Water Contamination from SSRIs and SNRIs

What are SSRIs and SNRIs?

SSRIs and SNRIs are classes of antidepressant and antianxiety medication. SSRI are selective serotonin reuptake inhibitors and SNRIs are selective norepinephrine reuptake inhibitors. These medications prevent brain cells from absorbing serotonin and norepinephrine thus allowing more of these chemicals to stay in the brain (Mole & Brooks, 2019). Many people rely on these medications. According to the CDC, from 2015 to 2018, 13.2% of adults in the United States were on some form of antidepressant (CDC, 2020). During the first months of the COVID-19 Pandemic, it is estimated that usage of these medications increased by 21% (Minemyer, 2020).

How SSRIs and SNRIs get into the water

There are three main pathways:
- wastewater effluent
- untreated sewage
- improper disposal

Wastewater effluent and untreated sewage are the highest contributors (Mole & Brooks, 2019). Studies have found the highest concentrations of SSRIs and SNRIs in wastewater effluent and in streams that are largely dependent on wastewater effluent (Schultz & Furlong, 2008).

Wastewater effluent into the South Platte River Photo Credit: https://www.watereducationcolorado.org/publications-and-radio/radio/what-not-to-flush/

Antidepressants and fish

Fish are susceptible to human antidepressants because fish have a similar system to process serotonin to humans. Fish also have slower metabolisms than humans, causing uptake and clearance of the medication to be slower (McDonald, 2017). Antidepressants affect fish in several different ways.

- Decreased aggression: This prevents the fish from chasing off intruders and also affects dominance hierarchies in some fish species (Kreke & Dietrich, 2008). This could affect reproduction and the genetic make up of the population (Kreke & Dietrich, 2008).
- Decreased appetite and feeding: Some of this may be directly related to the SSRI and SNRI exposure, but the exposure also decreases movement (McDonald, 2017). A decrease in movement prevents fish from being able to capture prey.
- Decreased anxiety and fear response: As in humans, SSRIs and SNRIs decrease anxiety and fear in fishes (McDonald, 2017). This prevents the fish from properly responding to predators and other dangerous situations.

These effects will affect fish survival rate as well as the ability to reproduce. Different species of fish react differently to different antidepressants.

Antidepressants and ecosystems

SSRIs and SNRIs have been found in insects in and around streams (Richmond et al., 2018). Insects travel outside the stream which allows the SSRIs and SNRIs to enter other ecosystems. These medications also can delay algae colonization (Richmond et al., 2019). Since the algae forms the bottom of the food chain in a stream, this impacts food sources throughout the food chain (Ferreira et al., 2023). Certain antidepressants such as fluoxetine (Prozac) bind to the streambed and organic matter in the stream (Richmond et al., 2019). This prolongs the amount of time fluoxetine will remain in the environment. It is one of the more persistent antidepressants in the environment and also has a long half-life (Kreke & Dietrich, 2008).

Mayfly, a common river species Photo credit: https://www.nwf.org/Educational-Resources/Wildlife-Guide/Invertebrates/Mayflies

How many SSRIs and SNRIs are in the water?

Wastewater effluent is not tested for SSRIs and SNRIs. Measurements are taken for individual studies. Across the United States, it is difficult to determine the extent of this problem due to lack of data. However, given that the population using antidepressants continued to increase given the report from the CDC in 2020 and the increase use of antidepressants at the beginning of the COVID-19 pandemic, the number of people using antidepressants has increased. It is likely the number of people using antidepressants continues to increase, it is likely the amount in the water also continues to increase.

The Solution

Without data, it is difficult to determine the extent of the issue. Legislation should be passed to mandate the testing and reporting of the amount of SSRIs and SNRIs in wastewater effluent. Once data is available, it will be possible to study the effects of specific concentrations on fish species as well as the riparian ecosystems. Then, regulation of these medications in wastewater effluent can be required.

Colorado is a headwaters state, making it a good state to begin this action as changes in the water quality in Colorado will impact states downstream. In Colorado, it would be possible to bring legislation at the municipal, county, or state level. As Colorado allows for home rule, municipalities and counties have greater freedom to legislate and regulate without state input (Bernard, 2020).

The Capitol Building of Colorado Photo Credit:https://capitol.colorado.gov/
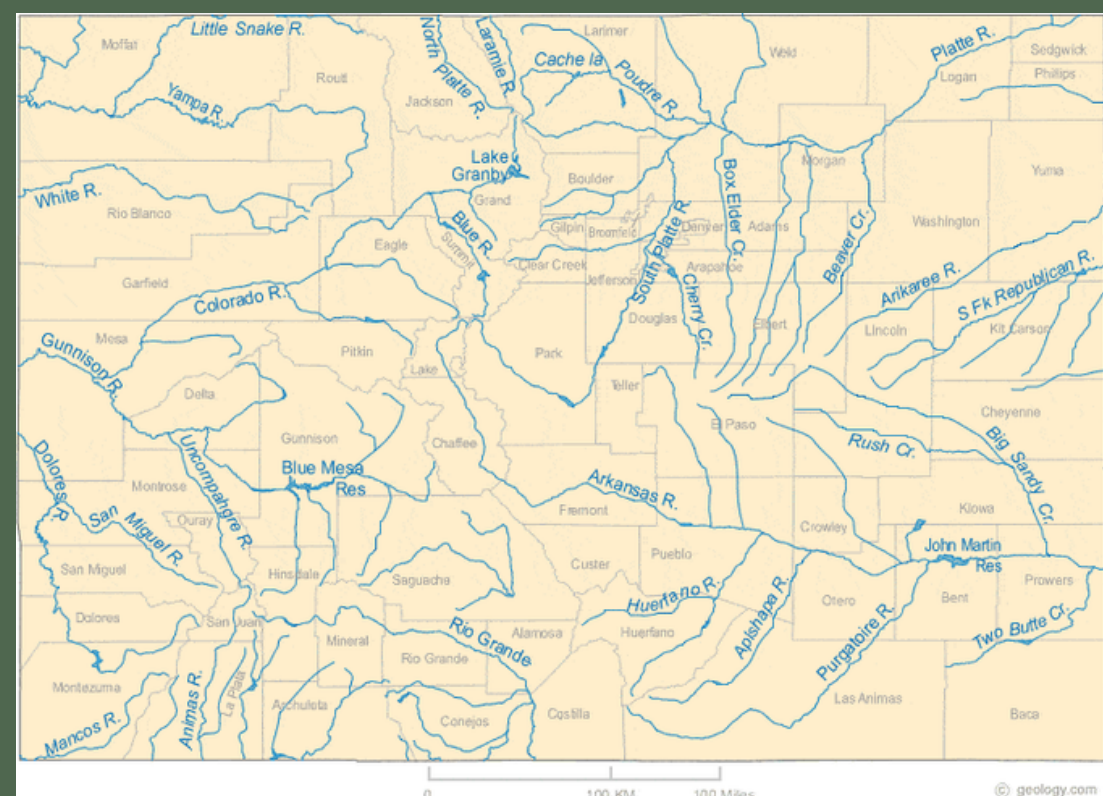
Rivers of Colorado Image Credit: https://geology.com/lakes-rivers-water/colorado.shtml

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