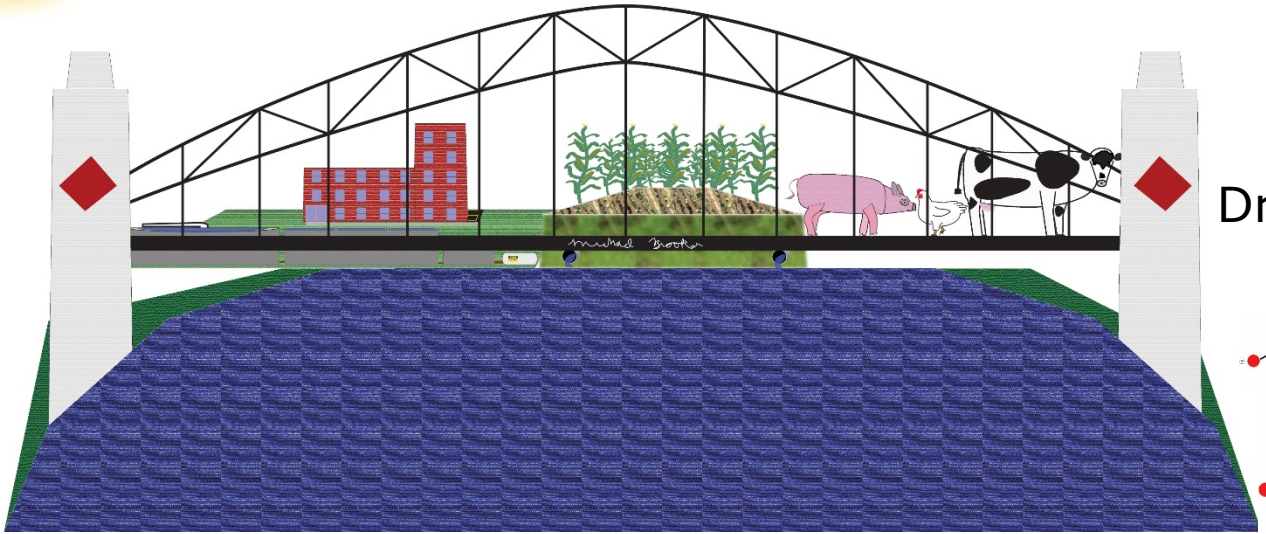
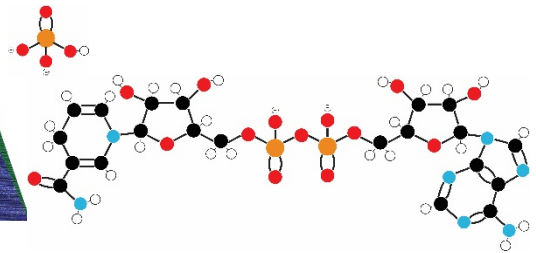
THE OHIO STATE UNIVERSITY

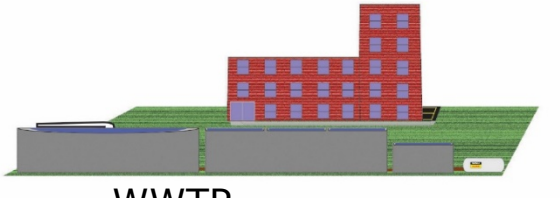
Discerning Organic Phosphorus Signatures in Pollutant Sources from Lake Erie Tributaries



