

What Happens to Pharmaceuticals in Wastewater?

by P.W. McRandle



Antidepressant-addled bluegills, gender-confused sucker fish—our nation's wildlife are becoming the stuff of tabloid headlines. And obviously they're not the ones popping pills. With 45 percent of Americans taking at least one prescription drug, we flush away a constant flow of old and unused medications that keep on working after they disappear down drains, moving to wastewater-treatment plants and into waterways.

Take those transdermal birth-control patches. Only a small amount of the drug they contain, ethynyl estradiol, ever passes into the body; the rest remains in the patch as it heads to the sewer. At risk is the collapse of whole fish populations, as happened to fathead minnows in a Canadian test lake exposed for several years to ethynyl estradiol. Both males and females showed changes in sex organs that made reproduction difficult and drove them to near extinction, according to this May's *Proceedings of the National Academy of Sciences*.

Aging sewer systems and small municipalities without public sewers spill untreated sewage laden with bacteria and viruses into the Iowa River and others across the country, as noted in American Rivers' recent report *America's Most Endangered Rivers 2007*. But treated sewage pouring into rivers isn't much better, especially when hormone-disrupting chemicals from pharmaceuticals and laundry detergents (see "[Virtuous Cycles](#)") sweep through treatment plants and into rivers, altering the reproductive abilities of fish. Not only can this lower their fertility, but estrogenic chemicals in the flesh and fat of fish caught downstream from waste-treatment facilities can cause human cancer cells to grow *in vitro*, as announced this April by researchers at the University of Pittsburgh Cancer Institute's Center for Environmental Oncology at the annual meeting of the American Association of Cancer Research.

Now, research into Atlantic salmon shows that hormone-disrupting chemicals may have played a major role in the near extinction of these fish. Salmon larvae exposed for 21

days to low levels of nonylphenol, which can end up in waterways from laundry detergents as well as from industrial discharge, face long-term health effects that threaten their survival. "A full year later, exposures to six parts per billion caused them to lose seawater tolerance [a critical stage in salmon development allowing them to move from freshwater to the sea]," says Steve McCormick, a research scientist with the U.S. Geological Survey (USGS), of research conducted by his graduate student Darren Lerner. "It's a very relevant concentration," McCormick adds, "and that's just one chemical, but others can interact as well at low levels."

Traditionally, as a safe, quick means of eliminating drugs, patients and pharmacists have been instructed to flush all old medications down the toilet. The troubles arise once medications reach sewage-treatment plants. "Removal rates can vary from almost zero to 100 percent, depending on the active pharmaceutical ingredient you're considering," says Christian Daughton, a scientist at the Environmental Protection Agency's National Exposure Research Laboratory. More sophisticated treatments can result in higher removal rates of drugs such as the antimicrobial triclocarban, but drugs that lodge in fats, such as the antibacterial triclosan, tend to go into sludge, and all drugs can end up in waterways to some extent. That sludge may then be mixed in commercial soil amendments, with resultant drug levels in the parts per million, and used by farmers. In 2006, researchers at Eastern Washington University detected pharmaceuticals including anti-epileptics and anti-depressants in commercially sold sludge, and the U.S. Geological Survey, in a 2002 analysis of 139 streams, detected non-prescription drugs more frequently than almost all other organic wastewater contaminants. Moving full circle, pharmaceuticals have found their way into drinking-water supplies, including Montana well water and New Jersey tap water.

Unfortunately, what might seem like the most obvious choice, a drug take-back program, is fraught with legal problems. Although pharmacies can sell controlled substances such as narcotics, they can't take them back. This October, the U.S. Fish and Wildlife Service (FWS), in conjunction with the American Pharmacists Association, is beginning SMARxT DISPOSAL, a public outreach effort focused on proper drug disposal. In the long run, "we want to build the social will to create a national take-back program," says Joe Starinchak, coordinator for FWS's Fisheries and Habitat Conservation Program, but he notes that every state has different authorities that handle pharmaceuticals, creating "unbelievable" bureaucratic challenges. For now, the program emphasizes flushing only those medications that specifically state you do so. Others may be crushed and mixed with cat litter or coffee grounds before disposing in the trash can, but "consumers should be aware that the extra step incurs some risk, such as dropping a pill unknowingly on the floor," where pets or children might encounter it, Daughton says. A take-back program remains your best solution.

National Geographic Green Guide 122 | October/November 2007 | For Your Health

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