

Occurrence of Antibiotics and Other Organic Wastewater Compounds in Selected Arkansas Streams, 2004



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Antibiotics and Other Organic Wastewater Compounds (OWCs)

- The occurrence of these compounds in surface and ground waters has become an emerging environmental concern.
 - Numerous studies across the Nation and other countries addressing the occurrence of these compounds in different environments
- Fate and transport, ecological effects of these compounds becoming the focus of several studies.

Antibiotics and Other Organic Wastewater Compounds (OWCs)

- Why are we finding these chemicals now?
 - Analytical techniques, methods and equipment have improved tremendously – we can now detect these chemicals at very low levels.
 - The USGS Toxic Substances Hydrology Program has made this a priority, and several state water sciences centers and cooperators now consider this emerging concern.
- The occurrence of these chemicals are wide-spread, resulting from human and agricultural activities.

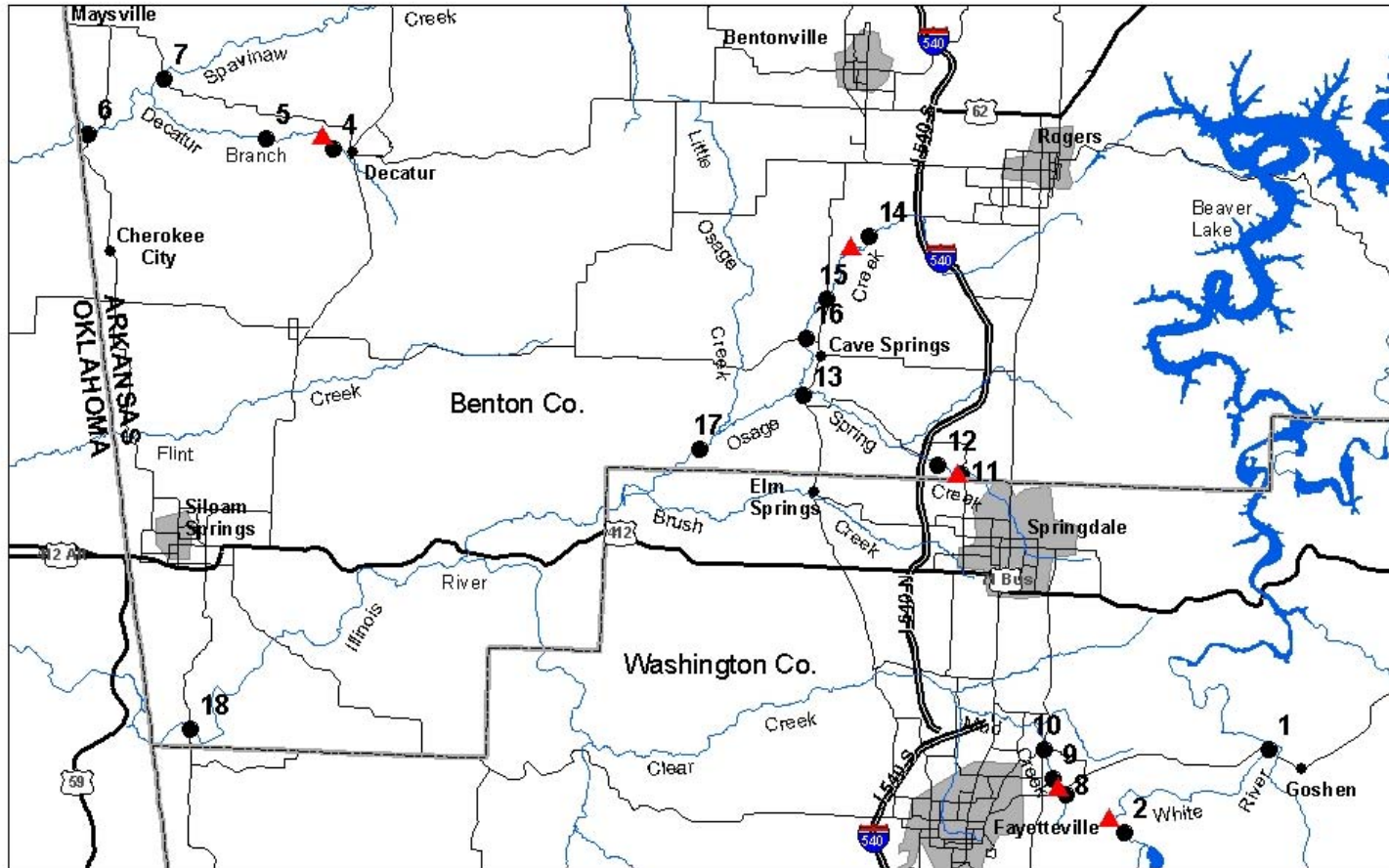
Antibiotics and Other Organic Wastewater Compounds (OWCs)