Michael Brooker
Dr. Krista Longnecker
Dr. Elizabeth Kujawinski
Dr. Paula Mouser



Sources and Types of Phosphorus in Lake Erie

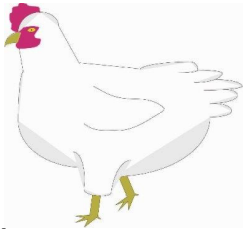


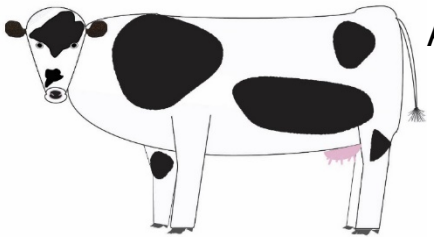
WWTP

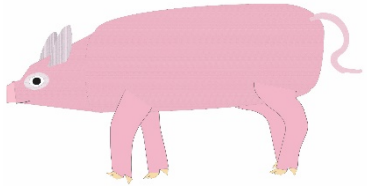
Point

Tile drainage

Non-point

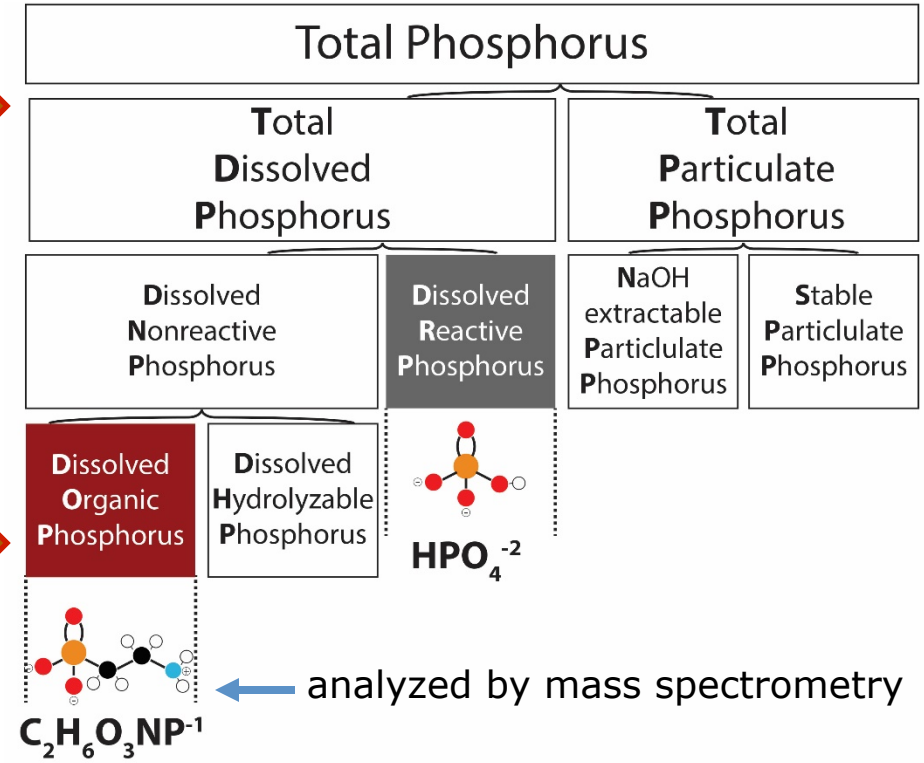




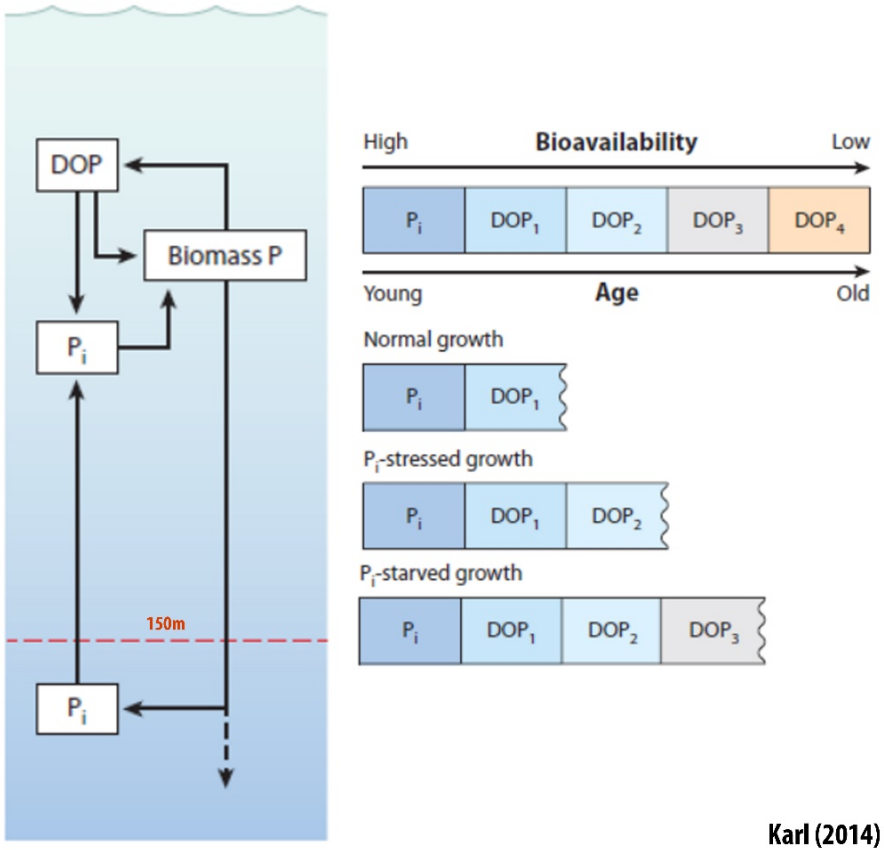


Animal waste

From Baker et al. 2010



Dissolved Organic Phosphorus is Derived from Biomass



Karl (2014)

