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Bats & Insecticides
Documenting toxins in the environment

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Bat populations around North America are declining year after year. Many of the reasons for these declines are well documented: widespread habitat loss, disturbance during winter hibernation and now White-nose Syndrome all take staggering tolls. But other likely causes remain a mystery, or at most, unconvicted suspects. Insecticides are often mentioned as potential culprits, but the evidence is lacking.

This study, supported in part by BCI's North American Bat Conservation Fund, is the first step in an investigation of the impacts of insecticides on bats. Its objective was to identify the insecticides to which bats are exposed and to focus further research on these specific chemicals.

First we searched the scientific literature for relevant data. In a 2002 BCI publication, The Indiana Bat, Thomas O'Shea and Donald Clark reported the presence of high levels of organochlorine insecticides in bat carcasses, brains and guano from Indiana and Missouri. "The role of environmental toxins in the decline of bats remains unclear," they wrote. "However, existing data suggest that they may be an important contributor to this decline."

And that was pretty much it for the past 20 years. In seeking additional information, we contacted Daniel W. Sparks, a toxicant specialist for the U.S. Fish and Wildlife Service. He quickly joined our effort.

Sparks and John Whitaker, Director of the Indiana State University Center for North American Bat Research and Conservation, where I was a post-doctoral fellow, came up with an idea that got the project moving. We would use bats submitted by the public for rabies testing as sentinels to identify insecticides in bats. Only about 5 percent of those bats are rabid, and the state rabies-testing lab regularly sends nonrabid bat carcasses to our center for use in research.

We sent nine of those bodies to a laboratory to be tested. Organochlorines (long-lived insecticides such as DDT and related insecticides) were detected in all nine bats. Widely used organophosphate pesticides, which have largely replaced organochlorines, were found in three.

Then we faced a major challenge: to identify insecticides in tissue samples, you must specify exactly which of the hundreds of different insecticides you are looking for. These chemical analyses are time-consuming and expensive, and trying to test many bats for everything is simply impractical. We had no current data on all of the insecticides being used in Indiana, so our only choice was a broad preliminary study to determine the most likely and important targets. We decided to use non-rabid bats from the rabies lab for this initial study.

These bats clearly would not be representative of free-ranging populations, since they were submitted for rabies testing precisely because they were grounded or otherwise weakened.

Although this sample offers scant evidence about the insecticide-exposure rate among wild bats, we would be examining bats that are more likely to have been affected by insecticides and should be able to identify critical insecticide groups.

We decided to test 40 bats from a typical Midwest mix of urban and agricultural land use (Lake, Porter and LaPorte counties in Indiana). For three years, Louis Douglas of the state rabies lab forwarded to Indiana State University all the bats that tested negative for rabies. We went through hundreds of those frozen bats before finding 40 (35 of them big brown bats [Eptesicus fuscus]) from the appropriate region to send to Michael Lydy of Southern Illinois University, Carbondale for chemical analyses.

Thirty-nine of the 40 bats contained detectable concentrations of organochlorine insecticides. This suggests that even today, decades after federal restrictions on the use of these insecticides, bats are still being exposed to them in the Indiana region. The U.S. Environmental Protection Agency (EPA) tightly restricted most organochlorine pesticides in the 1970s and early '80s; their presence in these bats likely results from accumulations of these chemicals that were applied years ago but still persist in the environment. We believe that the effects of chronic exposure of bats to organochlorines should be studied.

Organophosphates, primarily diazinon, were detected in 10 of the bats. Diazinon is used to control a wide range of insect pests, and research indicates considerable variation in susceptibility to its toxic effects. An EPA assessment in 2002 concluded that diazinon posed unacceptable risks to birds and other wildlife, but there is no information on its effects on bats. Finding diazinon in these samples is surprising because studies suggest it does not accumulate in living tissue. Therefore, its presence in these bats implies that they were exposed shortly before their deaths. It does not, however, confirm any clinical impact on the bats.

Our study also found residues of pyrethroid insecticides in five of the samples, and of the carbamate insecticide carbaryl in one, a female eastern red bat (Lasiurus borealis).

We found no significant geographical or gender differences in exposure. These results should, however, be interpreted cautiously because of the small sample size.

Nonetheless, the presence of insecticides in all 40 of our sampled bats raises the disturbing possibility that environmental toxins could have an important role in the health of bat populations. Our research on the prevalence and impacts of these chemicals continues.

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