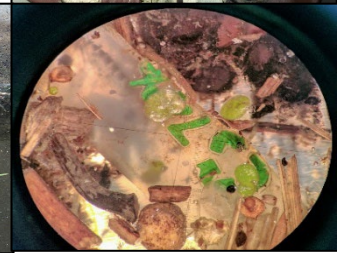
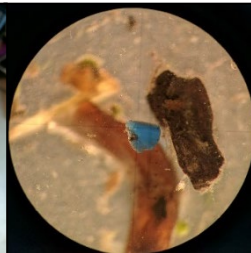




Terrestrial-aquatic connections: Plastic distribution, degradation, and impacts on macroinvertebrate communities

Rae M. McNeish and Amy K. Fetters
California State University, Bakersfield



**Massies Creek
Indian Mound Reserve, OH**





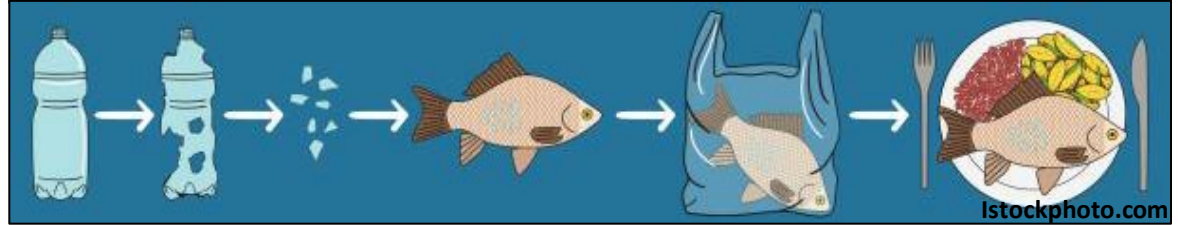




Accumulation & Persistence



Ingestion & infiltration into food webs

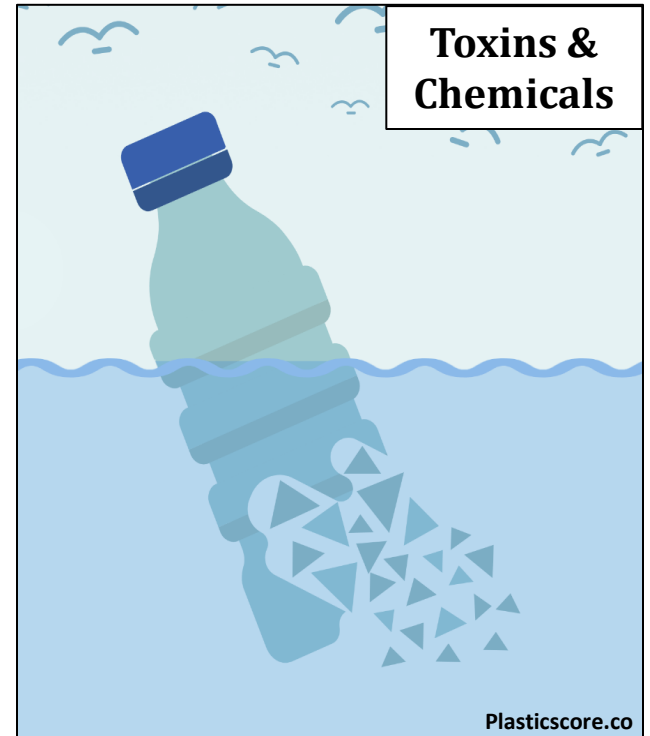


Consequences of AL & Microplastics

Entanglement & digestive blockage



Toxins & Chemicals



Plastic interacts with multiple levels of ecology

Plastic - Microbes



Zettler et al. 2013



McCormick et al. 2014
McCormick et al. 2016
Hoellein et al. 2017

Plastic - Terrestrial Biota



Blight & Burger 1997; Moser & Lee 1992

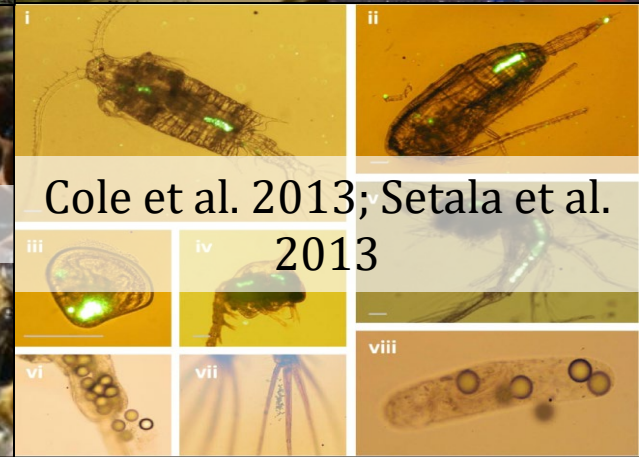


MacIvor & Moore 2013

Plastic - Aquatic Biota

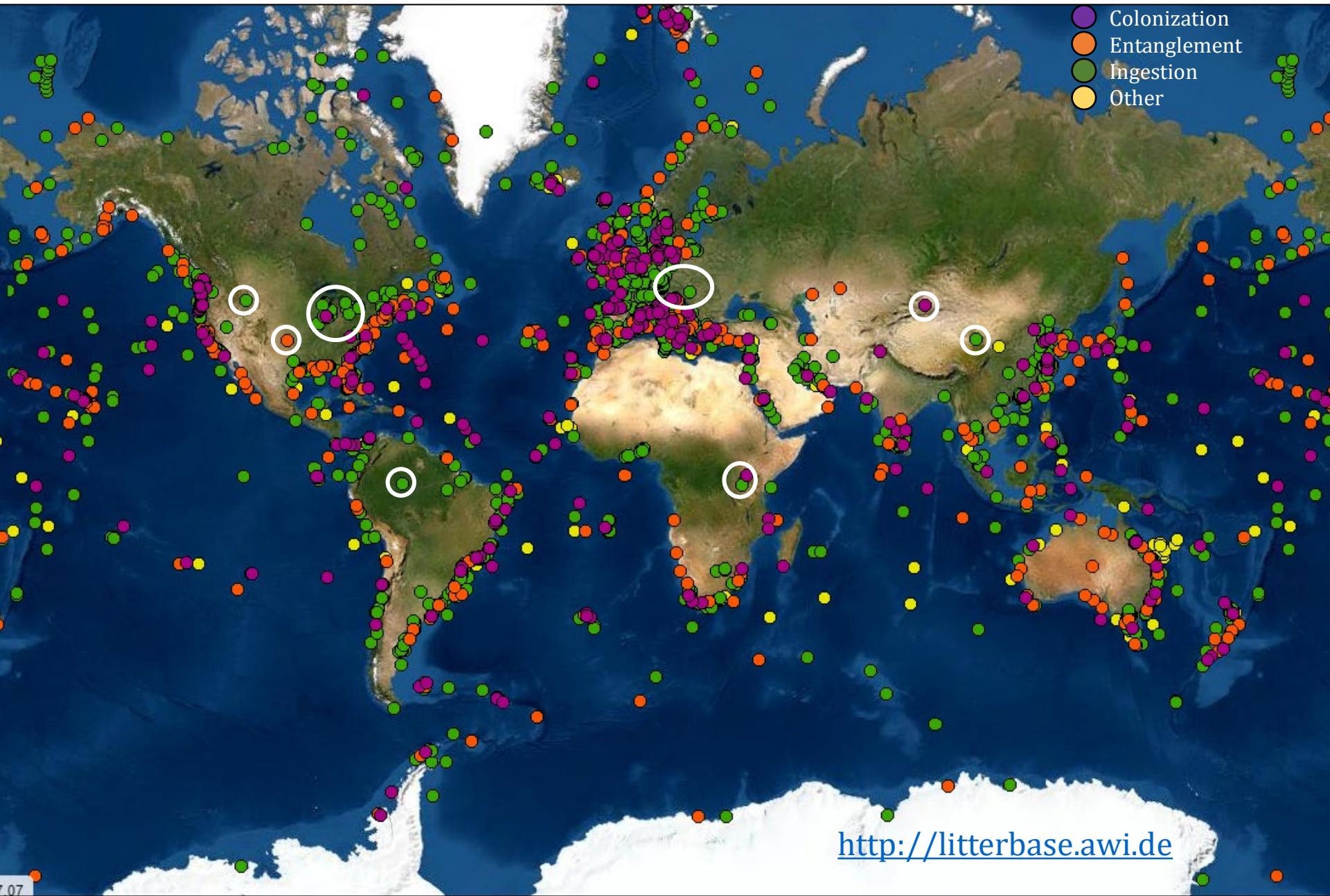


Moos et al. 2012; Miranda & Carvalho-Souza 2016