Varying biota of source material

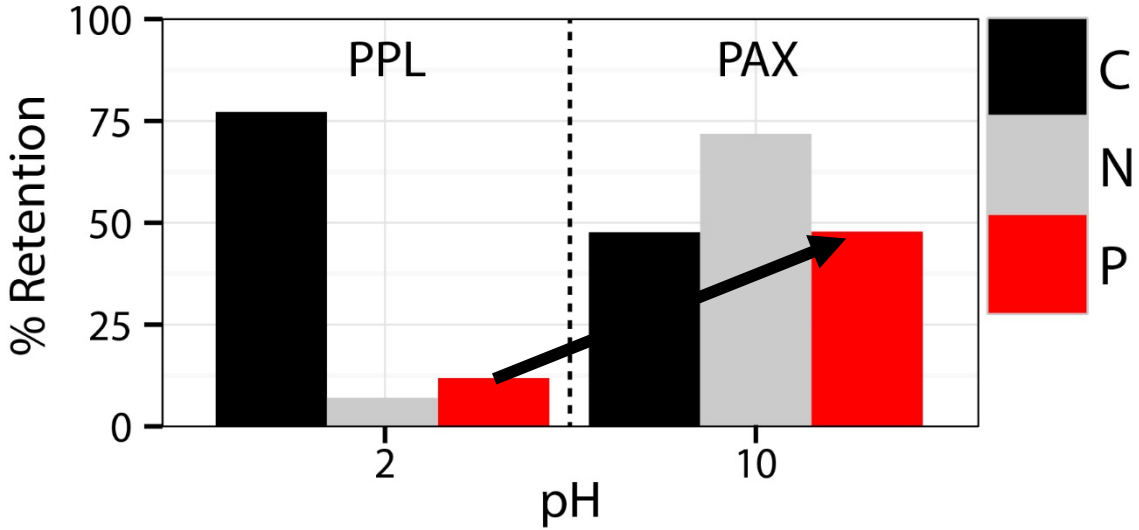
DOP may be conserved in transport

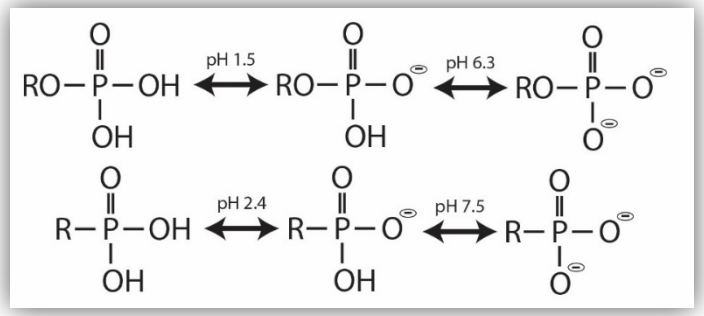
DOP Must be Concentrated for Mass Spectrometry

Solid phase extraction (SPE) commonly used for mass spectrometry

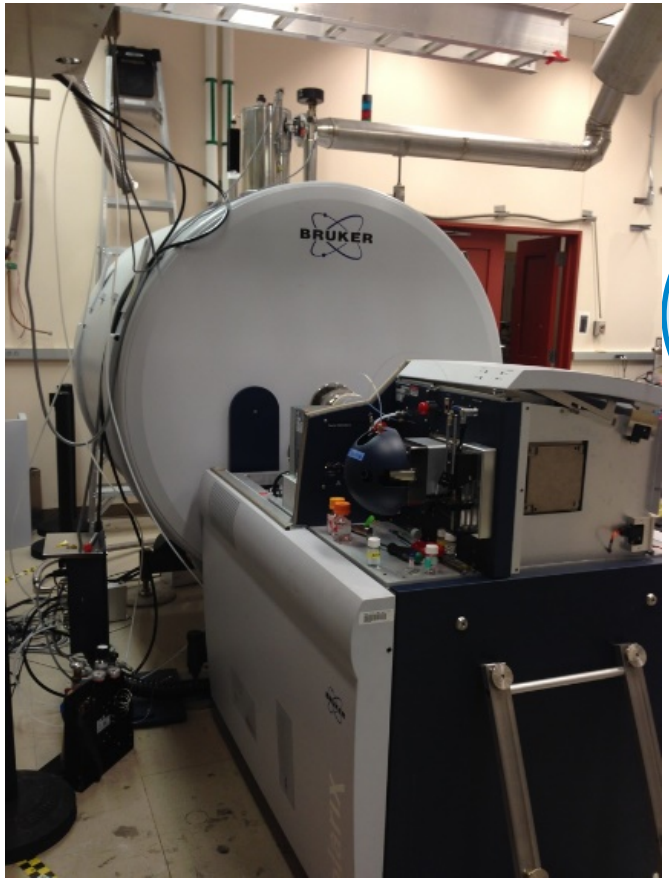
Typical SPE: PPL column at pH 2 — Selects for hydrophobic molecules

