

# Microplastics in Urban Waters: Sources to Lake Ontario

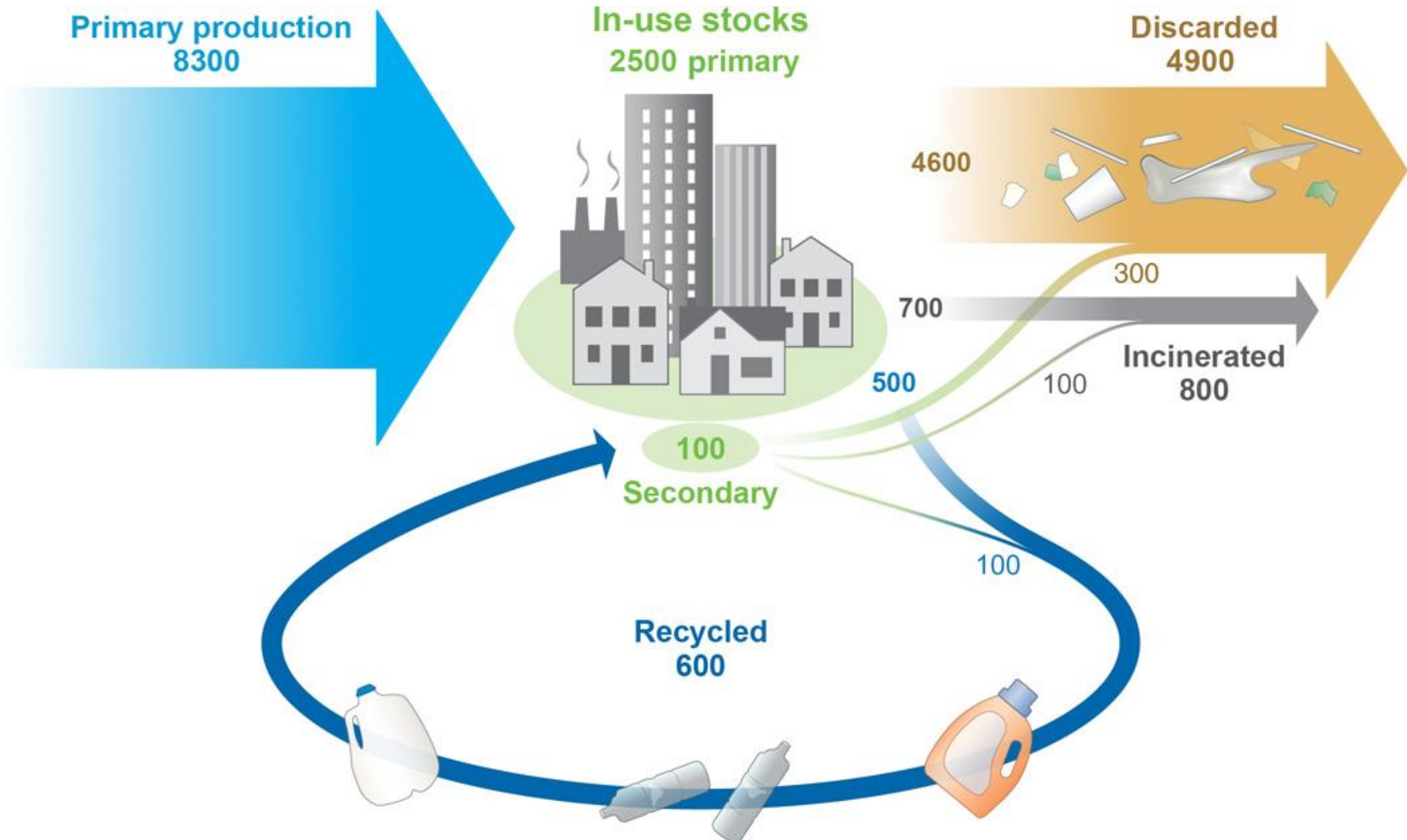
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# Plastic flows into and out of the Urban Areas



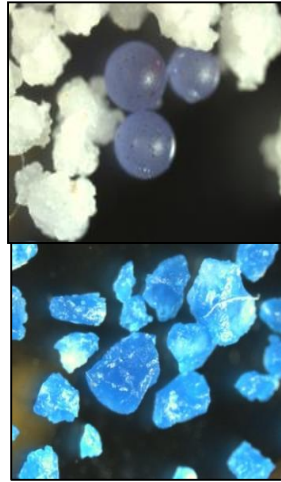
# Microplastics – plastic particles <5 mm in size

