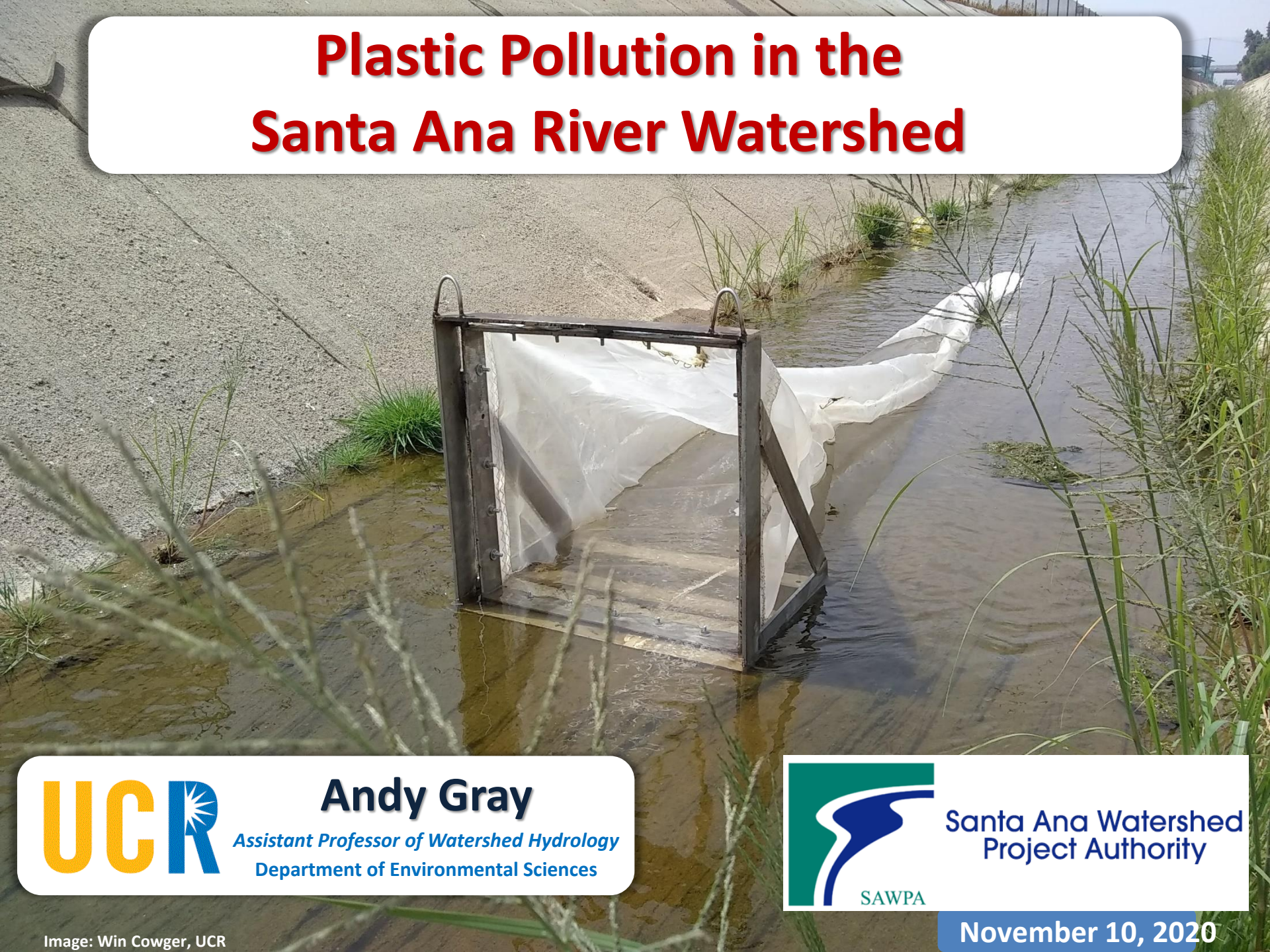
Plastic Pollution in the Santa Ana River Watershed



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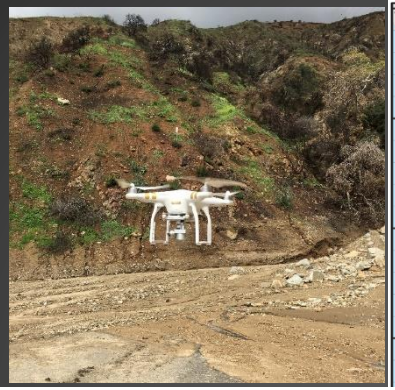
SAWPA

