area, and there are others, like on the edge of a golf course, where you're going to want to cut the sound off before you get to the course itself, so that you don't bother the golfers," she said. "My simulations allow us to see where the sounds are going to go before we build the speaker."

The team likes to compare different speaker designs to light sources. A regular speaker, Skinner explained, can be compared to a normal incandescent light bulb, illuminating a room, although diminishing with distance.

"Whereas, a parametric array would be like a flashlight. You can point it, direct it," she said. "And then the limited parametric array that we're working on is more like a light saber, where it will just cut off at a certain distance, but up to that distance, you'll still have that defined beam."

Sonic Nets is versatile in concept, but one size does not fit all applications. Scaling up—spreading out the sound—is easier than confining the sound to a defined space, Hinders said.

"If we need to cover a sunflower field in North Dakota, we would simply repurpose a stripped-down version of an emergency-alert kind of siren or maybe the PA system for a stadium," he said. Other agricultural applications might be as small as a portion of an acre or a couple rows of fruit trees, Swaddle added.

The team is working on variations in speaker design, sound and power source to engineer a Sonic Nets solution to any number of site-specific bird-pest problems. There is an almost limitless variety of bird issues, with consequences ranging from life-and-death to the most trivial of First-World Problems, Hinders said. Each problem poses a different set of engineering challenges.

"There are particular birds in sub-Saharan Africa that come and eat your rice and make your kids starve, so you want to encourage them to go somewhere else. The new football stadium in Minneapolis happens to be right in the major flyway for lots and lots of birds and apparently they are building this with lots of glass and they have to do something to head off a plague of bird deaths. A technology like this might be just what the NFL needs to avoid yet another run of bad press," he said. "It could be pigeons pooping on the cars in your parking lot. It could be gulls pooping on your yacht. "

Next steps for the project include more extensive field testing, speaker design, various technology-transfer options and getting a better understanding of aspects of both the avian and the human condition. The collaborators stress that they want to be careful to work with people who would use Sonic Nets applications, to understand the bird and the problem it's causing.

Hinders said the group hopes to introduce use of the technology in resource-poor areas such as sub-Saharan Africa. He has begun leveraging existing contacts, starting with consultations with a young Tanzanian who is about to get a degree in wildlife management, thanks to the support from St. Stephen's Lutheran Church in Williamsburg.

"The world is in fact that small," Hinders said. "As we develop this technology, partnering with a small company who intends to make money, we also have in mind the social entrepreneurship angle where we're solving the actual problem in a place like Tanzania. The engineering challenge is to engineer enough cost and complexity out of it that can actually solve the problem."

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