**Primary:** manufactured, direct release (pellets, microbeads)

**Secondary:** wear, fragmentation (debris, fabrics, tires)

## **Sources:**

- beads in care products
- Polymer production pellets
- fibers (clothing), line, rope
- degraded debris / litter
- food packaging, insulation
- tire dust/wear; road paints
- film, bags, sheeting

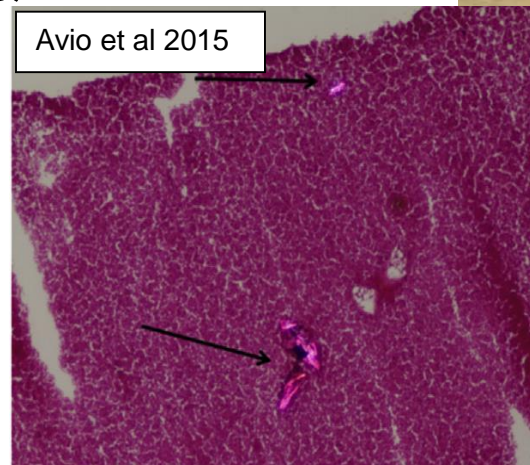


Pellets on Lake Ontario beach 2013



# Microplastics are ingested by organisms, and can circulate through out

- **Ingestion by organisms**
  - Observed in hundreds of organisms all over the world
- **Translocation from the Gut Tract**
  - 4, 16  $\mu\text{m}$  in mussels (Browne 2008)
  - Up to 500  $\mu\text{m}$  in fish liver (Avio 2015)
  - 5, 20  $\mu\text{m}$  mice (Deng 2017)
- **Vector for pathogens & contaminants**
  - Microbial communities
  - Sorption of contaminants
  - Leaching of additives



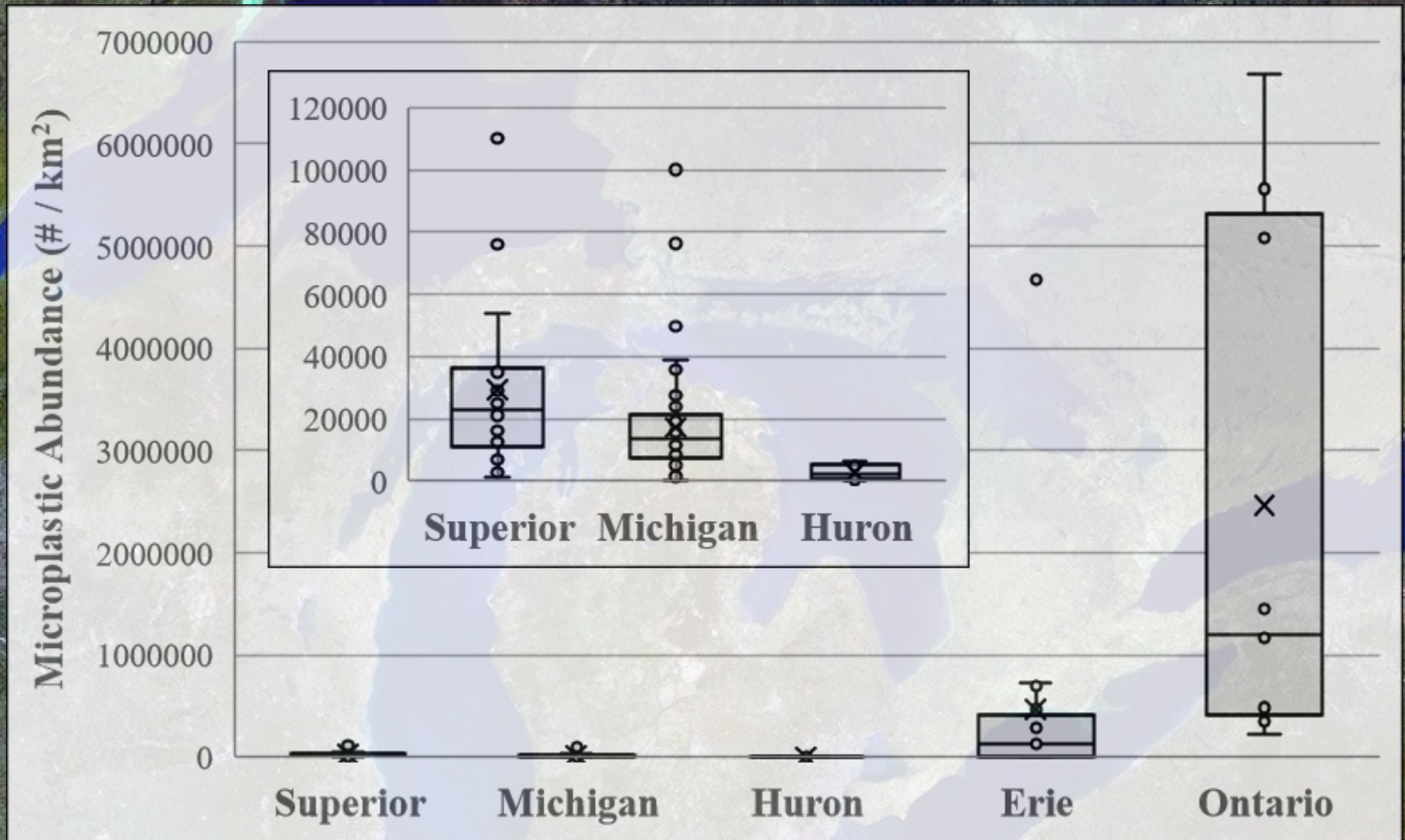
# Macroplastics (marine debris) can have devastating impacts on individual organisms