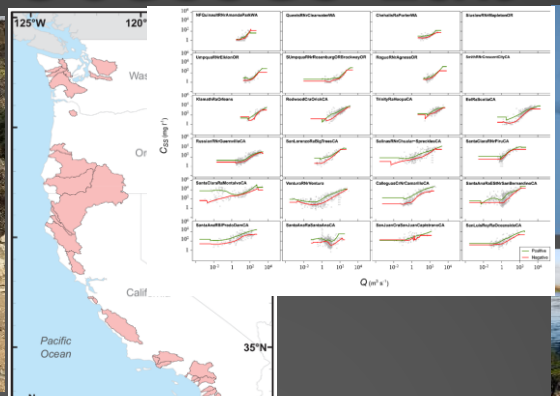
Santa Ana Watershed Project Authority

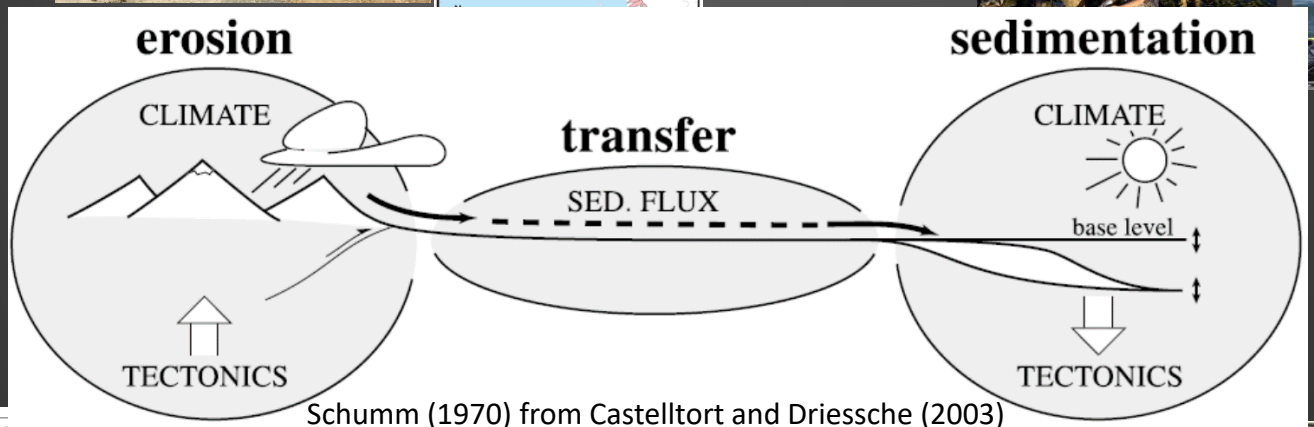
Image: Win Cowger, UCR

November 10, 2020

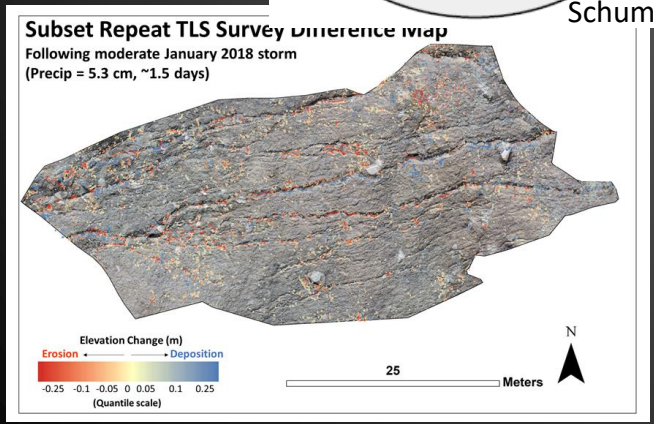
UCR Watershed Hydrology & Earth Surface Processes Lab

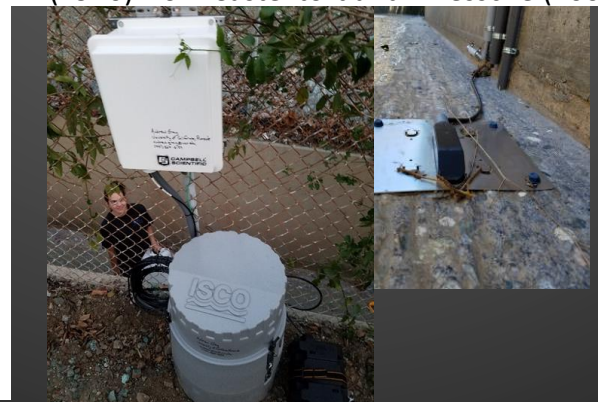




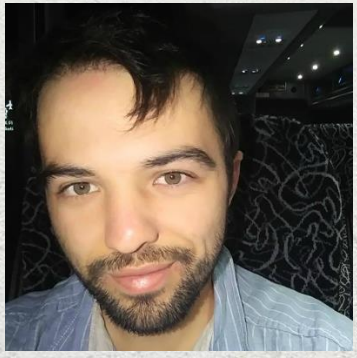


Schumm (1970) from Castelltort and Driessche (2003)