Our SPE: PAX column at pH 10 — Selects for anionic molecules



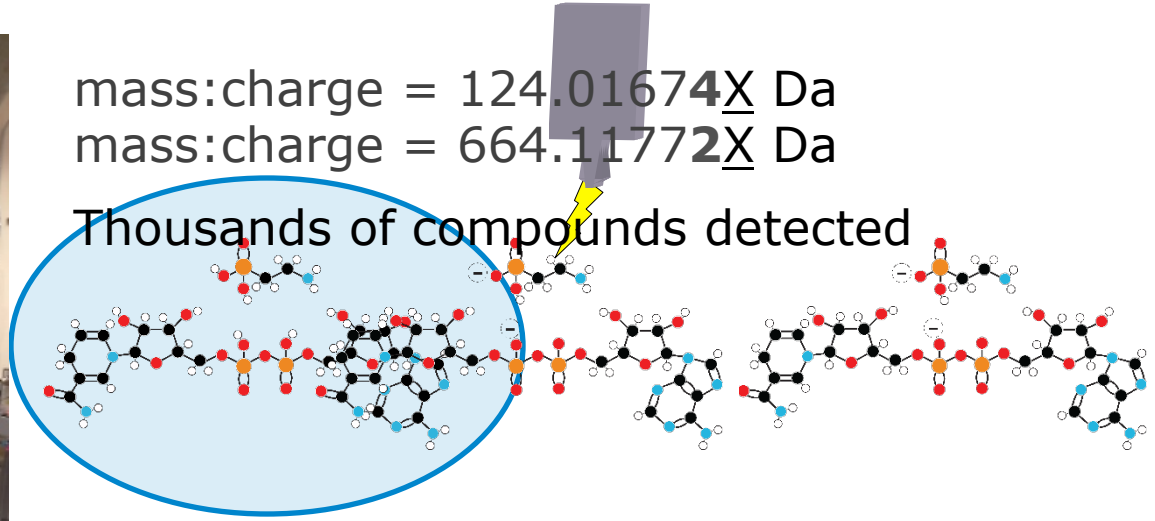


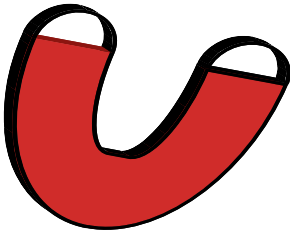
ESI FT-ICR-MS Provides Ultrahigh Resolution



mass:charge = 124.01674X Da
mass:charge = 664.11772X Da

Thousands of compounds detected

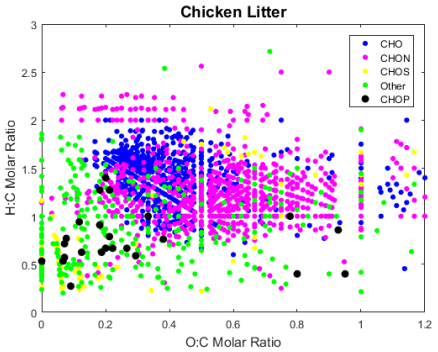


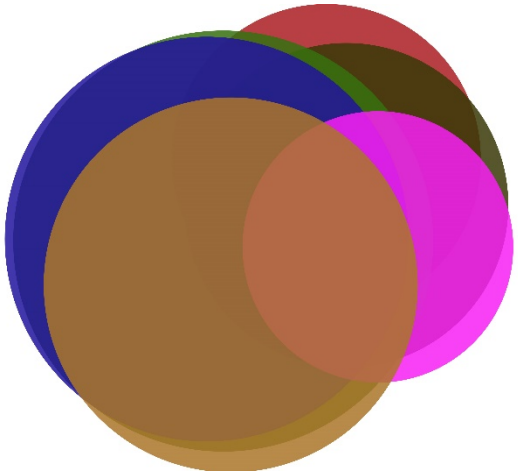


Motivation: Inform Nutrient Management Policy

Chain of Goals:

