

# Researchers profile pollutants present in an important river basin in São Paulo state, Brazil

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The Camanducaia is one of the rivers in the PCJ Basin. Credit: Cassiana Carolina Montagner/UNICAMP

The Piracicaba, Capivari and Jundiáí (PCJ) River Basin comprises 76

municipalities in São Paulo state, Brazil, with more than 5.8 million inhabitants and a drainage area of more than 14,000 square kilometers. These three rivers and their tributaries are essential sources of drinking water, energy, irrigation for agriculture, and water for industrial processes.

Demand is very high, and the resulting water shortage is exacerbated by the climate crisis. However, this is not the only problem or the worst: the many rivers, brooks, and creeks in the basin are severely contaminated by agricultural, industrial, and domestic effluents.

Visible evidence of this pollution is frequently highlighted by the media, but until now, there have been no in-depth scientific studies that identify the main contaminated areas, the specific contaminants and mixtures of contaminants, with their concentrations, occurrences, and toxicities, and the potential risks to people and [aquatic organisms](#).

Just such a study has recently been completed by researchers at the State University of Campinas (UNICAMP) and colleagues affiliated with other institutions in Brazil and abroad.

An article about the study is [published](#) in the journal *Chemosphere*.

"Besides the usual contaminants, which are well-known and subject to legislation, we also found emerging contaminants not covered by any legislation and with levels of toxicity in conditions of chronic exposure. Our study provides the first overview of the occurrence of PFAS compounds in São Paulo's rivers," said Cassiana Carolina Montagner, a professor at UNICAMP's Institute of Chemistry and principal investigator for the study.

Perfluoroalkyl and polyfluoroalkyl substances (PFASs) are a group of thousands of synthetic chemical compounds used by industry in a vast

array of products to make them waterproof, stain-resistant, and non-stick. Most non-stick cooking pans are coated with a form of PFAS, for example.

According to the United States Environmental Protection Agency (EPA), exposure to PFASs causes many human health problems, including an increased risk of kidney, prostate, and testicular cancer.

"The occurrence of seven PFASs in different rivers in São Paulo state is reported for the first time in our study," Montagner said. "We also detected many other contaminants, making a total of 45. The most frequent were the agricultural pesticides atrazine, carbendazim, tebuthiuron, and 2,4D, which we found in 100% of the samples collected. Caffeine and bisphenol A [BPA], which enter rivers in household waste, were also in 100% of the samples."

Caffeine is well-tolerated by humans but can be extremely harmful to aquatic organisms, Montagner noted. BPA is an organic chemical (2,2-bis(4-hydroxyphenyl) propane) used to produce polymers and high-performance coatings. Plastic containing BPA is used in appliances, computers, toys, disposable cutlery, baby bottles, food and drink can linings, and epoxy resin. BPA is also often used to coat the thermal paper used in cash registers and credit card receipts, ATM printouts and other everyday transactions.

Underscoring the severity of all this pollution, it should be noted that the area served by the PCJ Basin is important agriculturally and industrially, contains several significant cities, and accounts for 5.3% of Brazil's gross domestic product (GDP). Highlights include sugarcane growing in Piracicaba, textiles in America, and a large population in Campinas (1.1m in 2022).

"Not only is the PCJ Basin the main source of drinking water for the

entire area, but it also supplies water for irrigation, which isn't treated at all before farmers use it. At the same time, the region contains many small towns that discharge raw sewage into the rivers," Montagner said.

Emerging contaminants such as pesticides, hormones, pharmaceuticals, industrial chemicals, and PFASs are being dumped in the PCJ Basin, and no monitoring is required by the existing Brazilian legislation.

"In our study, we collected samples at 15 different points in the basin and measured the contaminants present considering three factors: concentration, frequency, and toxicity. Alongside the high frequencies already mentioned, we obtained elevated risk quotients for the herbicides diuron and atrazine, as well as the insecticide imidacloprid," she said.

"In addition to longstanding unsolved pollution problems, such as contamination by fecal coliforms, for example, new problems are being caused by the presence of emerging contaminants, which are produced to guarantee the quality of modern life but pollute the environment owing to mismanagement of solid waste and inefficient sanitation. Our study suggests the need for a comprehensive monitoring program to assure the protection of aquatic life and human health."

In response to inquiries from Agência FAPESP, the São Paulo State Environmental Corporation (CETESB) stated that it currently samples water at 519 points, of which 91 are in the PCJ Basin, analyzing traditional parameters such as [organic matter](#), nutrients, fecal coliforms, and metals, as well as agrochemicals and some emerging compounds, which it quantifies indirectly by means of two assays: one measuring estrogen activity to detect endocrine interferents (which mimic female hormones, including BPA); and another measuring glucocorticoid activity to detect anti-inflammatory drugs.

The statement also said CETESB has measured 42 different agrochemicals since 2017 in water samples from rivers in mainly agricultural areas.

"In the case of the PCJ Basin, we have monitored agrochemicals since 2018 in the headwaters of the Corumbataí [...] in the municipality of Analândia, where [land use](#) is agricultural in 65% of the basin. The agrochemicals most frequently detected in this part of the Corumbataí during the period 2018-22 were the insecticide imidacloprid [also very frequent in the samples analyzed by the UNICAMP researchers] and the herbicide tebuthiuron [found in 100% of the samples analyzed in the study].

Concentrations of imidacloprid frequently exceeded the chronic ecotoxicity limit for aquatic invertebrates set by the EPA [via the Office of Pesticide Programs, OPP], which is 10 ng/L [nanograms per liter]. In the same period, we did not detect 2,4 D or atrazine [both detected in 100% of the samples analyzed by the UNICAMP researchers], for which quality standards are specified for the protection of aquatic life in federal legislation," the statement from CETESB said.

Finally, the statement said no values have been established in legislation for estrogen or glucocorticoid activity, adding that the "levels found in both of these two assays during the last five years in the PCJ Basin are considered low or insignificant on the basis of studies performed previously and international experience."

**More information:** Camila Leite Madeira et al, Uncovering the impact of agricultural activities and urbanization on rivers from the Piracicaba, Capivari, and Jundiaí basin in São Paulo, Brazil: A survey of pesticides, hormones, pharmaceuticals, industrial chemicals, and PFAS, *Chemosphere* (2023). [DOI: 10.1016/j.chemosphere.2023.139954](https://doi.org/10.1016/j.chemosphere.2023.139954)

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