- Ingestion and Entanglement
- Well-documented impacts of plastics debris on individuals
- Ecological Impacts?
  - Effects on population?



## Microplastic Impacts

- Nutrition / nutrient use
- Feeding behavior
- Metabolic indicators  
(Oxidative stress, hormones, lipids)



# Questions for Assessing & Managing Microplastics

- 1) What, how much microplastics are in our waters?
- 2) Where are the microplastics coming from?
- 3) What harm do microplastics cause?
- 4) How can we reduce microplastics in the environment?



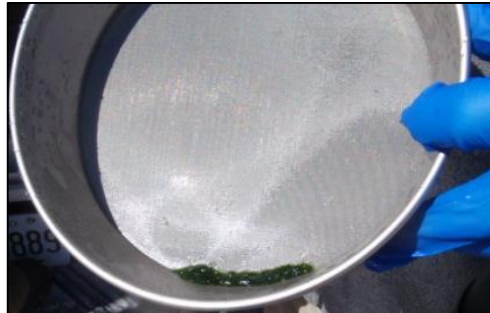
- **Microbeads** a first step; variety of sources will mean a broad range of solutions to address **microplastics**

# Sampling for Microplastics

## Collection:

Water – Plankton Nets (335; 363 $\mu$ m),  
Sieves, Filtration

Sediment – Bulk Collections





# Microplastics Project Examples

- Microbeads in Wastewater
- Lake Ontario receiving waters
- Sediment & Fish
- Watershed Outreach

# Current categorization of microplastic is broad, inconsistent

## Typical Categories

- Fragment
- Foam
- Fiber
- Film
- Pellets

Source specific?

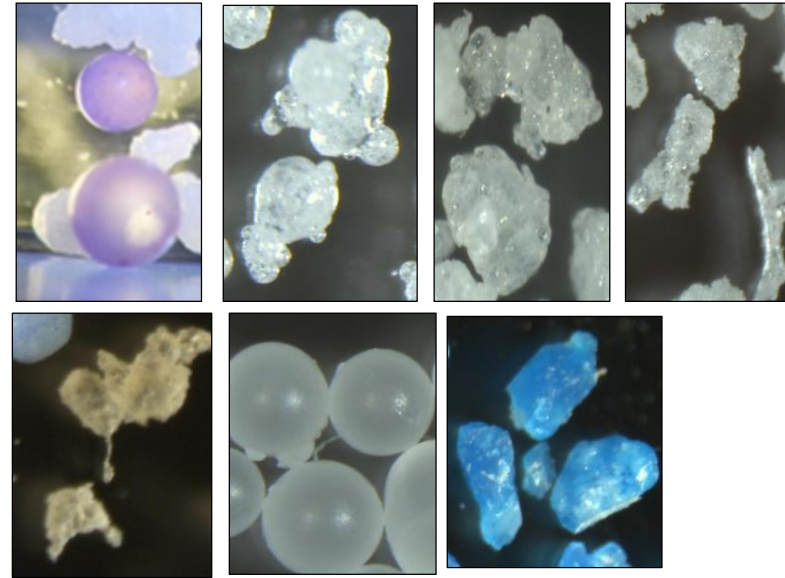
Guide management decisions?