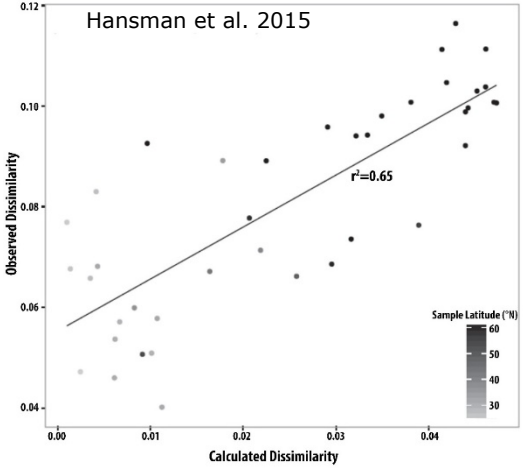
1. Define source signatures



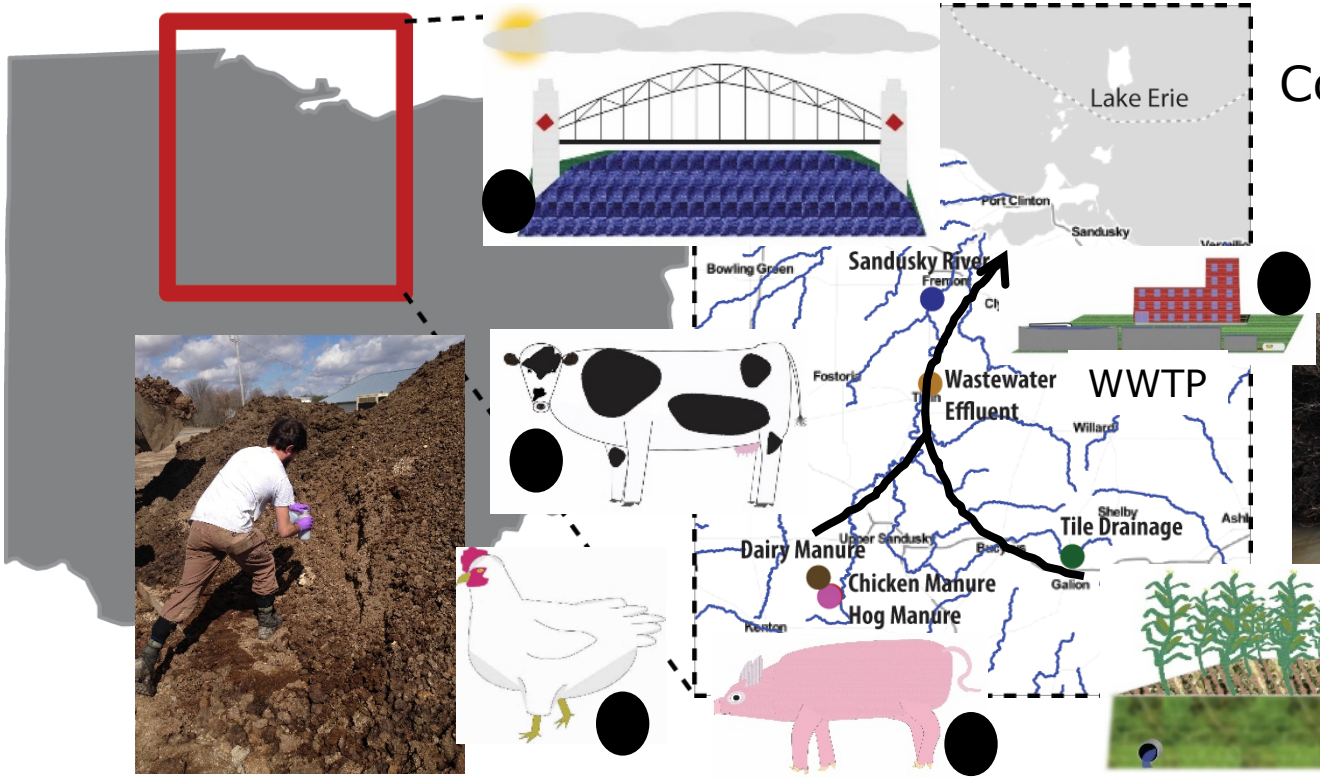


2. Detect shared organic compounds

3. End Member Mixing Analysis (EMMA) predict % contributions



Sampling Source Material in the Sandusky River Watershed

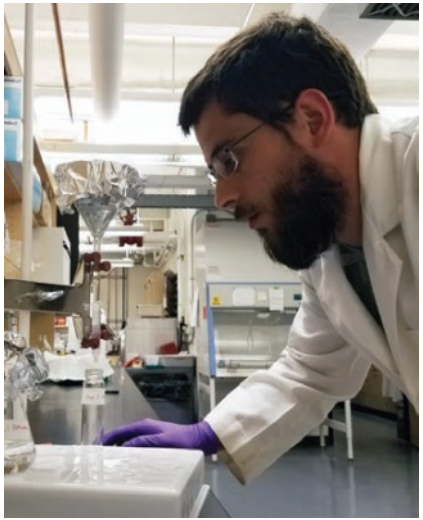


Collected in March 2016

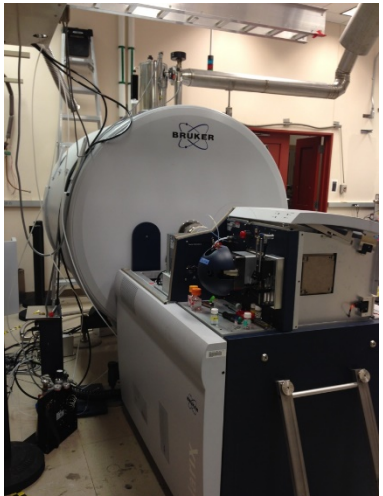
ESI FT-ICR MS Analysis of Source Organic Matter