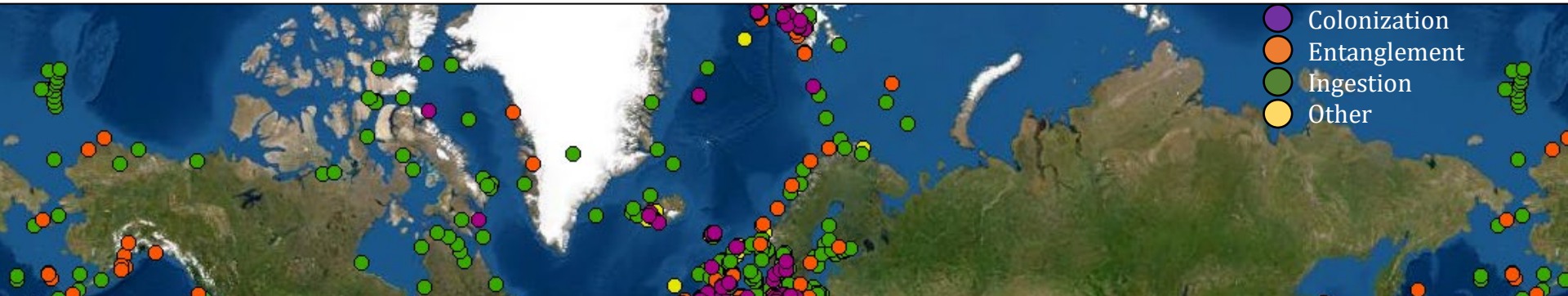


Cole et al. 2013; Setälä et al. 2013

Research Knowledge Gaps



Research Knowledge Gaps



Study anthropogenic litter similar to any material that is part of the environment

Collaborations!

<http://litterbase.awi.de>



**Anthropogenic
Activities**



**Landscape
Features**



**Environmental
Conditions**



**Organismal
Interactions**



**Kern River
Bakersfield, CA USA**



Debris Dams

- Ecologically important in freshwater
 - Retain organic matter
 - Serve as habitat
- Typically made of organic debris
- Now made of organic AND anthropogenic materials



**Water
Flow**

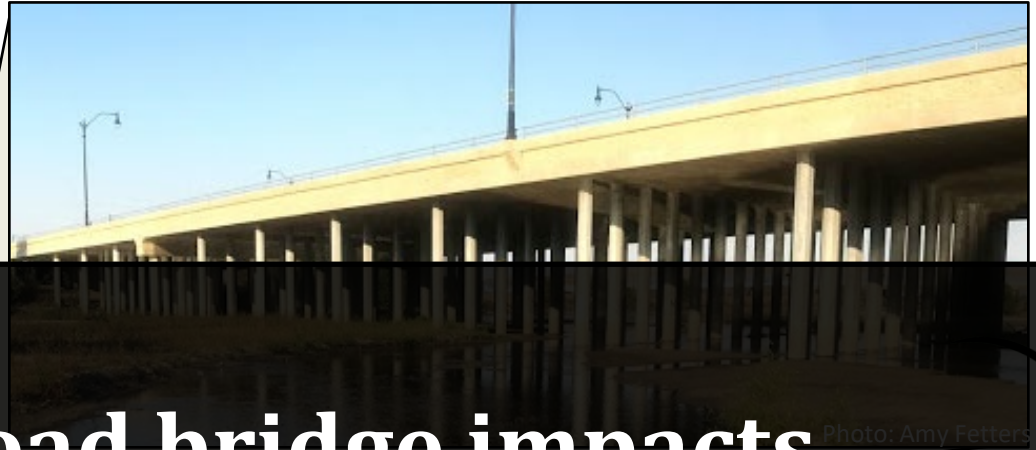


Photo: Amy Fetters

How do road bridge impacts anthropogenic litter distribution and 'community' composition in rivers?

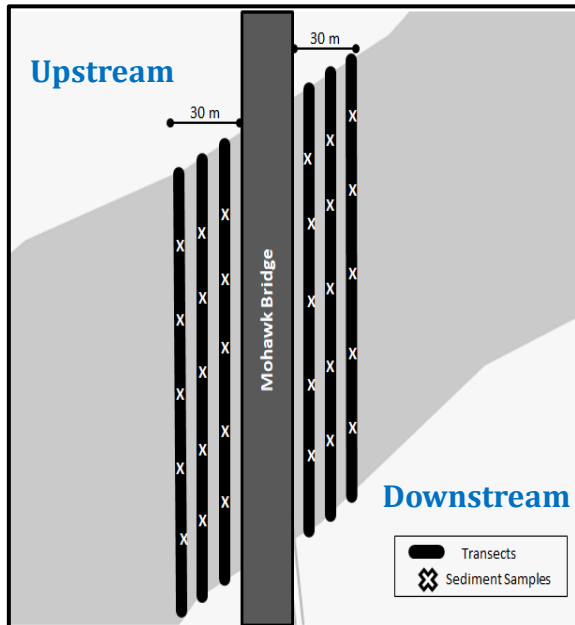


Photo: Amy Fetters

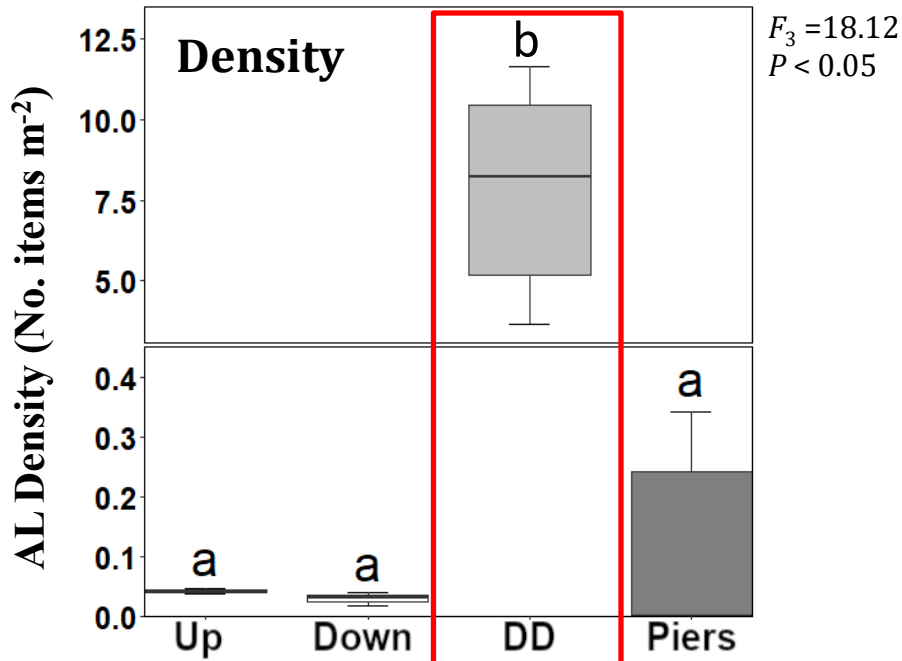
How do road bridges impact anthropogenic litter distribution & 'community' composition in rivers?



