

# Perfluorinated compounds found in African crocodiles, American alligators

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This crocodile inhabits waters around Flag Boshielo Dam, a reservoir on the Oliphants River, just upstream from South Africa's Kruger National Park. Researchers from the Hollings Marine Laboratory reported at least four types of perfluorinated alkyl acids in plasma samples drawn from 45 crocodiles at five sites in and around the park. The highest levels were found in animals living in the reservoir. Credit: John Bowden/HML

American alligators and South African crocodiles populate waterways a third of the globe apart, and yet both have detectable levels of long-lived industrial and household compounds for nonstick coatings in their blood, according to two studies from researchers at the Hollings Marine Laboratory in Charleston, South Carolina, and its affiliated institutions, which include the National Institute of Standards and Technology.

Production of some compounds in this family of environmentally persistent chemicals—associated with liver toxicity, reduced fertility and a variety of other health problems in studies of people and animals—has been phased out in the United States and many other nations. Yet all blood plasma samples drawn from 125 American [alligators](#) across 12 sites in Florida and South Carolina contained at least six of the 15 perfluorinated alkyl acids (PFAAs) that were tracked in the alligator study.

The two studies are first-of-their-kind examinations of PFAA levels in "sentinel" reptile species, especially useful for investigating the impacts of long-lived chemicals in the environment. PFAAs have been used in products that include water-repellent clothes, stain repellents, waxes, nonstick pans and fire-suppressing foams.

In alligators, plasma levels of perfluorooctane sulfonate (PFOS) ranged from 1,360 to 452,000 parts per trillion. In May 2016, the Environmental Protection Agency issued a drinking-water health advisory for PFOS and another PFAA, recommending a maximum exposure level of 70 parts per trillion for one of the PFAAs or the sum of the two. High PFOS levels reported for alligators at several sites may suggest the need to test drinking water for contamination at those locations, according to the researchers.

In a separate study, researchers report that all samples drawn from 45 crocodiles at five sites in and around South Africa's Kruger National

Park contained detectable levels of four PFAAs, often in different combinations with other of the 15 fluorinated organic compounds tracked. Present in all plasma samples, PFOS levels ranged from 776 to 118,000 parts per trillion.

"Alligators and crocodiles play a dominant role in their ecosystems," said Jacqueline Bangma, of the Medical University of South Carolina in Charleston. "Similar to humans, they are long-lived top predators. They stay in a select territory—waterways where runoff from human activities accumulates—and their PFAA burden increases through the consumption of fish."

To date, field studies of PFAA levels and health effects in reptiles have been few, focusing mostly on sea turtles. Across studies of animals—from rats to frogs to marine mammals—plasma levels, time required to eliminate PFAAs from the body, and health effects vary greatly, making it difficult to extrapolate from one species to another.

The landmark studies were initiated by the Hollings Marine Laboratory, a partnership including NIST, NOAA's National Ocean Service, the South Carolina Department of Natural Resources, the College of Charleston, and the Medical University of South Carolina. Plans are to continue PFAA monitoring on both continents, according to NIST research chemist Jessica Reiner.

Both studies identified "hot spots," where PFAA levels were significantly higher than in animals tested at other sites, an indication that the contaminants were emitted by a nearby source. In the U.S. study, median plasma levels of certain PFAAs were highest in alligators on Kiawah Island, an Atlantic Ocean barrier island southwest of Charleston, South Carolina, and on Merritt Island in Florida.

Past use of PFAA-containing foams, such as those employed in

firefighting training, may account for the higher levels, the researchers suggest. High environmental concentrations have been reported at fire-training sites and at manufacturing plants.

In contrast, alligators at two sites in the Florida Everglades exhibited some of the lowest levels of the two "highest burden" PFAAs reported across all adult alligators sampled in the U.S. study. The result was somewhat unexpected, Reiner said, because Everglade's alligators have been reported to have some of the highest levels of mercury, a toxic heavy metal, among Florida alligators.

Among the South African crocodiles tested, PFAA levels were highest for animals tested from Flag Boshielo Dam, a reservoir on the Oliphants River, just upstream from Kruger National Park.

Among the American alligators studied, some PFAA levels tended to be higher among males, regardless of locations. Levels also tended to increase with age, as determined by snout length. Age- and sex-related associations with PFAA levels were not found in the crocodiles sampled.

**More information:** Jacqueline T. Bangma et al, Perfluorinated alkyl acids in plasma of American alligators () from Florida and South Carolina, *Environmental Toxicology and Chemistry* (2016). [DOI: 10.1002/etc.3600](https://doi.org/10.1002/etc.3600)

Ian Christie et al. Perfluorinated alkyl acids in the plasma of South African crocodiles (*Crocodylus niloticus*), *Chemosphere* (2016). [DOI: 10.1016/j.chemosphere.2016.03.072](https://doi.org/10.1016/j.chemosphere.2016.03.072)

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