6 samples run in duplicate + 2 reference NOM standards (n=14) + blanks

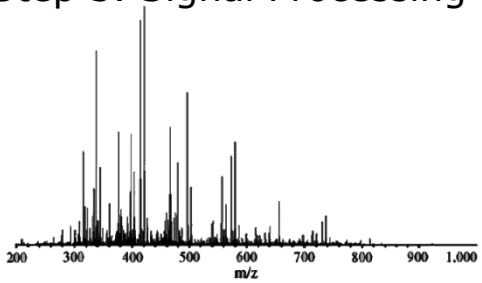
Step 1. DOP Concentration



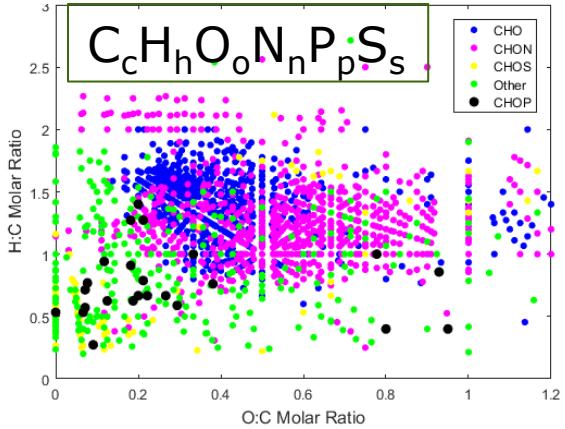
Step 2. Mass Spec



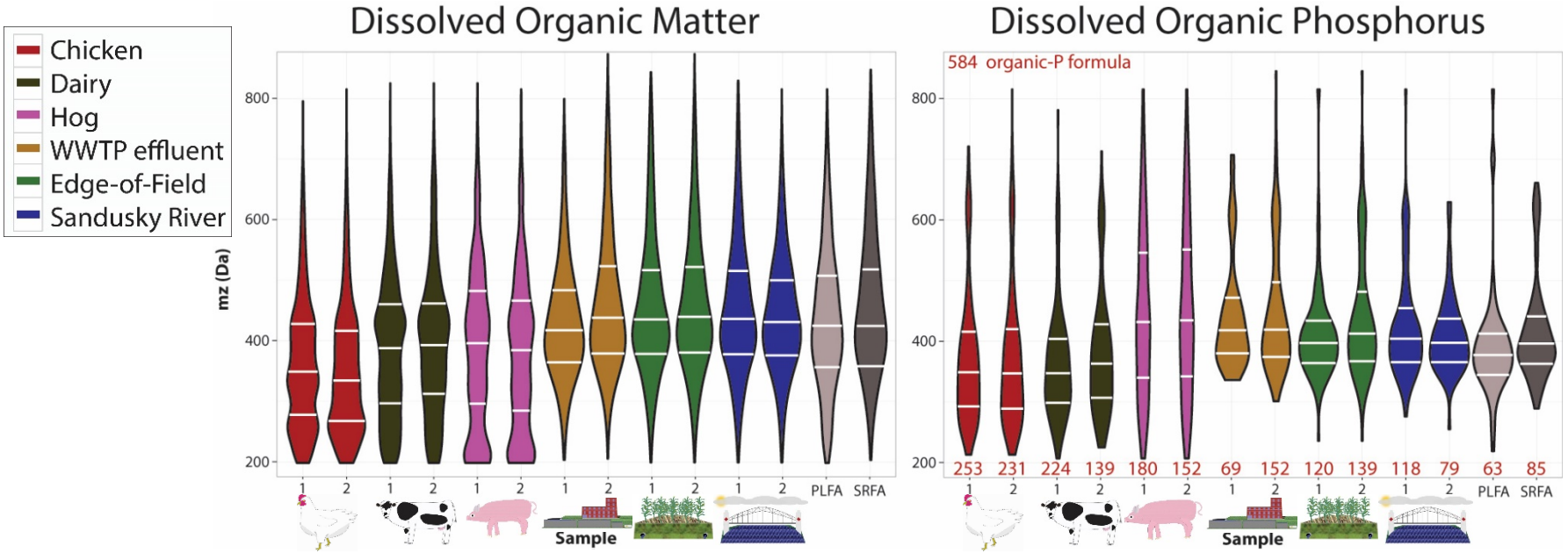
Step 3. Signal Processing



Step 4. Compound Identification



Distribution of Molecular Mass by Replicates/Samples



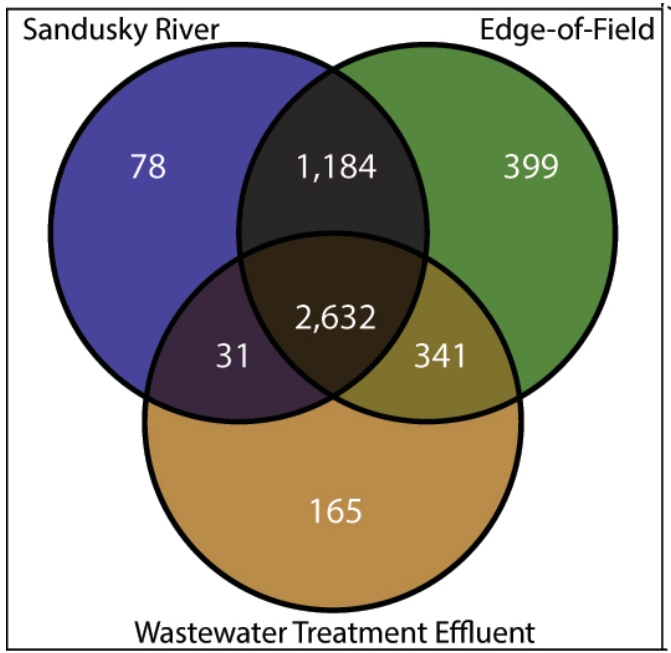
Good replication (>80% reproducibility)

