Plastic Pollution in the Santa Ana River Watershed

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Image: Win Cowger, UCR

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Subset Repeat TLS Survey Difference Map
Following moderate January 2018 storm
(Precip ~ 5.3 cm, ~1.5 days)
Plastic Pollution Team

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Plastic Dominates Stream Trash Composition in Southern California Urban Streams

Macroplastic in streams is regulated (Trash TMDLs)

Microplastic in streams is not currently regulated
Macroplastic

> 5 mm

“Trash”

Microplastic

< 5 mm

Images: Win Cowger, UCR
Plastic Pollution Fate and Transport Projects

Middle Santa Ana

Preliminary investigations/Method Development

Macro/Microplastic

Santa Ana River above Prado
Arlington Channel

Los Angeles River
San Gabriel River
Coyote Creek

Santa Ana River below Prado
San Pedro Bay

San Diego Creek

Santa Ana Delhi Channel
Marsh and subtidal sediment

San Pedro Bay

Integrated river/coastal ocean monitoring/modeling

Microplastic

Newport Bay

Fluvial flux and sedimentation monitoring

Macro/Microplastic
Plastic Flux in Streamflow

The $C-Q$ Relationship

Discharge

Internal + External

Plastic Supply

Rating Curve

Plastic Concentration

Plastic Flux

Antecedent Hydrologic Conditions

Plastic Concentration

Discharge Time Series

Internal External

log $C_{ssf}$ (mg/L) log $Q_i$ (m$^3$/s)

$y = 1.57 + 0.713x$

$R^2 = 0.56$
What is suspended sediment?

Schmidt et al. 2017
Besseling et al. 2018
Lebreton et al. 2017
Fluvial transport of plastics cannot be simplified to a single transport mode.
Stream Microplastic Monitoring

Challenge:
• Coarse Microplastics (~ 0.5 - 5 mm) and Macro-
  — Concentrations highly variable, low \((n < 1-10^4 \text{ m}^{-3})\)
  Solution $\rightarrow$ Large samples \((0.1 - 100 \text{ m}^3) \rightarrow$ Nets

Challenge:
• Fine Microplastics \((1 – 100 \mu m)\)
  — not captured well by nets
  — concentrations geometrically higher
  Solution $\rightarrow$ Grab or pump samples \((1-10 \text{ L})\)
Stream Plastic Pollution Sampling

*Summer ‘Dry’ Flows*

- Easy Deployment
- Challenges Remain
Stream Plastic Pollution Sampling

Winter Storm Flows

Challenging Deployment

Challenging Sample Composition
Coarse & Fine Microplastics must be sampled through different techniques

Must be separated from organic and mineral material

Automated imaging increases throughput & geometric data acquisition

Spectroscopic characterization remains time intensive
Santa Ana River at Van Buren Bridge
Macroplastic in Stormflow

Discharge is positively related to concentration but there is high variability.
Clockwise hysteresis and source timing likely exist.
Preliminary Microplastic Findings

• Very little medium to coarse (0.3 to 5 mm) microplastic in dry season flow.

• Initial stormflow samples appear to have much higher concentrations.

• Potential to simplify monitoring approaches by focusing on washload.
References


*Cowger W, Schultz RC, Bernstein NP, Gray AB. in review. Anthropogenic litter cleanups in Iowa riparian areas reveal the importance of near-stream and watershed scale land use. Environmental Pollution.