Plastic Pollution Team



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PhD Student

Hannah Hapich
Undergraduate Student

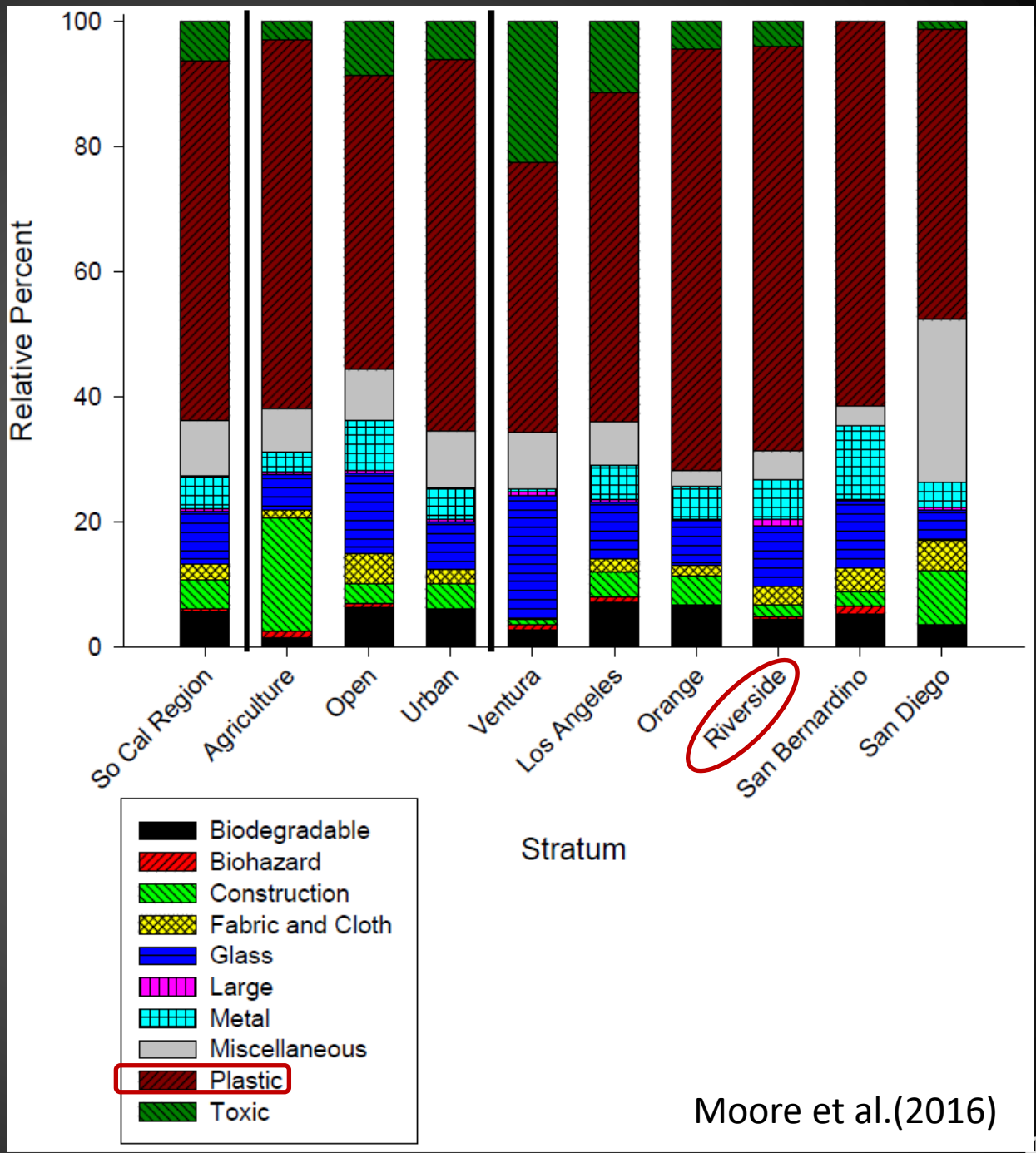
Hinako Nogi
Undergraduate Student

Southern Bight Regional Monitoring Program -- Stream Trash Surveys

Plastic Dominates
Stream Trash Composition in Southern California Urban Streams

Macroplastic in streams is regulated (Trash TMDLs)

Microplastic in streams is not currently regulated



Moore et al.(2016)

Macroplastic

> 5 mm
"Trash"

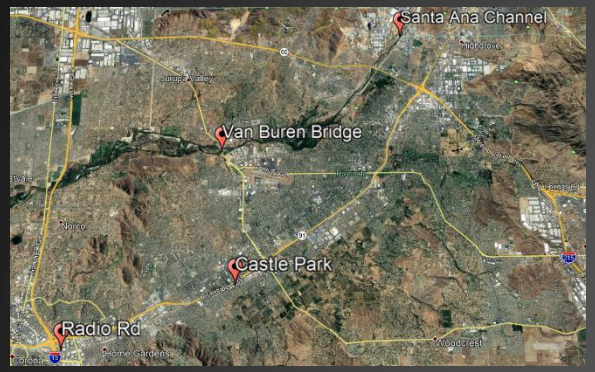
Microplastic

< 5 mm

Images: Win Cowger, UCR

Plastic Pollution Fate and Transport Projects

Middle Santa Ana

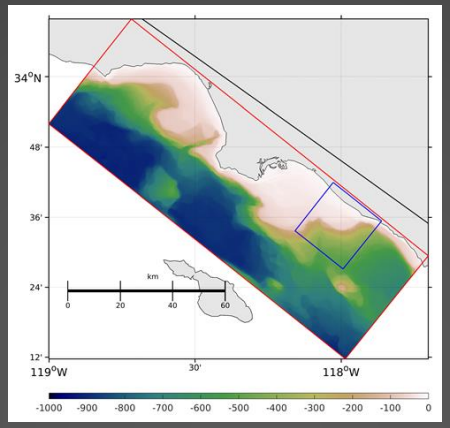


Preliminary investigations/
Method Development

Macro/Microplastic

<u>Santa Ana River above Prado</u>
<u>Arlington Channel</u>

San Pedro Bay

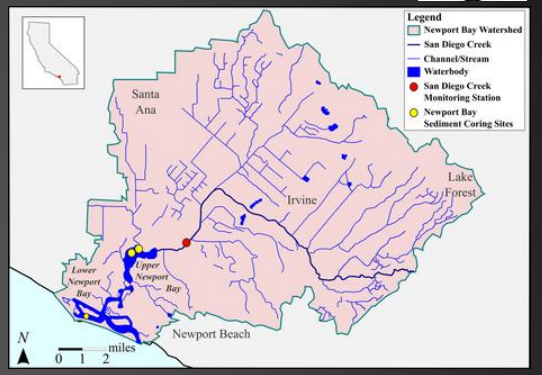


Integrated river/coastal
ocean monitoring/modeling

Microplastic

Los Angeles River
San Gabriel River
Coyote Creek
<u>Santa Ana River below Prado</u>
San Pedro Bay