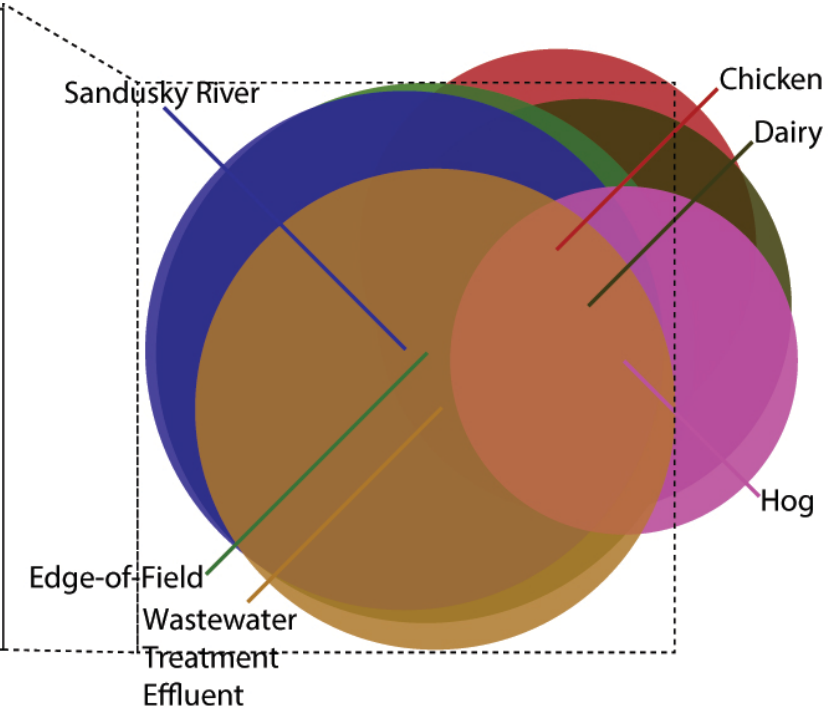
Manure samples had more low MW compounds

Edge-of-Field, WWTP, & Sandusky River had similar MW distributions

Edge-of-Field, Wastewater Treatment Plant, and Sandusky River had Similar DOM

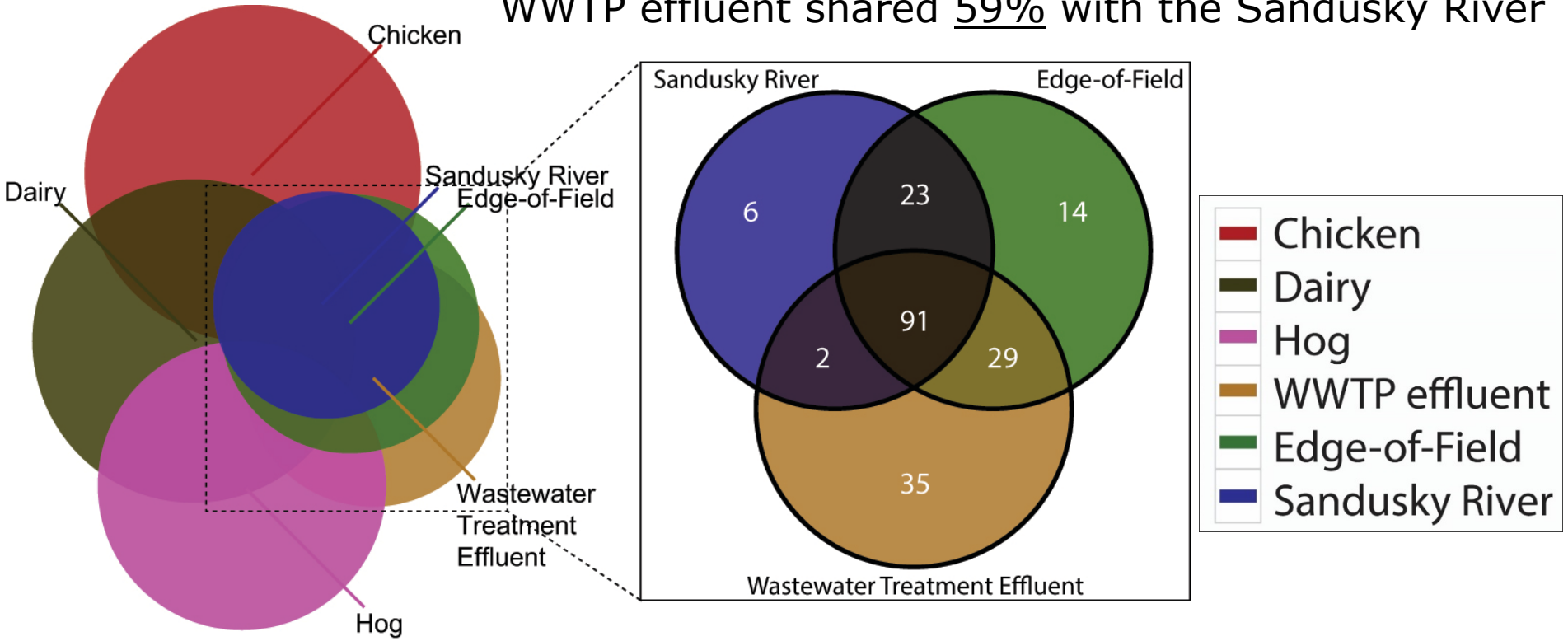
Edge-of-Field and WWTP shared ≥84% of compounds with Sandusky River