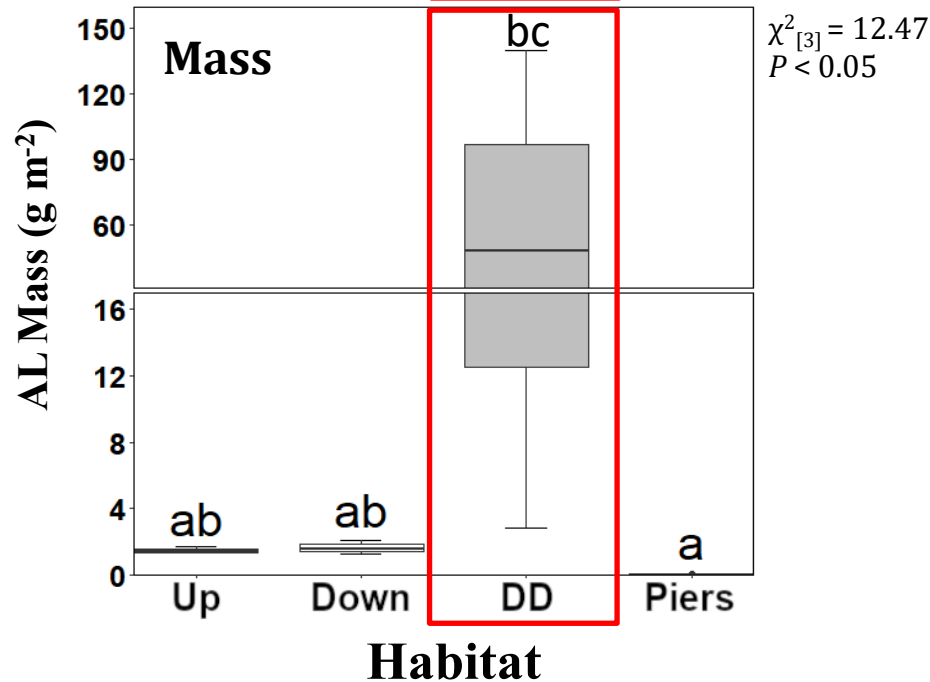
Cleaned
↓
Air dried
↓
Categorized
↓
Measured