- The purpose of this study was to evaluate the occurrence of antibiotics and other OWCs in selected streams of north–central and northwest Arkansas.
- This project was completed as a joint effort between the USGS Arkansas Water Sciences Center, USDA–ARS, and the University of Arkansas.

Water–Quality Monitoring Sites in North–Central and Northwest Arkansas

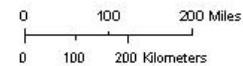
- Streams in northwest Arkansas were selected because of the presence of municipal WWTP effluent discharges.
- The stream in north–central Arkansas drains a relatively undeveloped catchment.
 - North Sylamore Creek near Fifty-Six, Arkansas
 - USGS Hydrologic Benchmark Network
- Water samples were collected at 18 sites in March and April 2004; water samples were collected at 3 selected sites in August 2004.
 - A total of 21 samples were collected and analyzed for antibiotics and other OWCs.

Water–Quality Monitoring Sites in North–Central and Northwest Arkansas



EXPLANATION

- 3 WATER-QUALITY SAMPLING LOCATION WITH ASSOCIATED MAP IDENTIFICATION NUMBER
- ▲ WASTEWATER TREATMENT FACILITY DISCHARGE LOCATION



Water Sample Collection and Laboratory Analyses

- Water samples were collected following standard USGS techniques.
- The USGS National Water Quality Lab measured pharmaceutical and other OWC concentrations in water samples.
- The USGS Organic Chemistry Research Lab measured antibiotic concentrations in water samples.
 - Water samples analyzed in August 2004 had reporting limits (RLs) an order of magnitude less than that in March and April 2004.