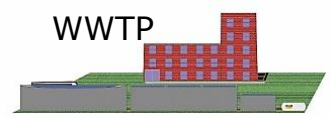
Edge-of-Field, Wastewater Treatment Plant, and Sandusky River had Similar DOP

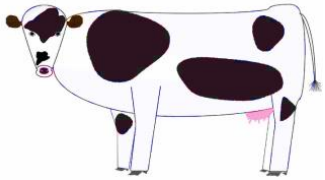
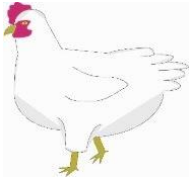
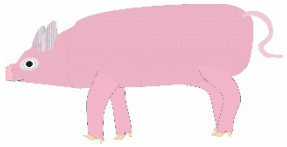
Edge-of-Field shared 72% with the Sandusky River
WWTP effluent shared 59% with the Sandusky River



Sandusky River and Edge-of-Field DOP&DOM are Highly Similar

Indicates  is the primary DOM source



may also be present

Will this relate to phosphorus loads?

future research

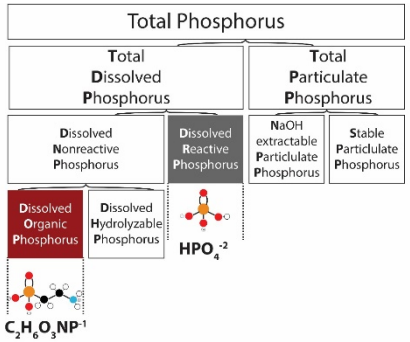
Can This Analysis Inform Nutrient Management Policy?

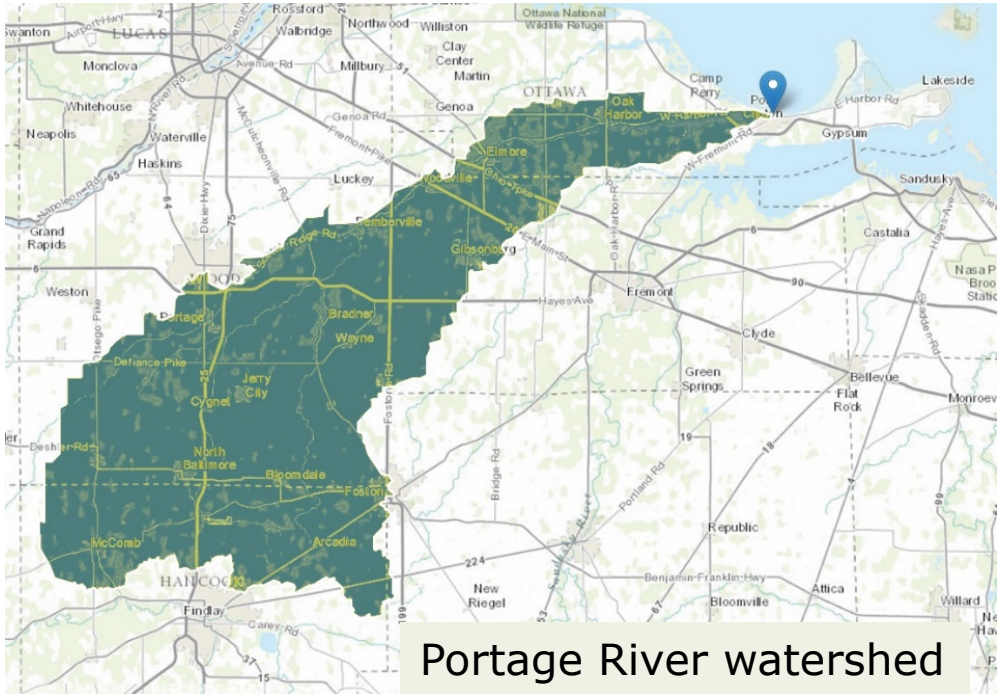
In progress: EMMA model to estimate source contributions

$$River = a_1 Chicken + a_2 Hog + a_3 Dairy + a_4 Edge\_of\_Field + a_5 WWTP$$

$$\sum_{n} a_n = 1$$

Upcoming:
Mixing in Portage River
Incorporate phosphorus loads

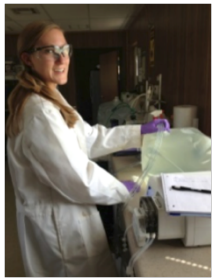




Acknowledgements

Paula Mouser

Mary Evert



OSU Environmental Biotechnology Laborartory

Sea Grant

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Questions?