Amy Feters
M. S. Student



Debris dams had a higher AL density than other habitats



Debris dams contained a high abundance of small/lightweight items

Aquatic vegetation can serve as accumulation zones for AL in rivers



Habitat complexity

Honingh et al. 2020

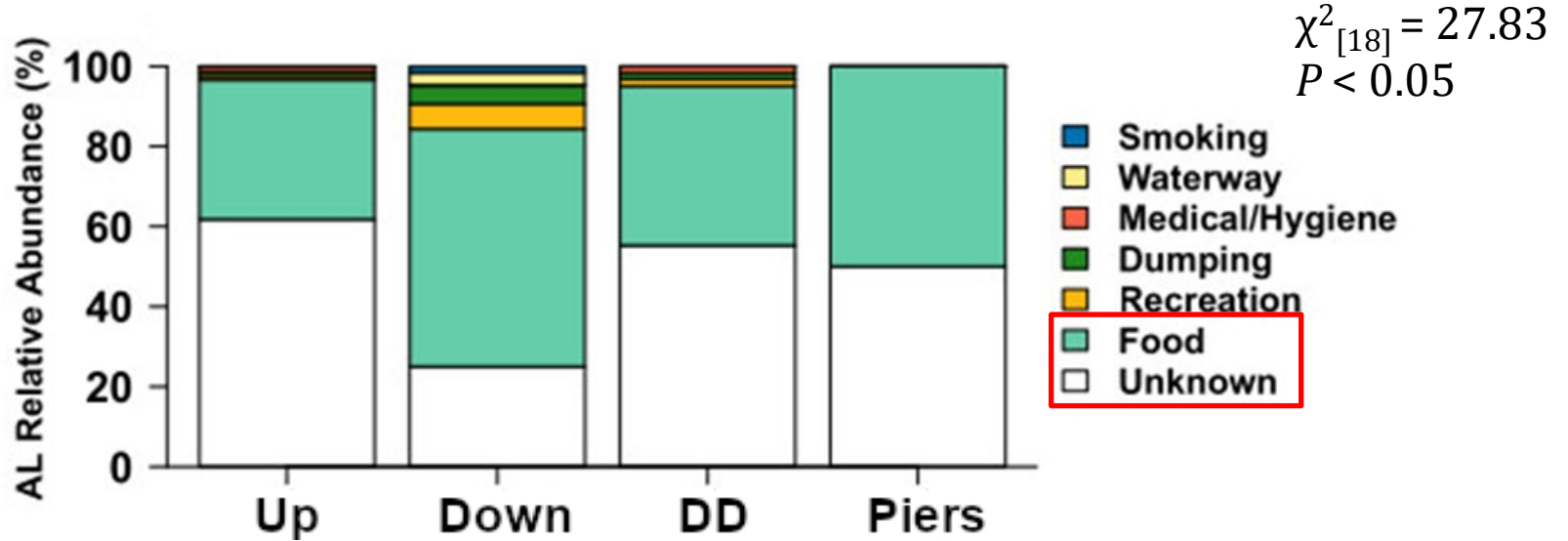
Lebreton et al. 2017

Tasseron et al. 2020



AL Relative Abundance - Functional Categories

Total AL



Plastic only AL



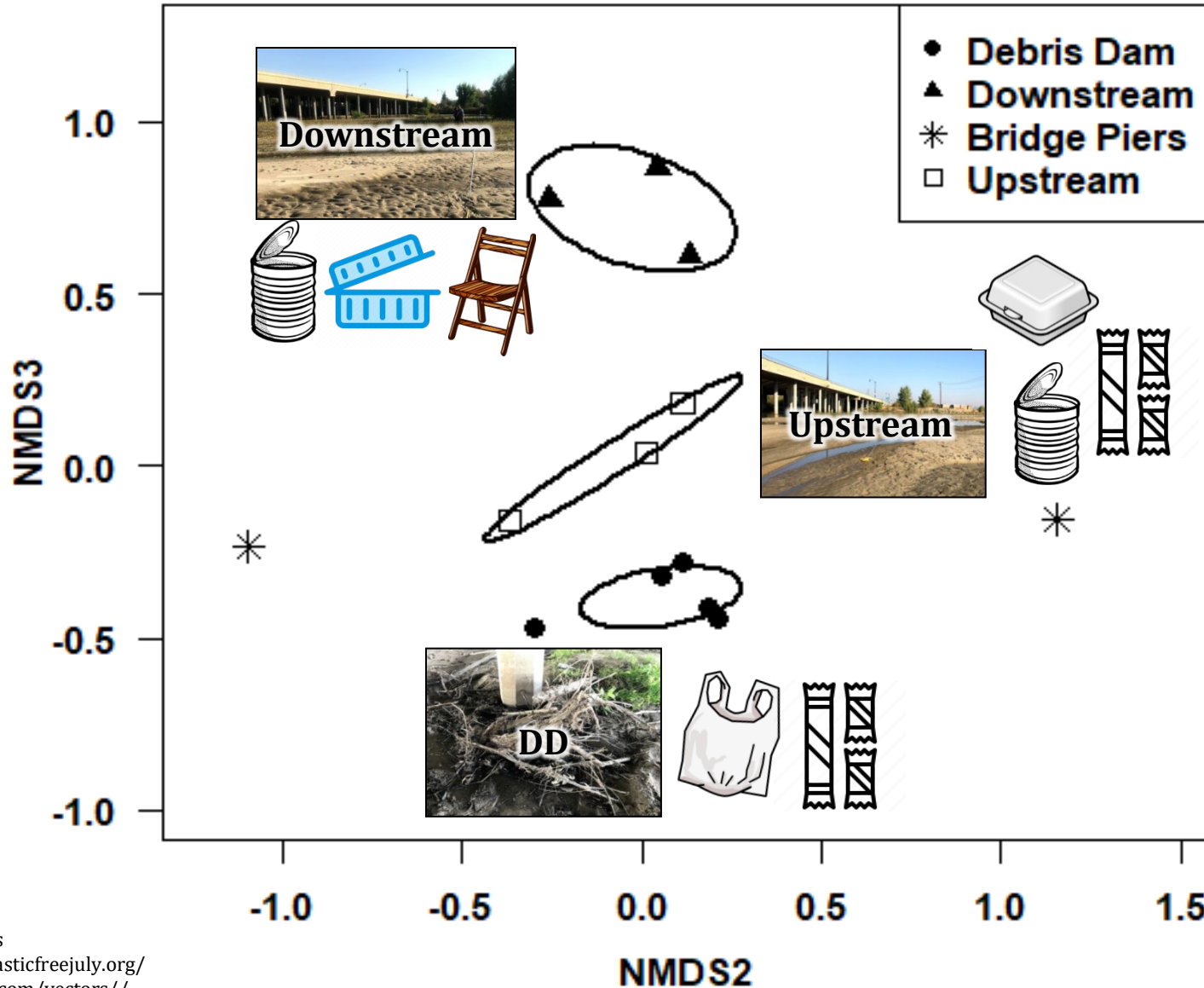
AL 'Community' Dynamics

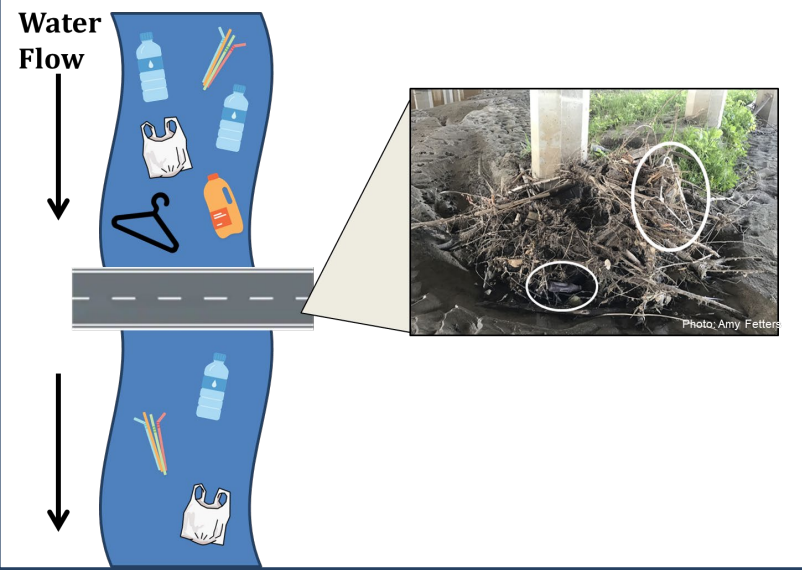
Stress = 0.042

$F = 2.78$

$df = 3$

$P < 0.001$

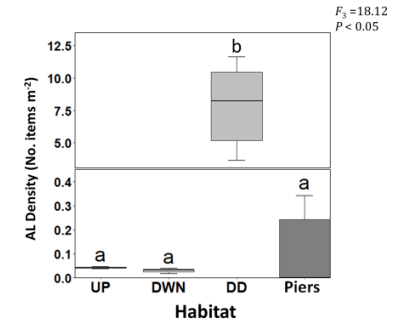
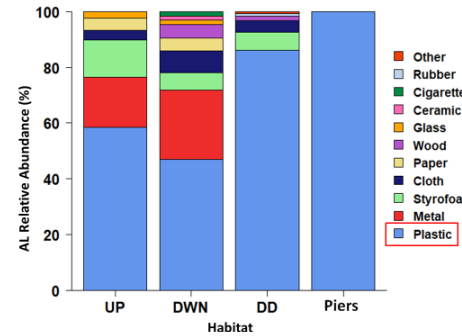




Bridges and Debris Dams Alter AL in Rivers

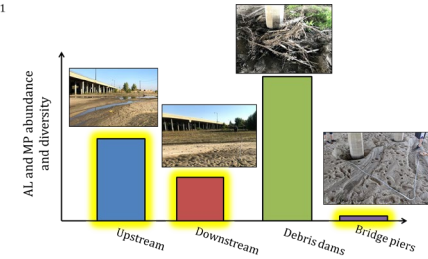
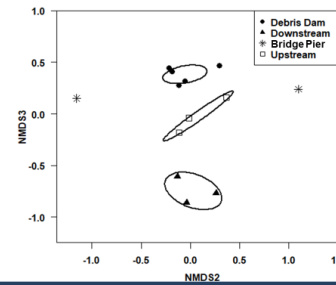
AL relative abundance - material type

$\chi^2_{(10)} = 68.6$
 $p < 0.05$



NMDS Results - AL

$P < 0.001$



Fetters *et al.* (In Prep)

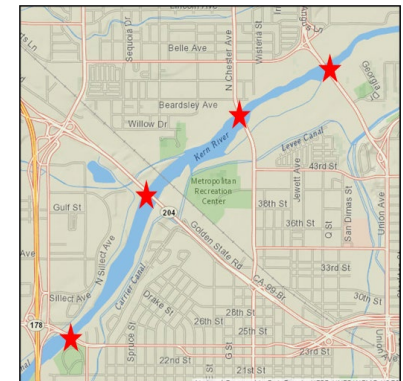
Anthropogenic Litter Management



Biotic Communities?

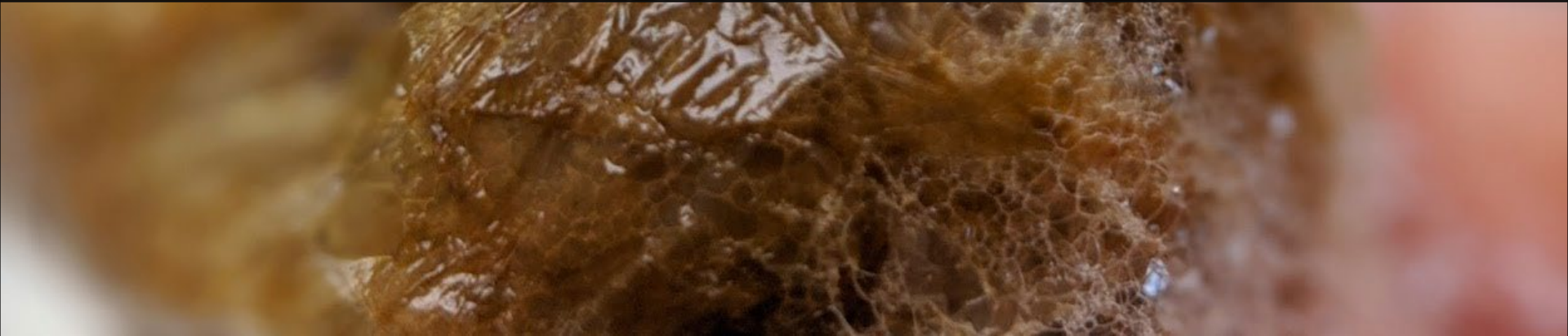


Spatial Patterns?

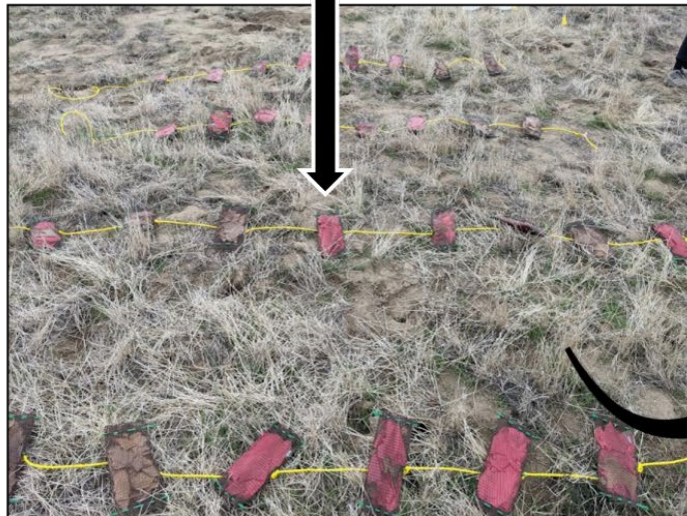
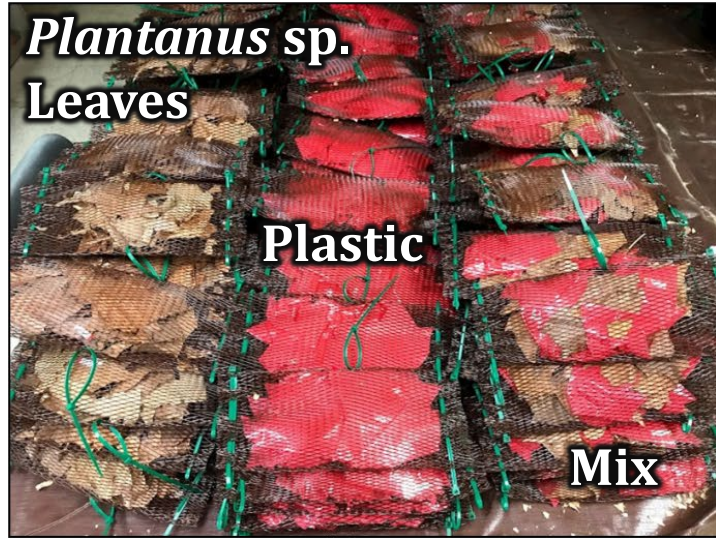


