

Evaluating the estrogenicity of an effluent-dominated river in California, USA: Comparisons of in vitro and in vivo bioassays

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ABSTRACT

Estrogenically active compounds (EACs) in surface waters can disrupt the endocrine system of biota, raising concern for aquatic species. Concentrations of EACs are generally higher in effluent-dominated aquatic systems, such as California's Santa Ana River (SAR). Addressing estrogenicity of effluent-dominated waters is increasingly important due to both increasing urbanization and climate change. To this end, water samples were collected from multiple sites downstream of wastewater treatment plants (WWTPs) and intermittent points along the SAR during 2018–2019 and cell-based bioassays were used to determine estrogen receptor activity. During baseflow conditions, the highest estradiol equivalencies (EEQs) from all SAR water between summer (August and September) and fall (November) sampling events in 2018 were from Yorba Linda (EEQ=1.36±0.38 ng/L) and Prado (1.14±0.13 ng/L), respectively. Water extracts in January 2019 following a major rainfall generally had higher EEQs with the highest EEQ of 10.0 ± 0.69 ng/L observed at Yorba Linda. During low flow conditions in November 2018, male Japanese medaka (*Oryzias latipes*) fish were exposed to SAR water to compare to cell bioassay responses and targeted analytical chemistry for 5 steroidal estrogens. Chemical-based EEQ correlations with in vitro EEQs were statistically significant. However, vitellogenin (vtg) mRNA expression in the livers of medaka exposed to SAR water was not significantly different compared to controls. These results indicate that seasonal variation and surface water runoff events influence estrogenic activity in the SAR and may induce estrogenic effects to native fish populations in wastewater-dominated streams in general.

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