## Alternative Categories

- Fragment
- Commercial Fragments
- Spherical Microbeads
- Irregular Microbeads
- Foam
- Fiber
- Film
- Pre-production Pellets

More source-specific ✓

Potential to guide management decisions ✓



## How to categorize microbeads?

- Irregular microbeads likely included as “Fragments”
- Spherical microbeads sometimes included as “Pellets” (along with pre-production pellets)

Analytical  
Methods

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Improving microplastics source apportionment:  
a role for microplastic morphology and taxonomy?

Paul A. Helm



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# Differing trends for irregularly-shaped and spherical microbeads can be explained by product formulations

## Exfoliating face wash products

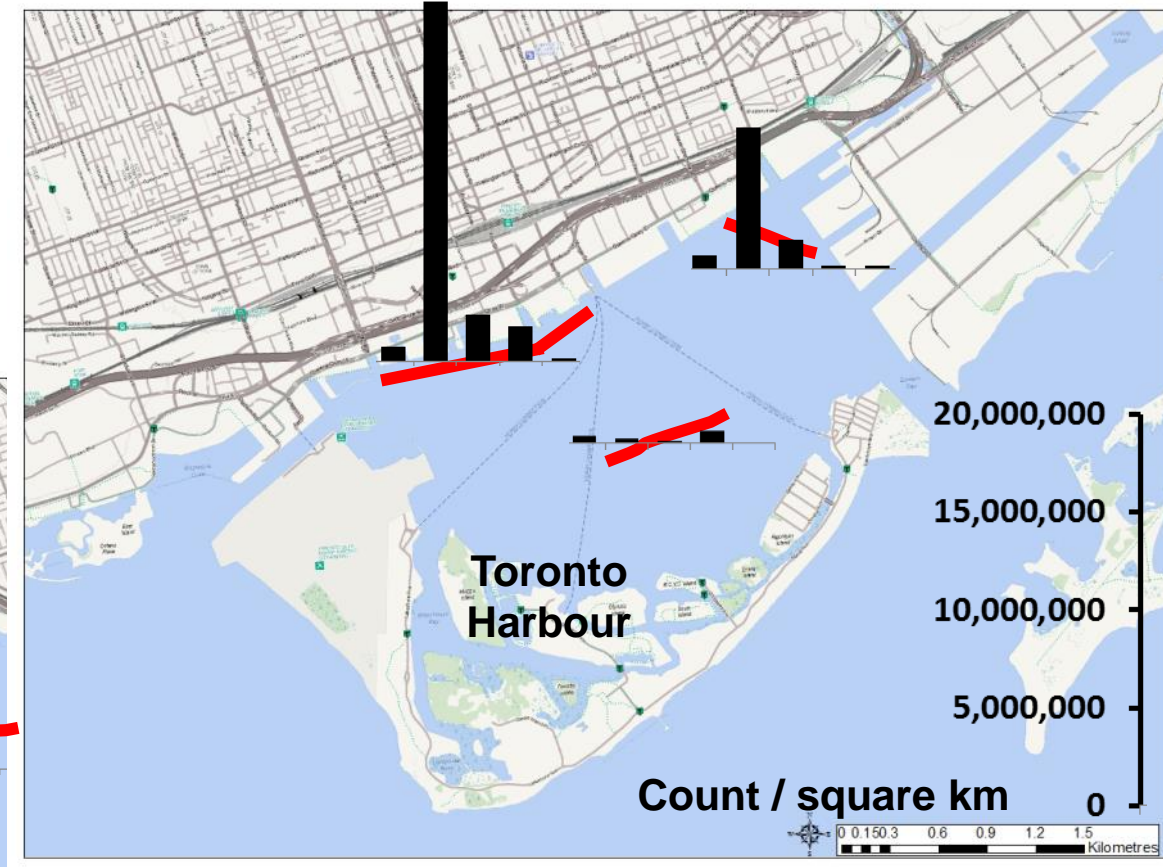
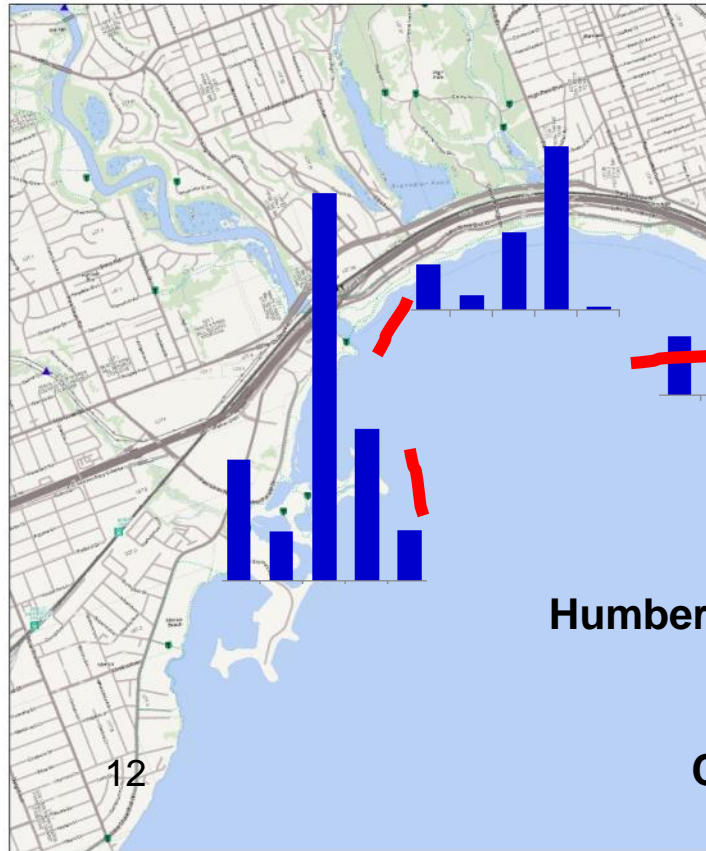
2015

