Alligators exposed to PFAS show autoimmune effects

October 20 2022

Credit: Pixabay/CC0 Public Domain

A recent study of alligators in the Cape Fear River found the animals had elevated levels of 14 different per- and polyfluoroalkyl (PFAS) chemicals in their blood serum, as well as clinical and genetic indicators of immune system effects. The work adds to the body of evidence

connecting PFAS exposure with adverse immune system effects.

The research team, led by Scott Belcher, associate professor of biology at North Carolina State University, took blood samples and did health evaluations on 49 alligators living along the Cape Fear River between 2018 and 2019. They compared these results to a reference population of 26 alligators from Lake Waccamaw, located in the adjoining Lumber River basin.

"We looked at 23 different PFAS and saw clear differences between both types and levels of PFAS in the two populations," Belcher says. "We detected an average of 10 different PFAS in the Cape Fear River samples, compared to an average of five different PFAS in the Lake Waccamaw population.

"Additionally, blood concentrations of fluoroethers such as Nafion byproduct 2 were present at higher concentrations in alligators from the Cape Fear River basin, whereas these levels were much lower—or not detected—in alligators from Lake Waccamaw. Our data showed that as we moved downstream from Wilmington to Bald Head Island, overall PFAS concentrations decreased."

But the most unusual observation the team made was that alligators in the Cape Fear River had a number of unhealed or infected lesions.

"Alligators rarely suffer from infections," Belcher says. "They do get wounds, but they normally heal quickly. Seeing infected lesions that weren't healing properly was concerning and led us to look more closely at the connections between PFAS exposure and changes in the immune systems of the alligators."

A qRT-PCR genetic analysis revealed significantly elevated levels of interferon-alpha (INF-α) responsive genes in the Cape Fear River

alligators: their levels were 400 times higher than those of the Lake Waccamaw alligators, which had much lower PFAS blood concentrations.

"INF-α is a secreted immune protein involved in stimulating immune response," Belcher says. "The set of INF-α responsive genes we analyzed are normally involved with viral infections. In humans, chronic (or long-term) high expression of this set of genes is an important indicator of autoimmune diseases, especially lupus. Additionally, some PFAS exposures in humans are linked with chronic autoimmune disorders like ulcerative colitis and thyroid disease.

"When we see elevated expression of INF-α in these alligators, then, it tells us that something in these alligators' immune responses is being disrupted."

With five years' worth of sampling data, much of it taken from the same alligators on an annual basis, the researchers are in a good position to continue following PFAS exposure and health changes in both individuals and the larger alligator populations within both habitats.

"Alligators are a sentinel species—harbingers of dangers to human health," Belcher says. "Seeing these associations between PFAS exposure and disrupted immune function in the Cape Fear River alligators supports connections between adverse human and animal health effects and PFAS exposure."

The work appears in *Frontiers in Toxicology* and was supported by the National Institute of Environmental Health Sciences (award numbers P42ES031009, P30 ES025128 and T32ES007046), North Carolina Sea Grant, and the North Carolina Policy Collaboratory. Belcher is corresponding author of the work, which is part of a collaboration with the PFAS testing network and Cape Fear River Watch.

More information: Blood Concentrations of Per- and Polyfluoroalkyl Substances are Associated with Autoimmune-like Effects in American Alligators from Wilmington, North Carolina, *Frontiers in Toxicology* (2022). DOI: 10.3389/ftox.2022.1010185

Provided by North Carolina State University