Newport Bay

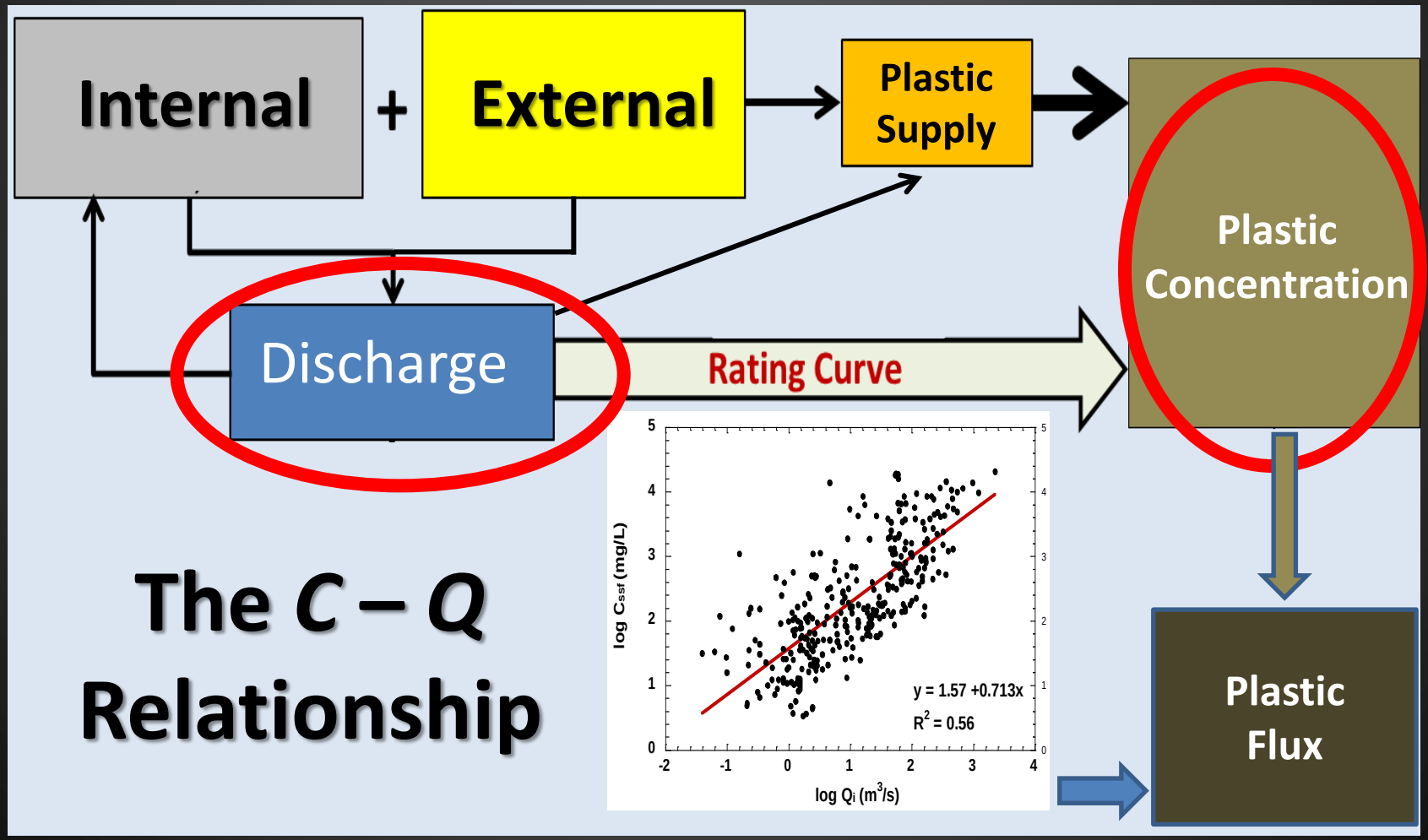


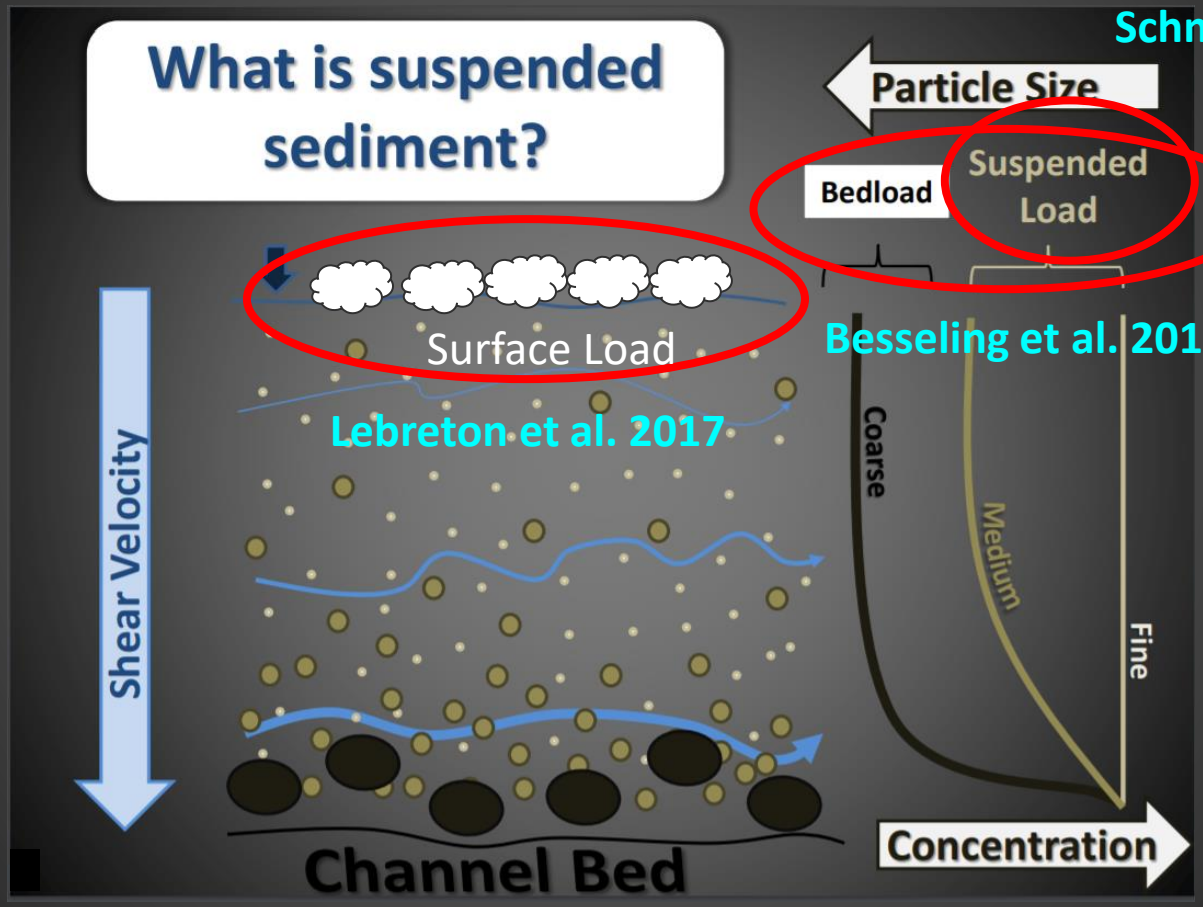
Fluvial flux and sedimentation
monitoring

Macro/Microplastic

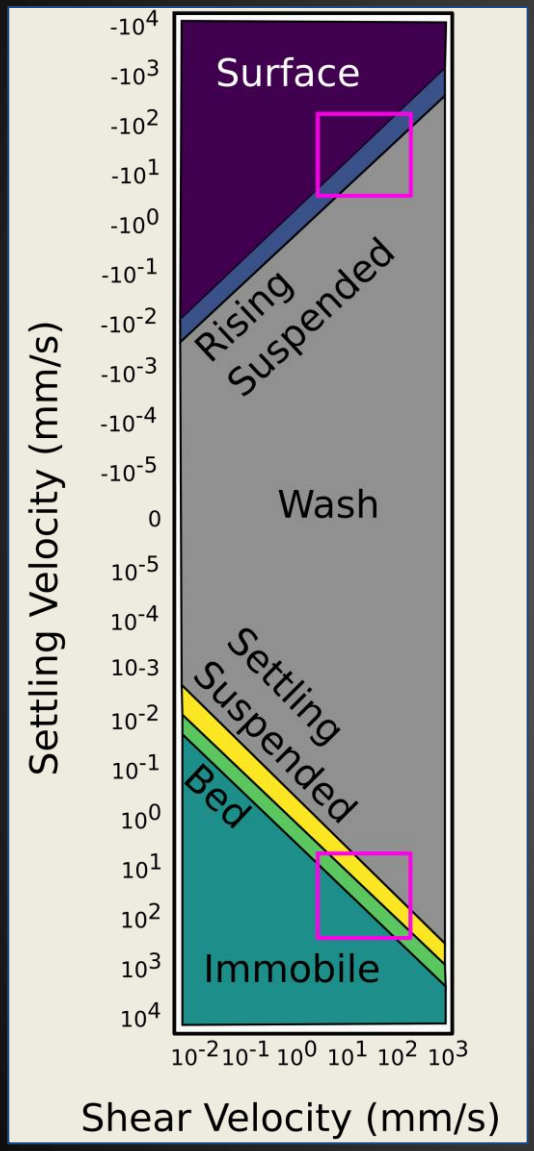
San Diego Creek
<u>Santa Ana Delhi Channel</u>
Marsh and subtidal sediment

Plastic Flux in Streamflow




What is suspended sediment?
Schmidt et al. 2017
Particle Size
Bedload
Suspended Load
Surface Load
Besseling et al. 2018
Lebreton et al. 2017
Shear Velocity
Coarse
Medium
Fine
Concentration
Channel Bed

Plastic Concentration-Depth Profile



$$w_s = \frac{2(\rho_p - \rho_w)gr^2}{9\mu}$$

$$u_* = \sqrt{ghs}$$

*Fluvial transport of plastics **cannot** be simplified to a single transport mode.*

Cowger et al., *in revision*

Stream Microplastic Monitoring

Challenge:

- Coarse Microplastics (~ 0.5 - 5 mm) and Macro-
  - Concentrations highly variable, low ($n < 1\text{-}10^4\ m^{-3}$)

    Solution → Large samples (0.1 - 100 m^3) → Nets

Challenge:

- Fine Microplastics (1 – 100 µm)
  - not captured well by nets
  - concentrations geometrically higher