**INGREDIENTS** : Water (eau), Methyl Gluceth-20, Sodium Laureth Sulfate, Lauryl Glucoside, Disodium Lauroamphodiacetate, Polyethylene, PEG-80 Sorbitan Laurate, Panthenol, Dimethicone PEG-8 Meadowfoamate, Polyquaternium-7, Sodium Benzotriazolyl Butylphenol Sulfonate, Menthol, Acrylates/C10-30 Alkyl Acrylate Crosspolymer, Disodium EDTA, DMDM Hydantoin, Sodium Hydroxide, Synthetic Wax, Citric Acid, Ultramarines, Blue 1, Parfum.

2018

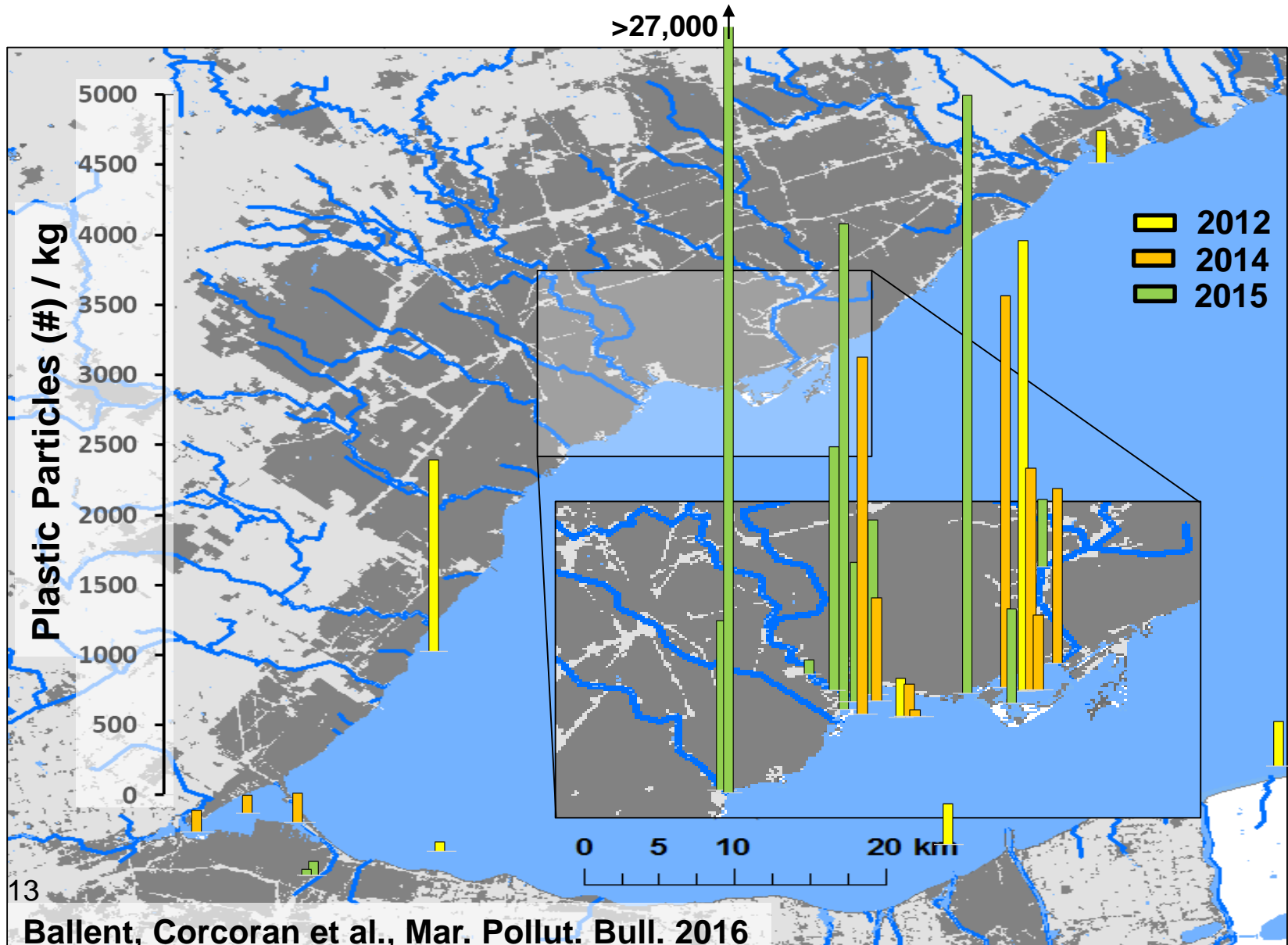
**INGREDIENTS** : Water (eau), Glycerin, Sodium Laureth Sulfate, Cellulose, Lauryl Glucoside, Acrylates/C10-30 Alkyl Acrylate Crosspolymer, Microcrystalline Cellulose, Phenoxyethanol, Parfum, Synthetic Wax, Methylparaben, Sodium Hydroxide, Menthol, Disodium EDTA, Polyquaternium-7, Sodium Benzotriazolyl Butylphenol Sulfonate, Ultramarines, Blue 1.