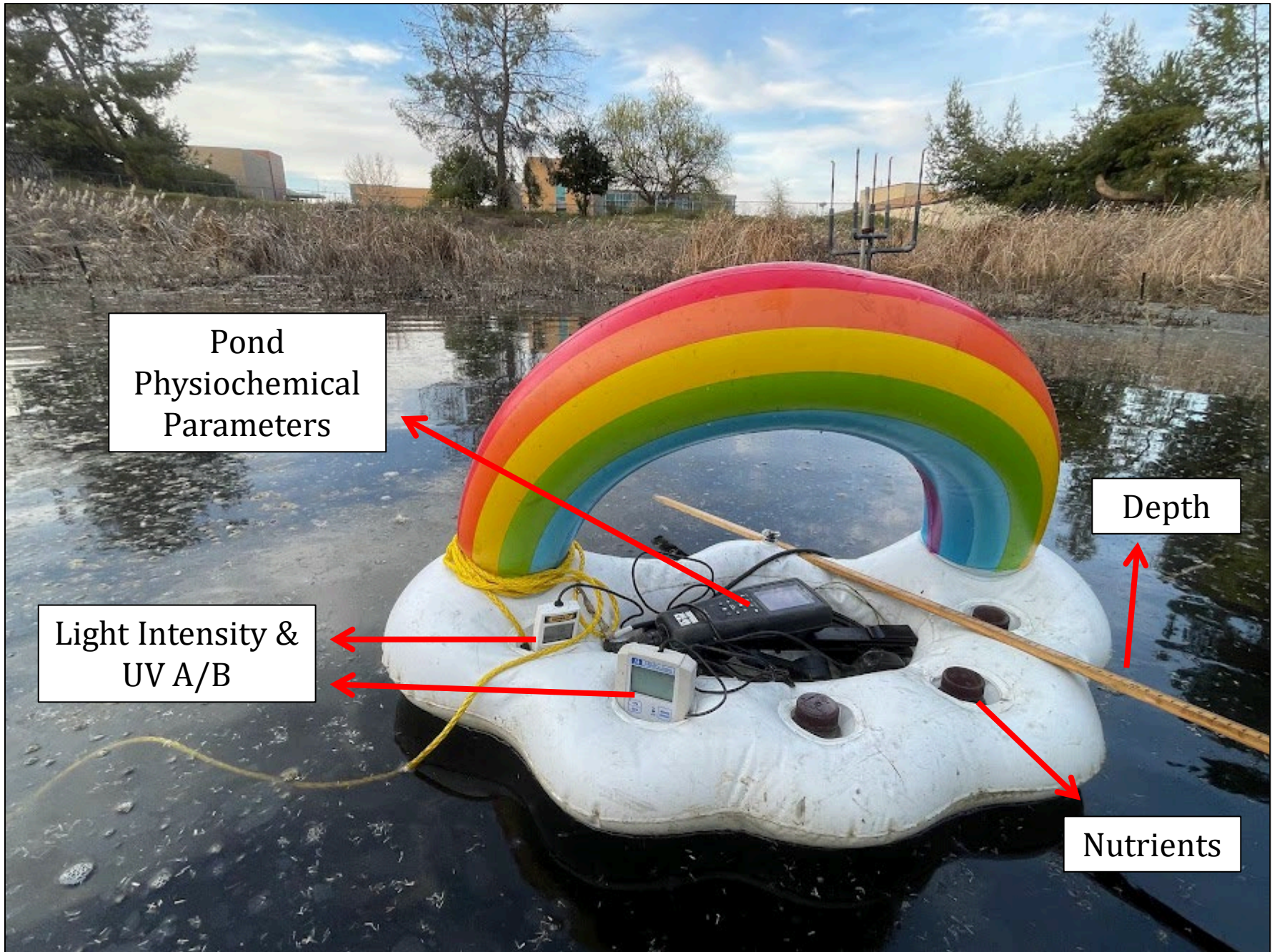


How do environmental conditions
impact AL degradation and
colonizing macroinvertebrate
communities?



How does anthropogenic litter affect ecosystem process and macroinvertebrate communities?