Antibiotics and OWCs Chemical Categories



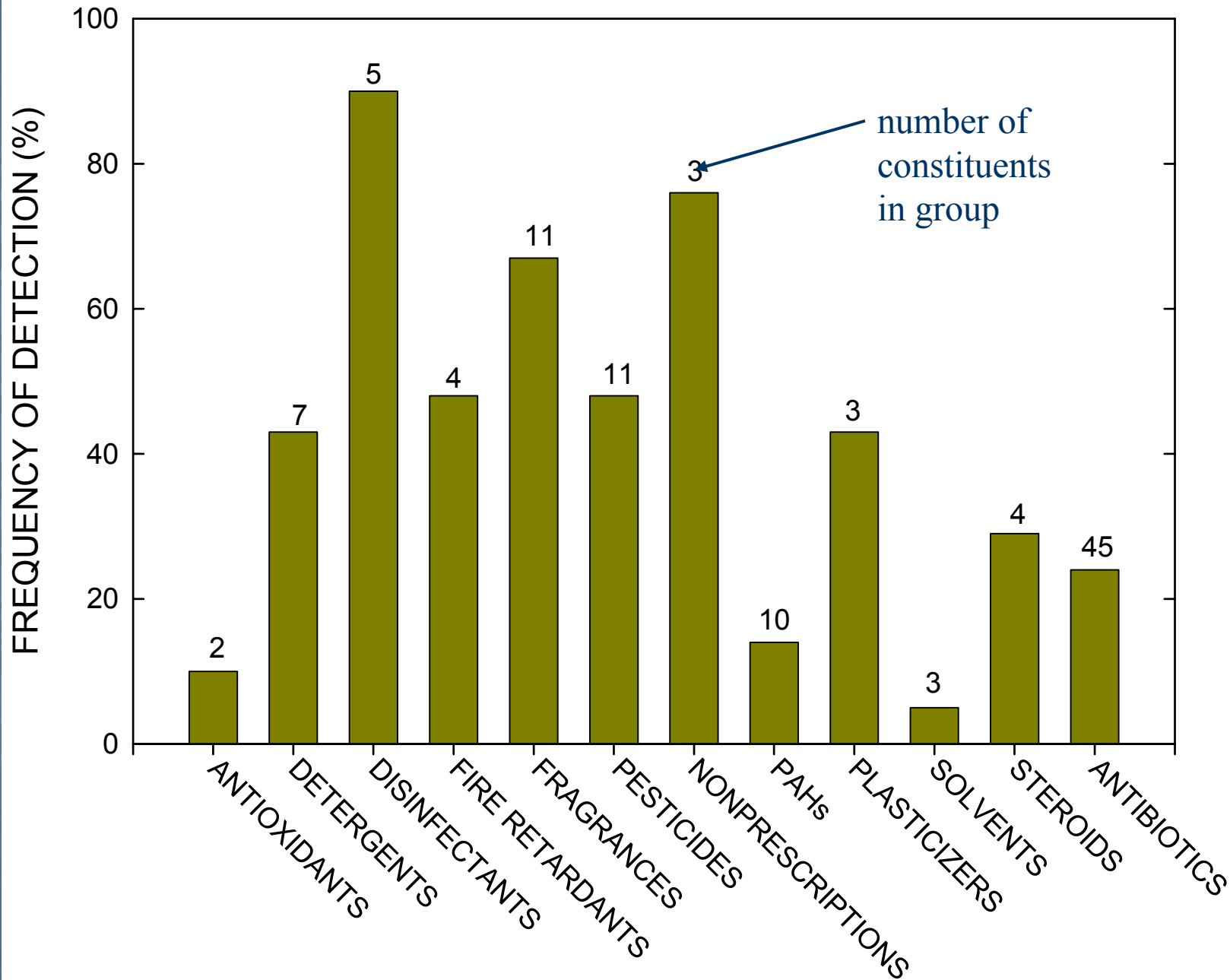
- Antioxidants (2)
- Detergent
- Metabolites (7)
- Disinfectants (5)
- Fire Retardants (4)
- Fragrances & Flavors (11)
- Insect Repellents & Pesticides (11)
- Nonprescription Drugs (3)
- Polycyclic Aromatic Hydrocarbons (10)
- Plasticizers (3)
- Solvents (3)
- Steroids (4)
- Antibiotics (45)

