



Ronald J. Kendall, PhD

ASK THE EXPERT

MULTIPLEX QUANTITATIVE PCR IN WILDLIFE TOXICOLOGY

by Michelle Dotzert, PhD

Ronald J. Kendall, PhD, discusses the declining number of northern bobwhite quail in Texas, and how molecular techniques are used to assess parasitic infection in this population.

Q: What is wildlife toxicology? Can you please elaborate on your current research?

A: Wildlife toxicology is the study of how environmental contaminants affect the health, reproduction, and well-being of wildlife and their populations. The current commitment of the Wildlife Toxicology Laboratory at Texas Tech University is to address the effects of environmental contaminants and/or disease on our wildlife and develop and contribute solutions to these problems. Wildlife toxicology is truly an interdisciplinary science requiring multiple aspects of science involving wildlife biology, toxicology, disease ecology, environmental and drug chemistry, statistics, and mathematical modeling, as well as molecular biology.

Q: Do you work with a team of researchers and students? How many projects are ongoing?

A: The Wildlife Toxicology Laboratory represents a multidisciplinary scientific research team. Our students and staff have backgrounds in molecular biology, parasitology, field ecology and wildlife management techniques, analytical chemistry, drug chemistry, and mathematics and statistics. The blend of this interdisciplinary team in the lab has allowed us to advance many

projects, including parasitic disease in wild quail, evidence of parasitic disease in songbirds, mitigation techniques to support monarch butterfly populations in West Texas, neonicotinoid pesticides in the environment, the importance of pollinators in West Texas rangeland, and environmental issues associated with the release of nanomaterials into the environment.

field currently for registration approval with the United States Food and Drug Administration. We are also studying the release of neonicotinoid pesticides into the environment, including environmental fate, and potential effects to vertebrate wildlife, particularly pollinators. Another very important project to us is the development and application of mitigation strategies to

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Q: What contaminants are you investigating in different species of birds and what implications do they have for environmental/wildlife health?

A: One of the leading projects currently in the Wildlife Toxicology Laboratory is assessing widespread parasitic infection in wild northern bobwhite (*Colinus virginianus*) quail, an important game bird in Texas, particularly in West Texas. The goal of the Wildlife Toxicology Laboratory is to create solutions to declining wild quail populations; a medicated feed treatment for parasitic disease in wild quail has been developed and is being evaluated in the

encourage monarch butterfly populations, another significantly declining species, in West Texas. The goal of the Wildlife Toxicology Laboratory is not only to identify problems, but to bring solutions to the forefront.

Q: You mentioned part of your research is also focused on the release of nanomaterials into the environment. What are nanomaterials and what are some challenges associated with studying their toxic effects?

A: Nanomaterials are very small particles or substances with technology applications

all the way from sunscreens to electronics. The problem with nanomaterials is, because of their shape, size, and structure, the particles can enter into living organisms, having a variety of deleterious effects. For instance, nanoparticles entering the lungs of mammals can cause significant damage to lung epithelial cells that facilitate breathing and oxygen exchange. There are many challenges in addressing the significance and role of nanomaterials in living organisms. We have studied nanomaterials extensively and how they can be incorporated into the food chain, such as through arthropods like crickets, then continued on to birds and other wildlife.

Q: What technologies do you use in your research?

A: The Wildlife Toxicology Laboratory is at the forefront of using molecular techniques to assess parasitic infection in both the definitive and intermediate hosts in the life cycle. We have perfected a multiplex quantitative PCR technique and published this in the scientific journal *Veterinary Parasitology* to advance this science. We have also been able to demonstrate these quantitative PCR techniques in both the laboratory as well as in a mobile laboratory platform that we have deployed across the Rolling Plains of West Texas. In other words, we are able to capture wild quail, sample them, and do molecular analysis to determine their infection levels with parasites, and do this non-lethally, releasing the birds after sampling.

Q: Have you faced any methodological challenges and what techniques or technologies have helped you overcome them?

A: It was very difficult to develop the quantitative PCR technique to analyze

for the DNA of two different parasites that were infecting wild quail and passed through the feces, which we could sample and determine infection levels. The strategy to develop a multiplex quantitative PCR to be able to detect the DNA of two parasites in one run of the PCR was particularly challenging. It took an extensive amount of time, interdisciplinary cooperation, and hard work to develop, perfect, and publish these techniques. The whole challenge of addressing and better understanding the role of parasitic infection in wild quail populations has required a “weight of the evidence” approach because the effects of parasitic infection and the circumstances they create as a disease in quail are very complex and multi-dimensional. Therefore, our thinking, research, and scientific publication has unfolded more than 30 scientific research papers in the world literature over the past seven years to address the issue of parasitic infection in our wild quail. We are continuing to advance this science at the cutting edge, and what is unfolding is a national conservation story since the wild northern bobwhite quail is one of the top declining bird species in America and has already been lost from more than 90 percent of its original range in terms of sustainable and huntable populations.

Q: Do you foresee any emerging areas of study in your field? What do you think will drive the shift to those areas?

A: The emerging areas of study that I see in the field include the interface of environmental contaminants with emerging disease. In that environmental contaminants can cause various stress on organisms, this may predispose organisms to be more susceptible to certain diseases. The extensive release of plastic materials into the environment is creating

a number of environmental issues. The role of the ingestion of microplastics into the gut of organisms is receiving increased attention. Also, the role of multiple chemical exposures is being more thoroughly studied now in terms of “mixtures.” The exposure of organisms to mixtures of contaminants, in addition to the role of global climate change, is increasing the challenges for environmental toxicologists to understand and fully evaluate these kinds of effects.

Dr. Ronald J. Kendall is head of the Wildlife Toxicology Laboratory and professor of Environmental Toxicology in the Department of Environmental Toxicology at Texas Tech University. He is founding director of The Institute of Environmental and Human Health (TIEHH), a joint venture between Texas Tech University and Texas Tech University Health Sciences Center at Lubbock, Texas. He was also the founding department chair of the Department of Environmental Toxicology at Texas Tech. He received his BS degree from the University of South Carolina, his MS degree from Clemson University, and his PhD from Virginia Polytechnic Institute and State University. He received a United States Environmental Protection Agency (USEPA) post-doctoral traineeship at the Massachusetts Institute of Technology. Dr. Kendall's current research through the Wildlife Toxicology Laboratory at Texas Tech University is dedicated to understanding the decline of wildlife species and evaluating a solution(s). His research has been sponsored the past several years by the Rolling Plains Quail Research Foundation, the Park Cities Quail Coalition, and the Texas A&M AgriLife Extension Service.

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