Pond
Physiochemical
Parameters

Light Intensity &
UV A/B

Depth

Nutrients

Observations: 8 months

Pond

Grassland

Natural



Plastic



Observations: 12 months

Pond

Grassland

Natural

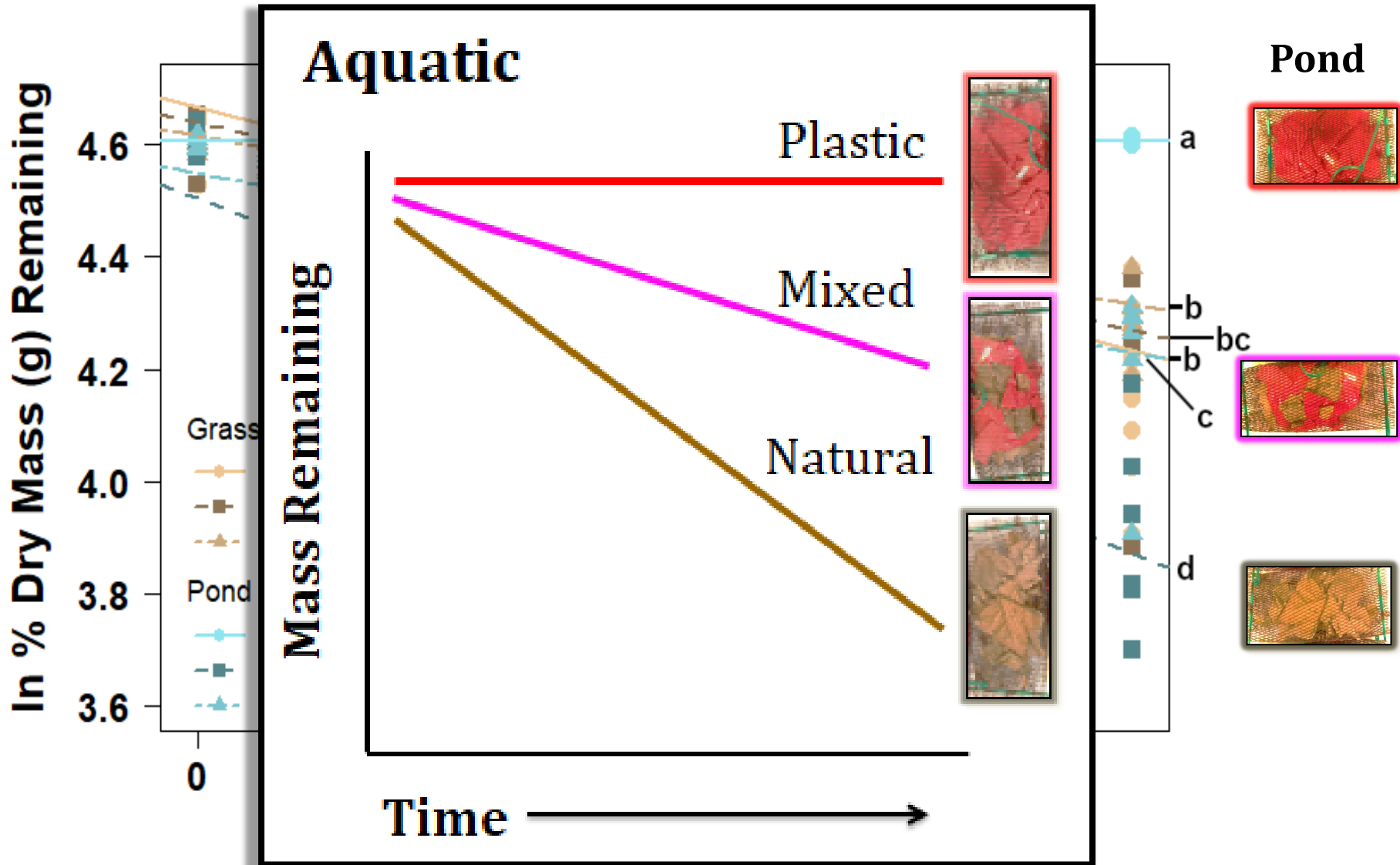


Plastic

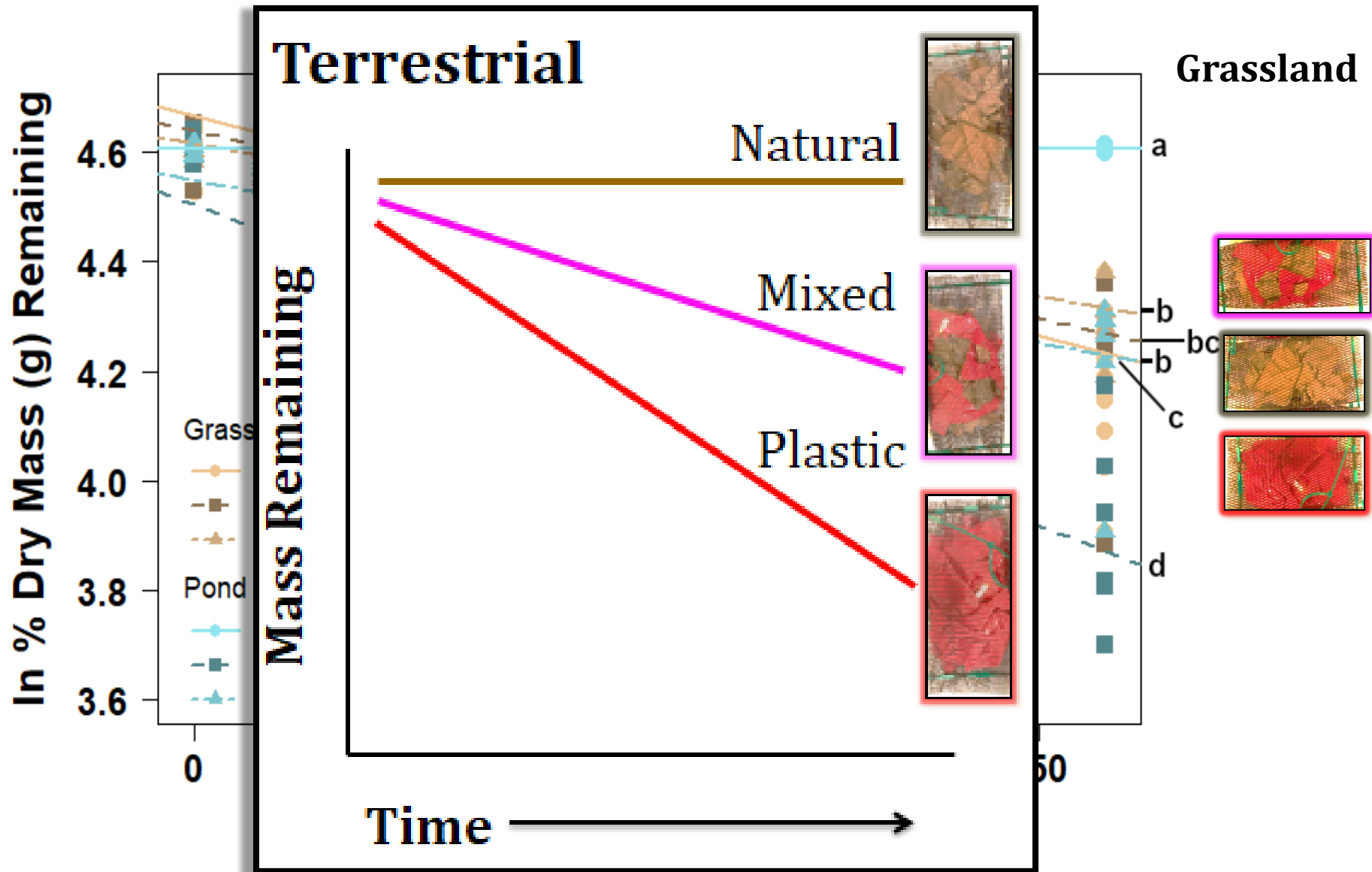


Microplastics released from leaf packs were cleaned up after the experiment ended!

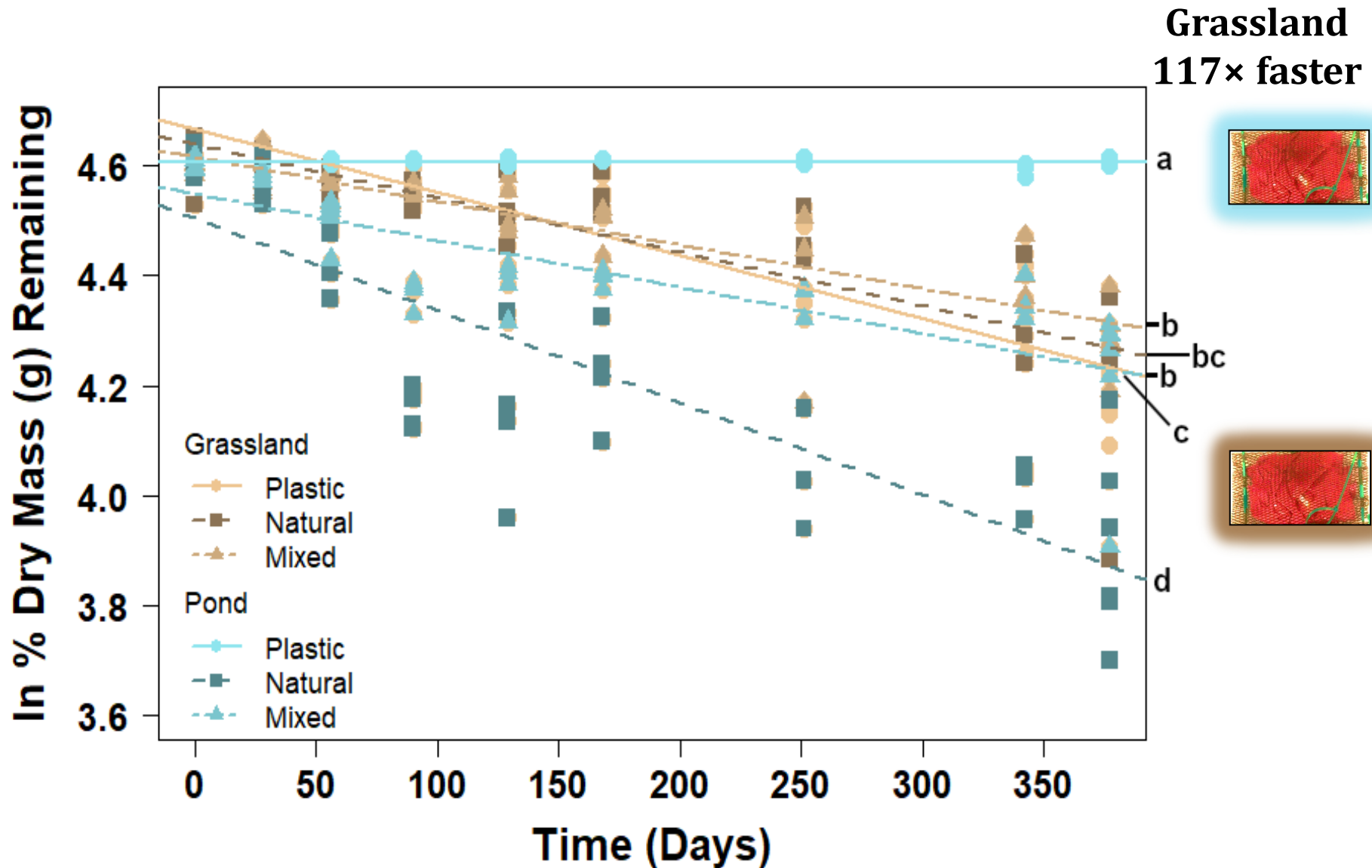
How do environmental conditions impact plastic degradation compared to natural leaves?



How do environmental conditions impact plastic degradation compared to natural leaves?