    Solution → Grab or pump samples (1-10 L)

Concentration-Depth Dependence

Stream Plastic Pollution Sampling

Summer 'Dry' Flows

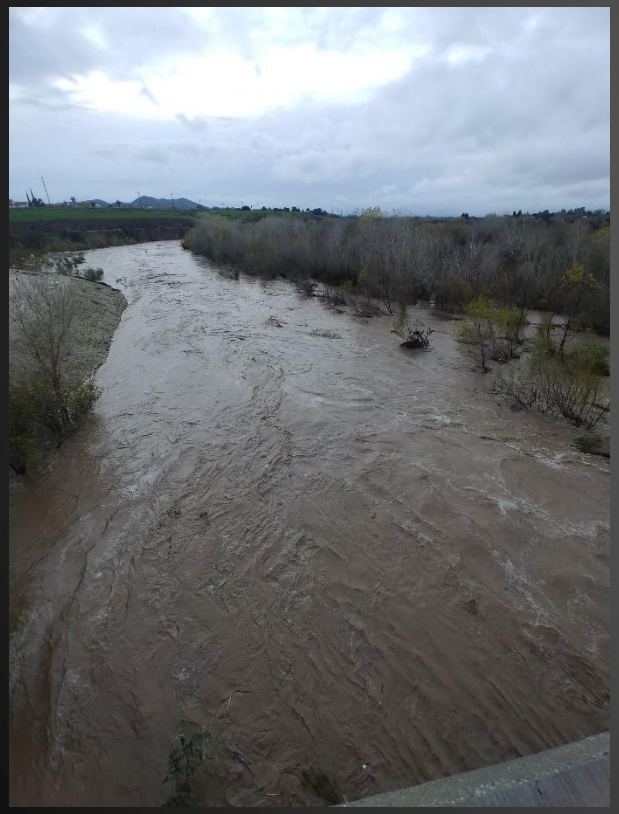
Easy Deployment

Challenges Remain

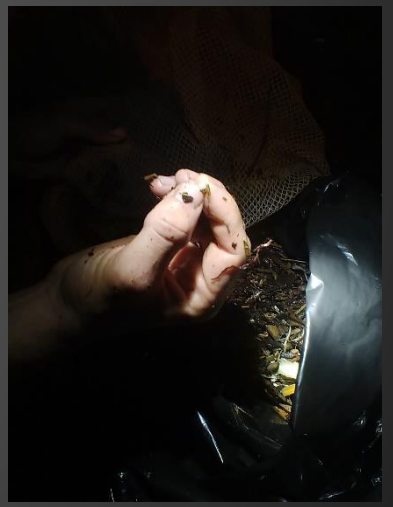
Stream Plastic Pollution Sampling

Winter Storm Flows

Challenging Deployment



