

IN A FLY'S EAR

CURWOOD: It's Living on Earth. I'm Steve Curwood. For most scientists, basic research is the pursuit of answers to fascinating questions, though those answers may not always lead to practical results. But in today's National Geographic Radio Expedition, NPR's Alex Chadwick finds that research into the ear of a fly has an unexpected and potentially useful outcome.

CHADWICK: The Department of Neurobiology and Behavior at Cornell University is in the campus' Mudd Hall.

(A door opens; crickets chirp)

CHADWICK: Off a linoleum corridor, there's a storage room with a research population of crickets. And a couple of hundred flies that can hear them -- although that's very unusual for a fly. Cornell biologist Dr. Ron Hoy.

HOY: In fact, no fly that we'd ever heard of at all, it's just not known.

(A fly buzzes)

CHADWICK: But for this fly, *Ormia ochracia*, to hear a cricket, to find one, is to survive. *Ormia* is a parasitoid, a creature that leaves its young inside others to eventually eat their way out. Like some movie demon.

HOY: You mean Alien, of course.

CHADWICK: Exactly, like Alien. Only *Ormia* likes crickets. With the postgraduate researcher Dr. Daniel Robert and later another colleague, Dr. Shelley Adamo, Dr. Hoy studied *Ormia*, which has other odd characteristics to go along with its ears. Most flies, for instance, lay eggs that turn into maggots. Not *Ormia*.

HOY: They're carrying live maggots, and very small maggots, half a millimeter long. These maggots are quite active and they will actually search out and can find the host.

CHADWICK: In size, these maggots are a fine point pencil dot with teeth and appetites. They cut the hard cuticle of the cricket's upper body and settle in the abdomen.

HOY: And there, they begin feeding voraciously on the fat bodies, as it were, of the cricket.

(Crunching)

CHADWICK: This actually is a maggot inside a cricket, recorded by Dr. Hoy.

(Crunching continues)

CHADWICK: Do the crickets seem to know that they have the larvae in them in any way?

HOY: That's a good question. Of course, we'd like to know what a cricket knows, period. But they don't behave in any particular way that would give away the fact that they're infested.

CHADWICK: Eight days after entering as a tiny speck, the maggot is a half-inch worm thing.

And it exits exactly like the Alien. The cricket dies. The fly lives, for a week or so. Eats, mates, reproduces, and goes looking for crickets.

(A fly buzzes)

CHADWICK: They had *Ormia*'s life story, but something still nagged at the biologists, and they decided to ask for help.

MILES: I'm Ron Miles. I am a professor in the Department of Mechanical Engineering at the State University of New York at Binghamton. My area of research is vibrations and acoustics.

CHADWICK: An engineer, not a biologist, Dr. Miles was still intrigued by *Ormia*'s hearing.

MILES: What was interesting to me is that here is an ear or a pair of ears that are really, really close together. And yet it's obviously really good at localizing sound.

CHADWICK: We know where a sound originates because human ears hear slightly differently, and they do because they are separated.

MILES: If they were right next to each other, you wouldn't be able to tell where sound came from.

(Fly buzzing)

CHADWICK: *Ormia* is an insect. It wears its ears like a flattened baby snugly on what would be its chest. They're two millimeters across. Even if it can hear a cricket, an extraordinary feat, it should be very difficult to find one. In fact, for *Ormia*, it should be impossible.

(A cricket chirps)

CHADWICK: In an echoey basement with cricket bright chirp-chirps bouncing on the hard, flat surfaces, I can't tell where it's coming from. *Ormia* would find Mr. Cricket and hit him in seconds. Completely contrary to what the scientists would expect, that fly is much better at locating sound.

MILES: And that was the puzzle we were trying to figure out.

(Fly buzzing)

CHADWICK: To tether a lab fly for study, place a small dab of wax on the end of a slender wooden probe. The fly sticks to the wax.

MILES: We were looking at some fly ears under a microscope. And I found that if you press on one ear, the other ear pops up. And it was clear then that the two ears are mechanically coupled. And I said, "I know how it works." (Laughs)

CHADWICK: Have you ever seen a hearing device like this before?

MILES: No. I don't think anyone has, as far as I know.

(Fly buzzing)

CHADWICK: The coupling mechanism that connects Ormia's two ears acts to shut off the side that's farthest from the sound. That's how the fly can tell where sound comes from. It evolved a new kind of ear, or new to science. That is good, basic research, but Ron Miles is a mechanical engineer. And making a discovery, he wants to use it.

MILES: To me, the fly's ears are essentially a small directional microphone. And the question was, what can you do with a very small directional microphone?

CHADWICK: Almost 30 million Americans and more scores of millions around the world are deaf or hard of hearing.

MAN: Outdoor recording on Bourbon Street in New Orleans.

CHADWICK: A CD from an Illinois hearing products company, Etomodec Research, shows what normal hearing aids do.

MAN: Microphones worn in real ears, female talker in front of listener.

(Music, mulling voices, a woman's faint voice mixed in)

CHADWICK: Most aids boost sound, but do not focus in one direction and don't block sound from another, as we do normally, and Ormia does even better. Here's that same recording from a moment ago, this time with directional mikes.

(Music and mulling voices. A woman says, "The hogs were fed chopped corn and cabbage.")

CHADWICK: Again, non-directional mikes...

(Music, mulling voices, a woman's faint voice mixed in)

CHADWICK: And directional.

(Music and mulling voices. A woman says, "The hogs were fed chopped corn and cabbage.")

CHADWICK: Directional mikes exist now for hearing aids, but too big for the kind of aids people prefer. The kind worn discretely, inside the ear. The National Institutes of Health awarded a grant to Ron Miles and colleagues to design and build a new hearing aid, based on the ear of Ormia.

MILES: The fly, I see it, is an existing prototype. So that gives us some confidence that it's possible to make one of these things. Because Nature certainly has. The challenge that we have is to figure out how to fabricate it, so that it works the same way.

CHADWICK: You think you can do it?

MILES: Yeah, I think we can do it.

CHADWICK: A small fly with an amazing ear caught the attention of an engineering professor, Ron Miles, and a research biologist, Ron Hoy, and now it could help millions of people hear better. And for Dr. Hoy, Ormia ochracia has provided one more unexpected benefit. He is a very accomplished scientist, and still has felt awkward sometimes, devoting his intellect to studying insects. How do you explain that to others? How do you explain it to your mom?

HOY: She usually says, "That's nice." But I know what was going on in her mind was, "Bug ears? Why didn't you become a real doctor?" But when we came upon the fly's ear, and when I heard that, my God, this could actually turn out to be worth something out there in the real world, this has been one of the highlights of my life.

(Fly buzzing)

CHADWICK: For Radio Expeditions, this is Alex Chadwick, NPR News.

(Buzzing continues up and under)

CURWOOD: That Radio Expedition from NPR and the National Geographic Society was produced by Carolyn Jensen, with technical director Charles Johnson.

(Music up and under)