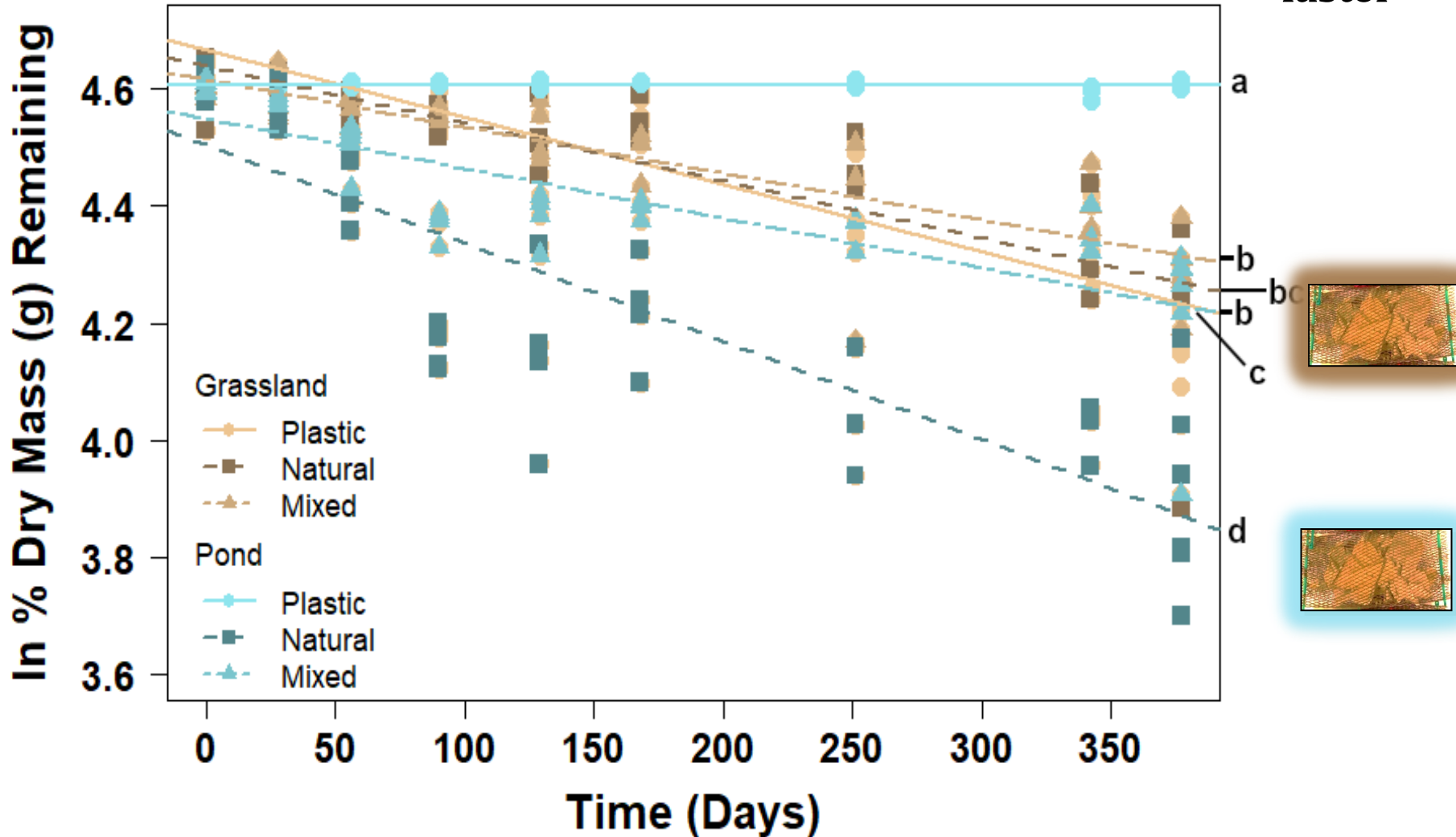


How do environmental conditions impact plastic degradation compared to natural leaves?

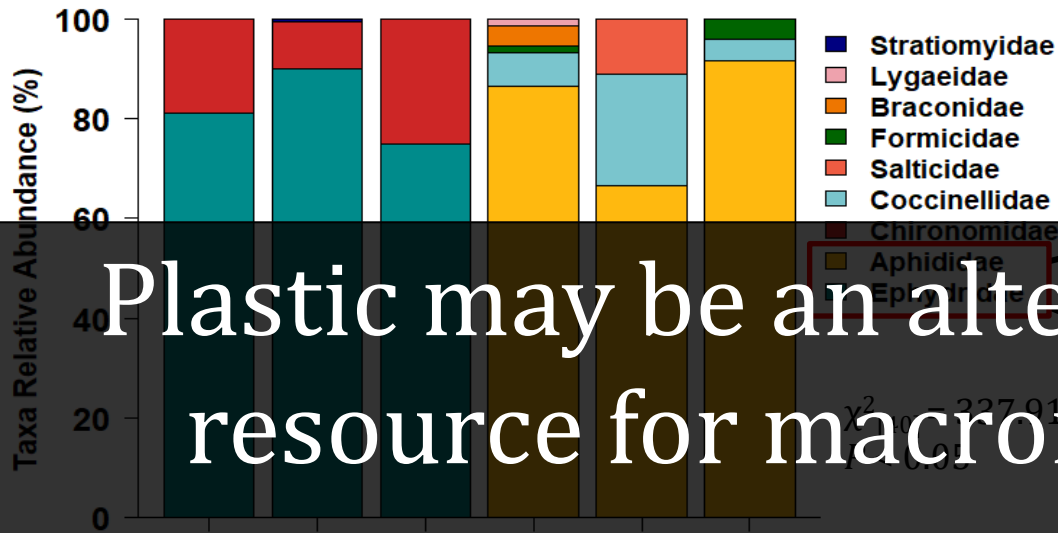


How do environmental conditions impact plastic degradation compared to natural leaves?

Pond 1.7x faster



Macroinvertebrate Families



Plastic may be an alternative habitat resource for macroinvertebrates

Macroinvertebrate



Wilson et al. 2020
Garcia-Vasquez et al. 2018

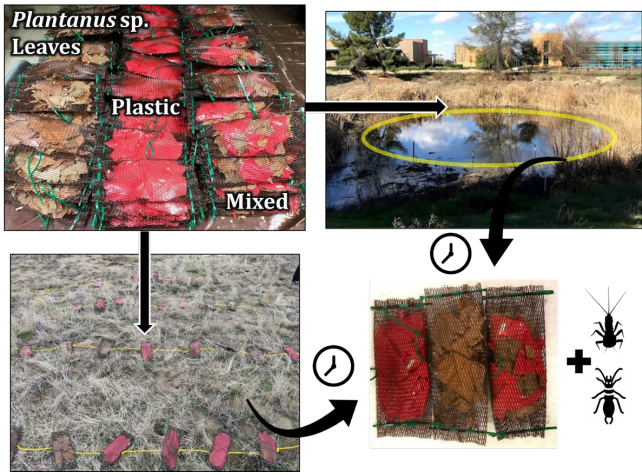
$P < 0.05$

and predators
in the grassland

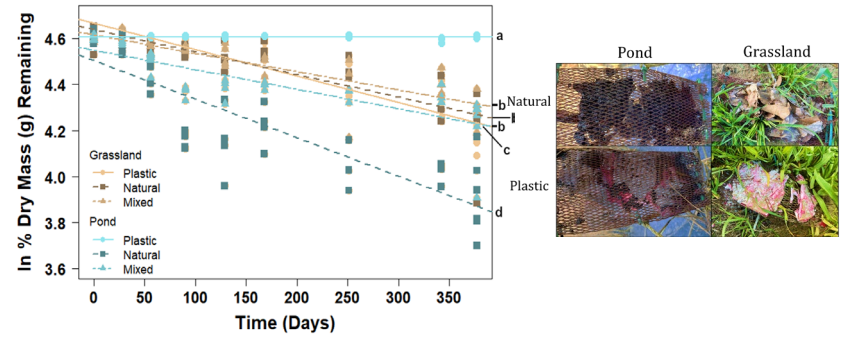
s dominated



Yum!