Challenging Sample Composition

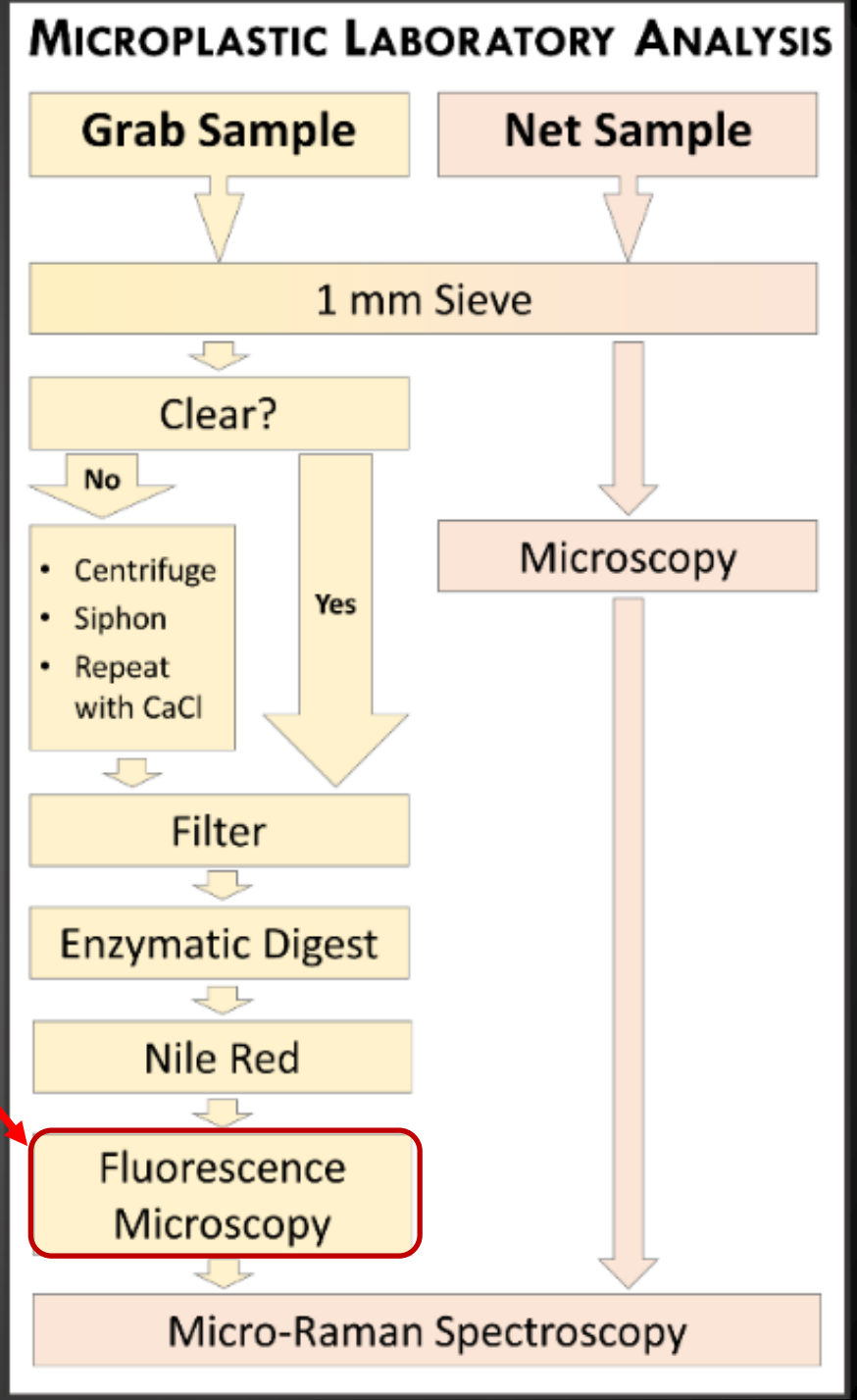


Coarse & Fine Microplastics must be sampled through different techniques

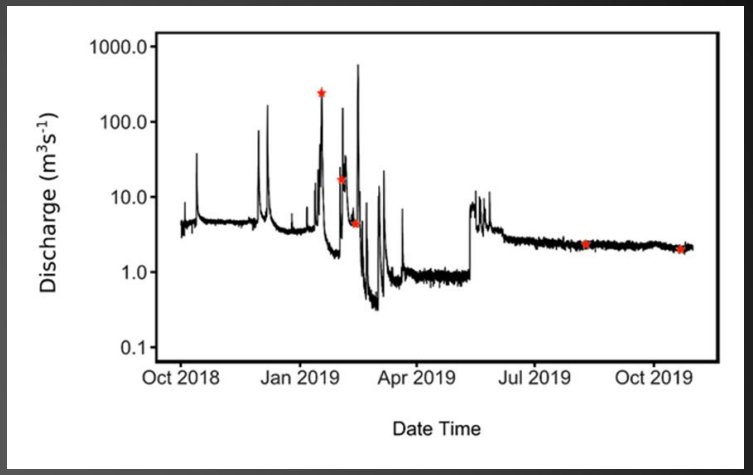
Must be separated from organic and mineral material

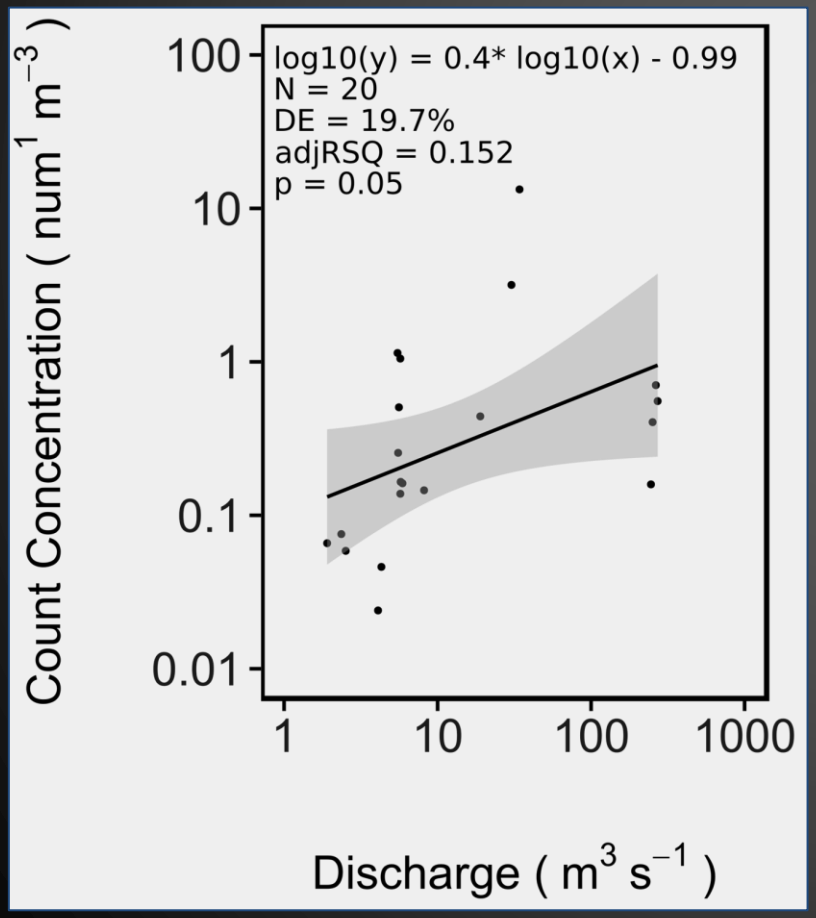
Automated imaging increases throughput & geometric data acquisition