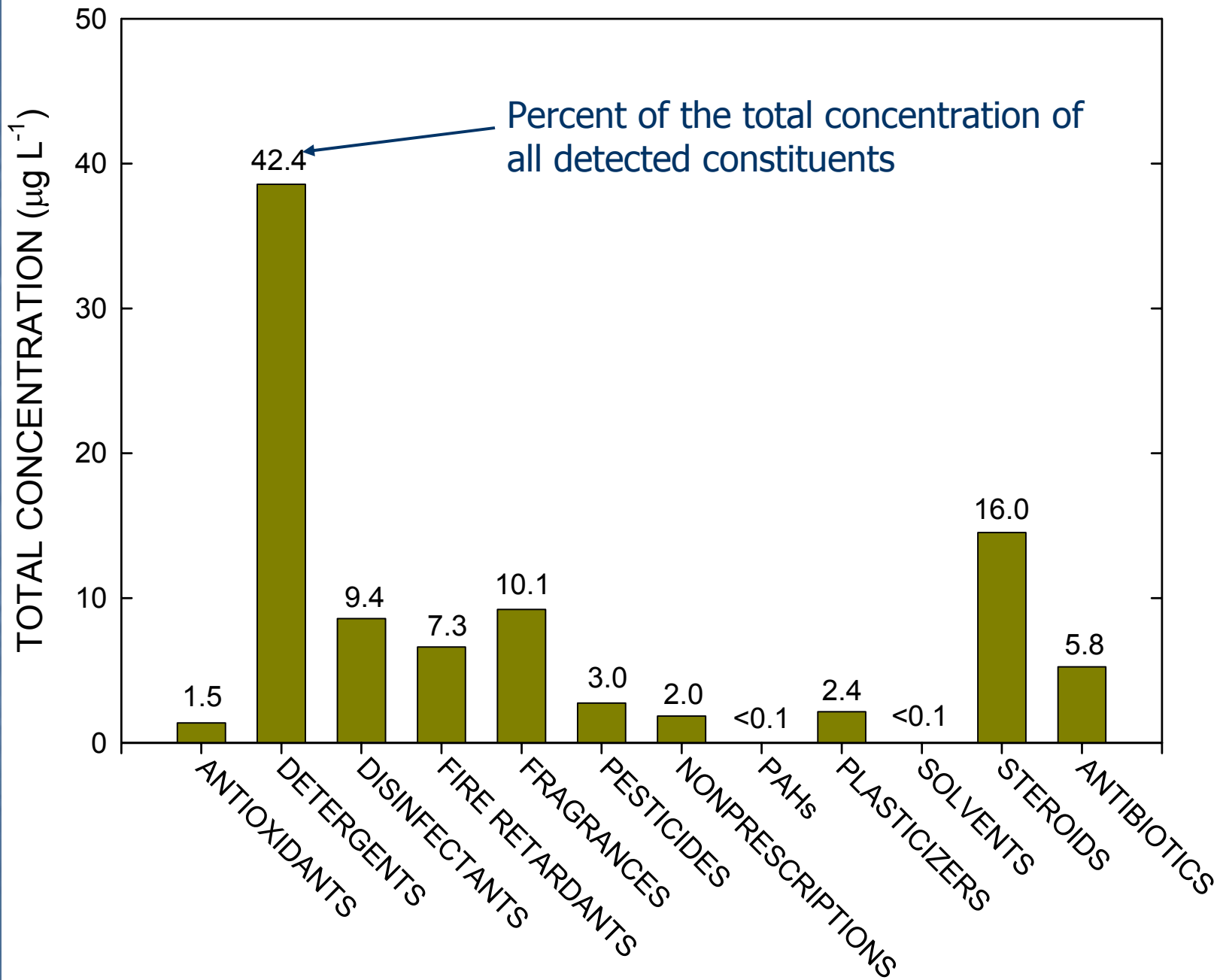


RESULTS AND DISCUSSION

- One or more OWCs were found in water samples collected at the sites in this study, except at Spavinaw Creek near Mayesville.
 - This catchment has a high density of poultry.
- Three OWCs were even found at North Sylamore Creek near Fifty-Six, including:
 - Caffeine (Nonprescription Drug)
 - Phenol (Disinfectant)
 - AHTN (Fragrances & Flavors)