Plastic Degradation was Impacted by Environmental Conditions



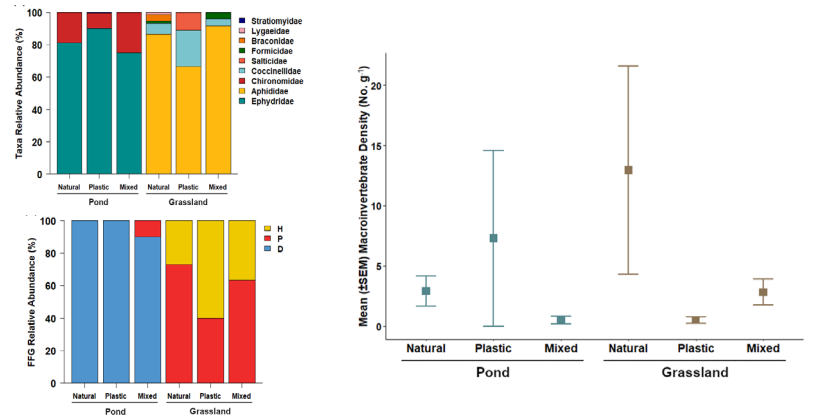
Plastic Habitats and Microplastic Pulses?



Yum!

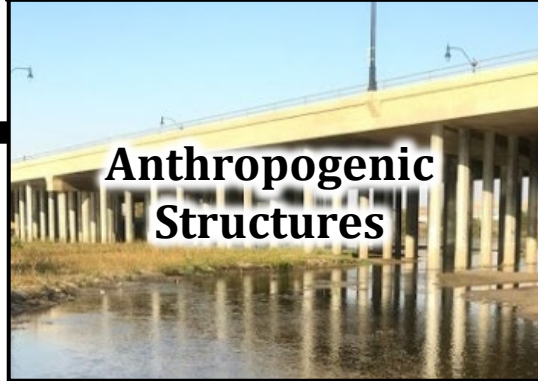


Potentially Unique Macroinvertebrate Communities



Fetters & McNeish. (In Prep)

Varying environmental conditions



Impact anthropogenic pollution dynamics



Fate of anthropogenic materials in the environment



Acknowledgments

McNeish Lab:



Pictured: Amy Fetters, Alyson Gil, Karina Perez, Dwight Ortiz



Cal State, Bakersfield

- Dr. Amber Stokes
- Dr. Paul Smith
- Dr. Bob Crewdson

Southern California Coastal Water

Research Project

- Dr. Charles Wong

Loyola University Chicago

- Dr. Tim Hoellein

Funding Resources:

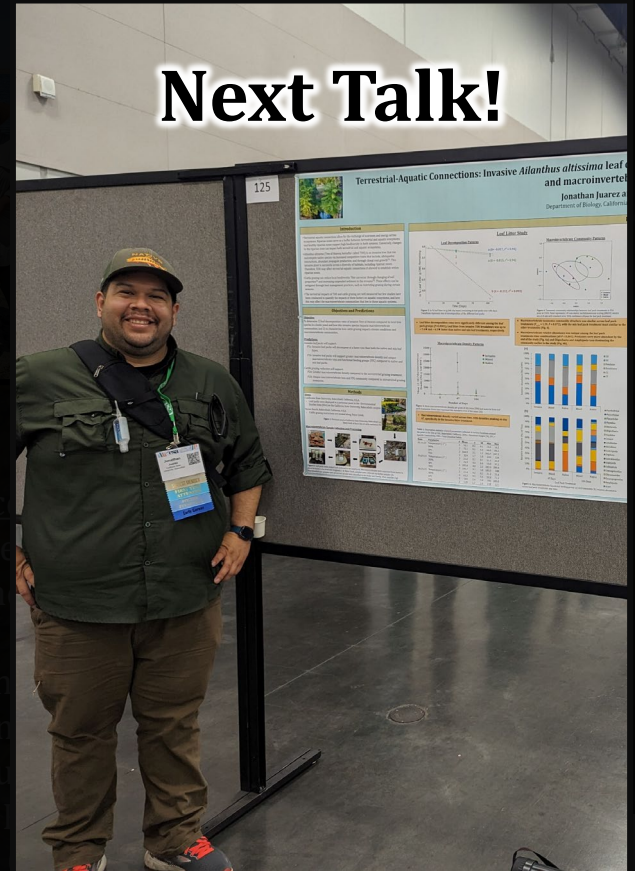
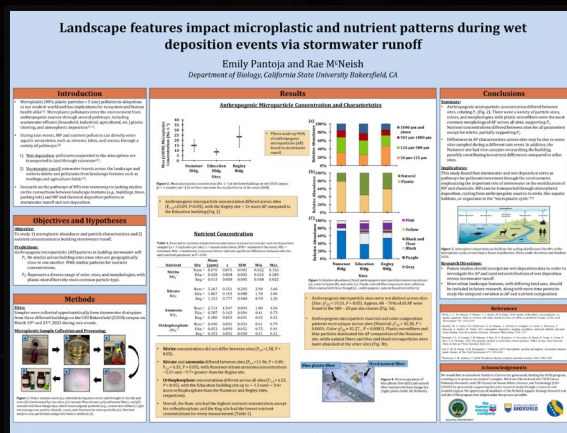
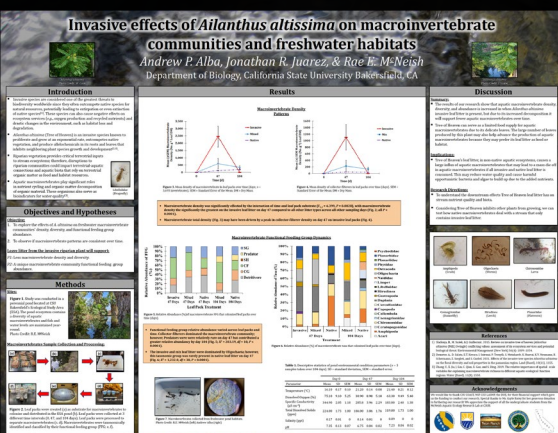
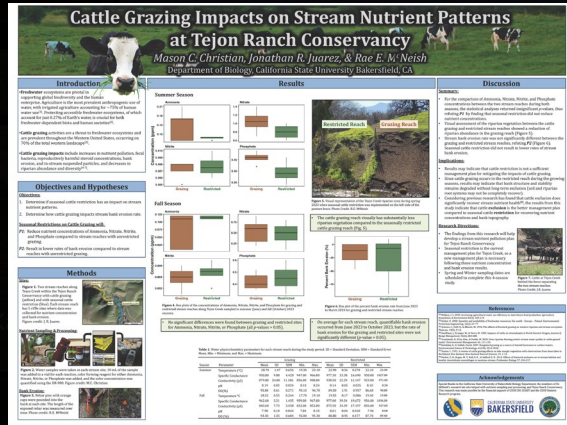
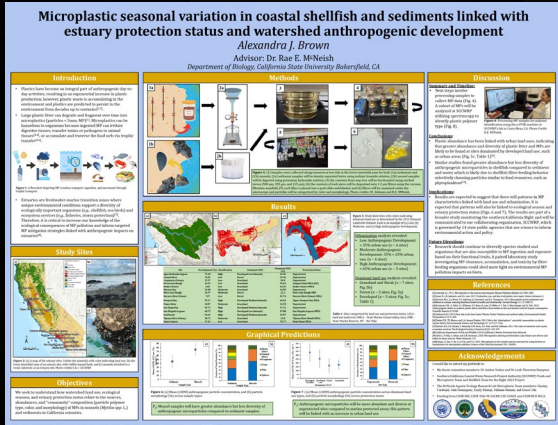
- California State University Bakersfield (CSUB) Natural Sciences, Mathematics, and Engineering startup funding
- CSUB Research, Scholarship, and Creative Activity
- CSU Council on Ocean Affairs, Science & Technology (COAST) Graduate Student Research Award
- CSUB Student Research Scholars Program
- NSF LSAMP at CSUB



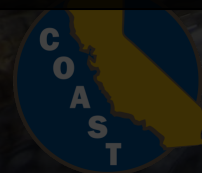


Acknowledgments

McNeish Lab Student Presentations



- Dr. Charles Wong
 Loyola University Chicago
- Dr. Tim Hoellen



Thank You!



Questions?



Comments?



rmcneish@csu.edu