Spectroscopic characterization remains time intensive

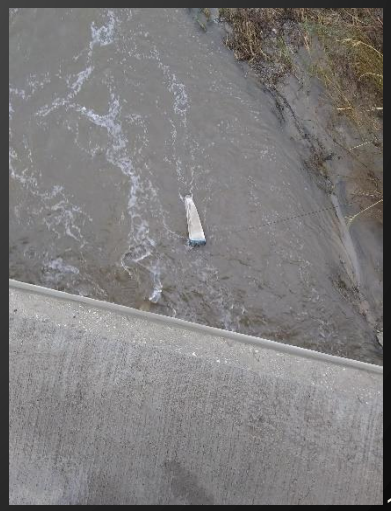


Santa Ana River at Van Buren Bridge
Macroplastic in Stormflow

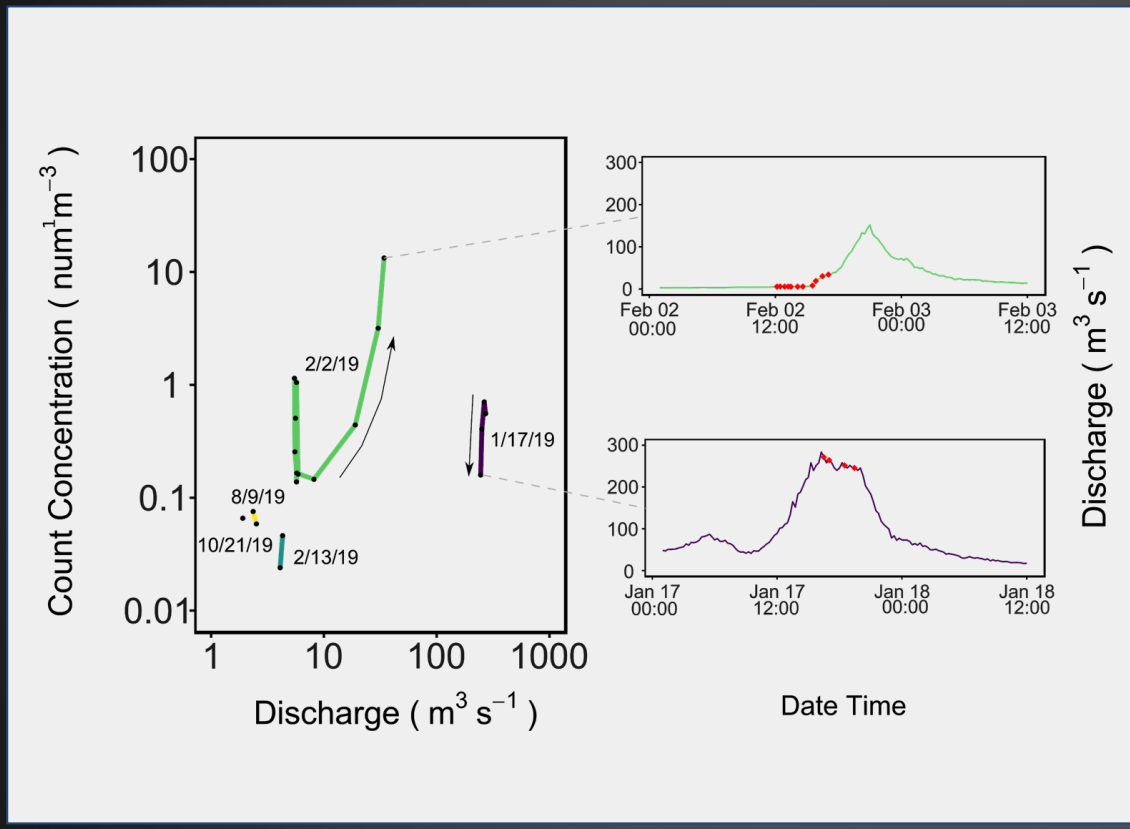


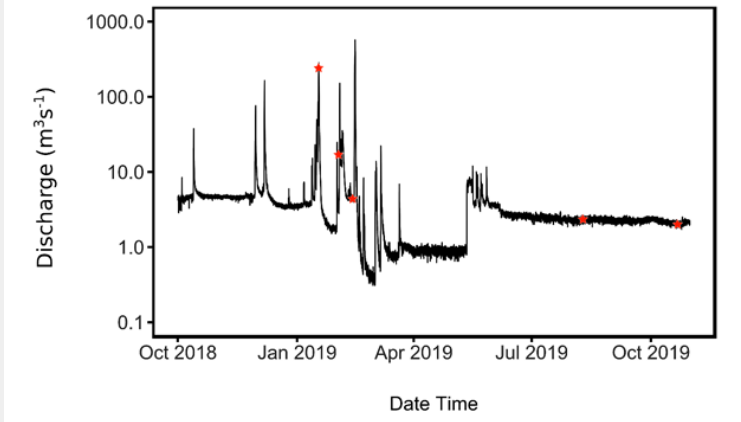


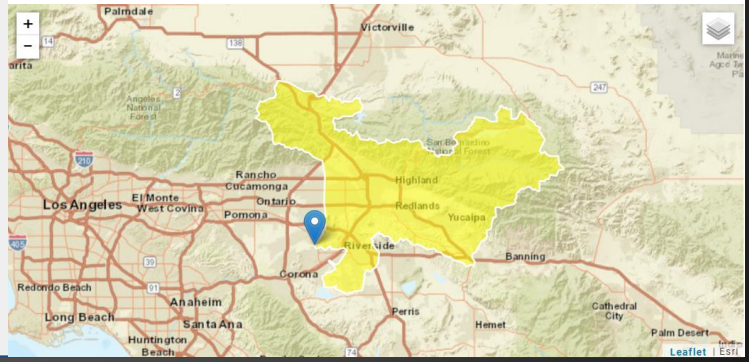
*Discharge **<u>is positively related</u>** to concentration but there is high variability.*



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.

Thank You!

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