Program: Drugs Down the Drain
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Attendance: 81
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The Recording of Today's Zoom Presentation can be found at: www.scientechclub.org/zoom/584.mp4

Dr. Melody Bernot is a professor of biology at Ball State University who has done extensive research into pharmaceuticals and personal care products (PPCPs) found in our waterways. These products come from both urban and agricultural sources. They are now at between 10-1000 times the levels in the waterways as in preindustrial times. PPCPs cause adverse effects such as algae blooms in the Gulf of Mexico, fish kills, and eutrophication, as well as human health concerns.

In aquatic ecosystems these substances either settle to the bottom or are assimilated by microbes, vertebrate or invertebrate organisms, or are washed on downstream. The impacts are affected by such things as temperature and pH, nutrients, sediments and organic wastes, metals, herbicides and pesticides in the water. The US is the largest market for PPCPs in the world. There are more than 400,000 of these compounds and the number is increasing every day. Dr. Bernot's research is focused on about 35-40 of the most common ones including things like acetominophen, albuterol, caffeine, carbomazepine (used in treatment of ADHD and depression), DEET (insect repellant),

nicotine, ibuprofen, and sucralose. These compounds get into the waterways through human waste products, drug disposal, and livestock treatments. The goals of Dr. Bernot's research are to predict the abundance of these compounds in the water and the adverse effects. Her study areas include the Upper White River watershed, the Ohio River watershed, Lake Michigan, areas near CAFOs (Confined Animal Feeding Operations) and the urban area around Muncie.

Dr. Bernot expected that there would be higher concentrations of PPCPs in urban areas versus agricultural areas but her research did not support that hypothesis. They turned out to have nearly the same levels. In the agricultural areas (CAFOs) farmers were treating the animals with lincomycin and sulfamethazine. Then the manure was applied to fields. There was a drug level increase in the waterways right after the area of treatment but it quickly disappeared downstream. On the other hand, human pharmaceuticals such as caffeine and paraxanthine were present in the water in higher concentrations and persisted downstream. These human pharmaceuticals peaked in the winter and were highest in March, while the insect repellant DEET peaked in the summer as would be expected. Also, water treatment plants in urban areas remove more of these compounds than septic tanks in rural areas.

The effects of these compounds on microbes were that as the concentration increased the respiration rate of the microbes decreased. However that depended to a large extent on the type of compound being measured and the other conditions in the water such as temperature, amount of oxygen present, and the history of exposure.

In invertebrates, such as snails, it was found that higher concentrations inhibited growth and slowed movement. In mayfly nymphs higher concentrations led to a longer time to molt and mayfly behavior

was also affected, in that they did not cling to rocks like they normally did, but instead just swam around more.

In vertebrates, such as yellow perch, it was found that higher concentrations of carbamazepine had a negative effect on growth and also made them more sluggish, as they didn't immediately flee when the water was disturbed.

This field of study is relatively new, so there is much more work to be done. We do know that PPCPs are ubiquitous in fresh water systems and that trace amounts do effect the growth and behavior of organisms. Some of the compounds of greatest concern include acetaminophin, carbamazepine, DEET, triclosan, and sucralose. Dr. Bernot is now expanding her research to other areas in the US.

Dr. Melody Bernot
(Photo courtesy of BSU)