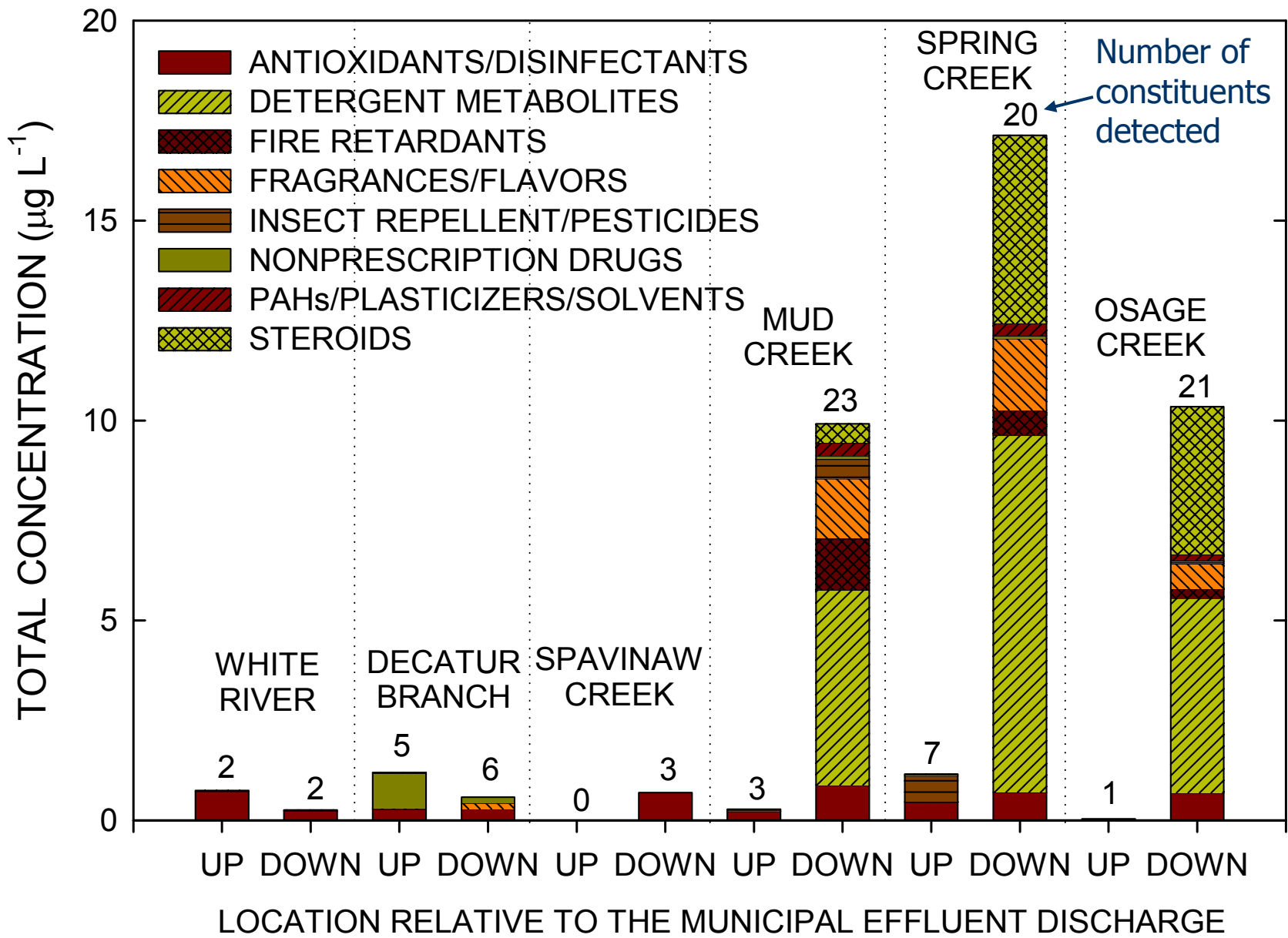


RESULTS AND DISCUSSION

- Overall, 42 of the 108 targeted antibiotics and OWCs were detected at least once.
 - Concentrations were generally low ($<1 \mu\text{g L}^{-1}$).
 - Many concentrations were estimated, because they were less than the reporting limit (RL).
- However, a few chemical concentrations were greater than $1 \mu\text{g L}^{-1}$, including:
 - 3- β -Coprostanol, β -Sigmastanol, & Cholesterol
 - *para*-Nonylphenol (total), NPEO2, & OPEO1
 - AHTN (widely used musk fragrance)
 - anhydro-Erythromycin

RESULTS AND DISCUSSION

- Individual OWCs detected in greater than 50% of the water samples, including:
 - AHTN, Caffeine, *para*-Cresol and Phenol.
- None of the individual chemicals exceeded drinking water guidelines, health advisories, or aquatic life criteria.
- It was apparent that municipal WWTP effluent discharges significantly increased the number of detections ($p < 0.05$) and total measured concentrations ($p < 0.10$).



RESULTS AND DISCUSSION

- Overall, four chemical categories produced the increase in the number of detections and total measured concentration downstream from municipal WWTP effluent discharges.
 - Detergent Metabolites
 - Fire Retardants
 - Fragrances & Flavors
 - Steroids
- Antibiotics were only found in water samples collected downstream from municipal WWTP effluent discharges.

Current Activities

- Evaluating the fate and transport of antibiotics and other OWCs in effluent dominated streams.
 - Whole–Reach Attenuation Factors
 - Sediment Accumulation
- Samples are being collected at more sites downstream from WWTP discharges 3 times a year (different flow conditions)
 - Mud Creek (Fayetteville WWTP), Spring Creek (Springdale WWTP), and Decatur Branch (Decatur WWTP)
- Evaluating the presence of antibiotic resistant bacterial strains in effluent dominated streams, especially in those with measurable antibiotics (Mary Sabin, University of Arkansas).
 - Focus on Fecal Bacteria
 - Evaluate Multiple Antibiotic Resistances

ANY QUESTIONS?

Report online:

<http://pubs.usgs.gov/sir/2005/5140/SIR2005-5140.pdf>