# Greatest abundances near points of input to Lake Ontario

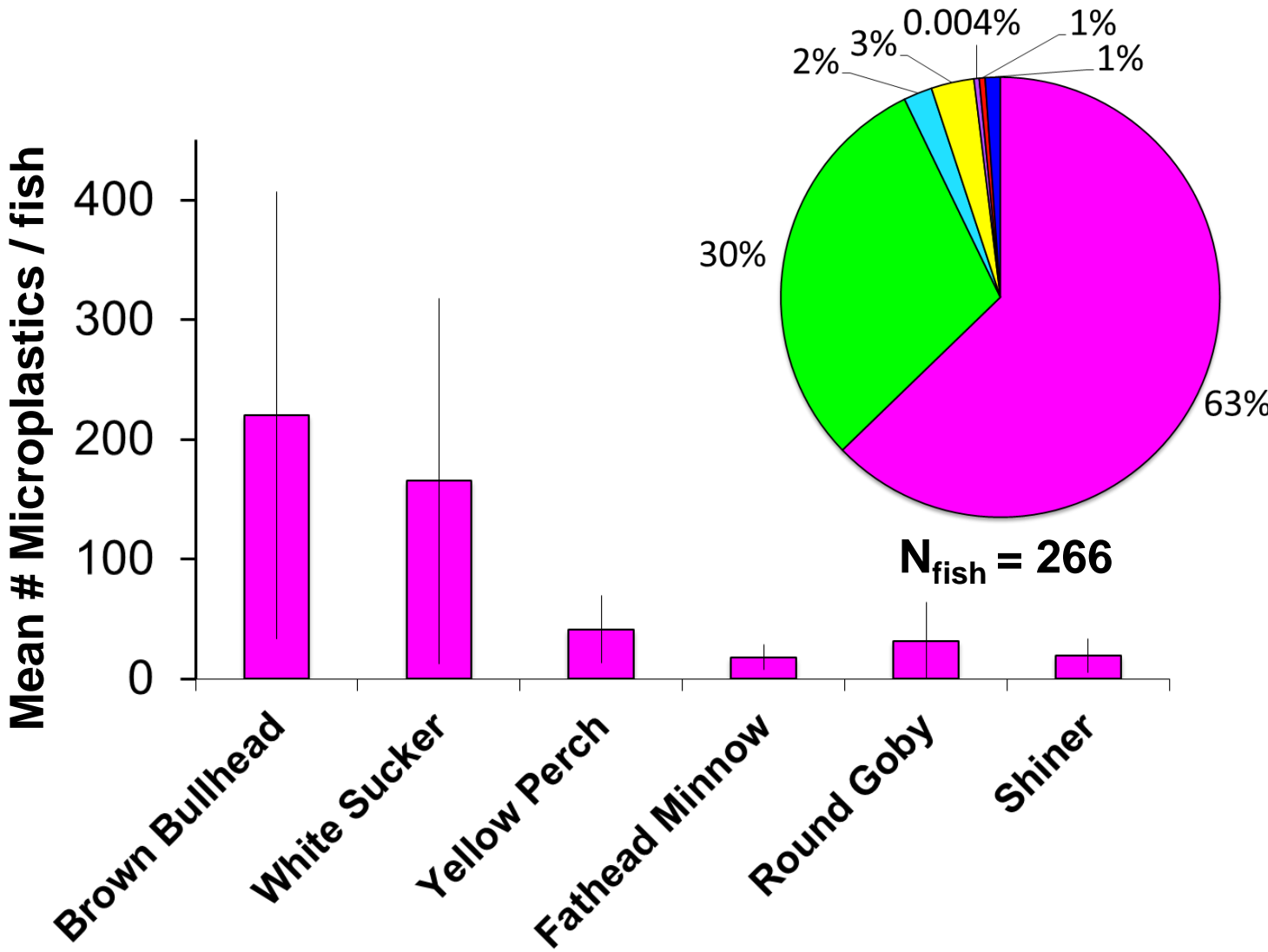


MECP Unpubl.

# Relatively high microplastic concentrations in bottom sediment near Toronto



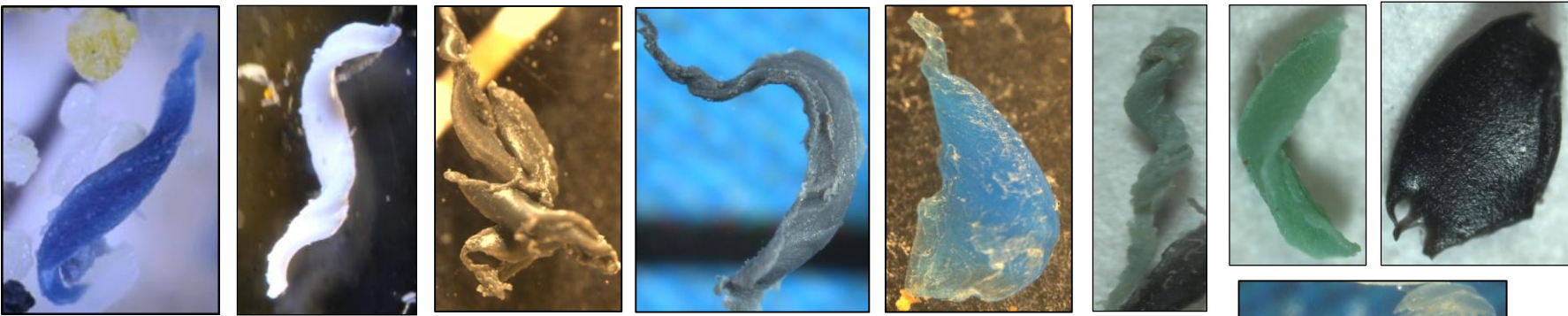
# Inputs of plastics to nearshore Lake Ontario evident in Toronto area fish



- Fibre
- Fragment
- Commercial Fragment
- Irregular
- Bead
- Bead
- Foam
- Film

**Keenan Munno**  
U of T; MECP

# Particles with character indicative of commercial activities regularly found



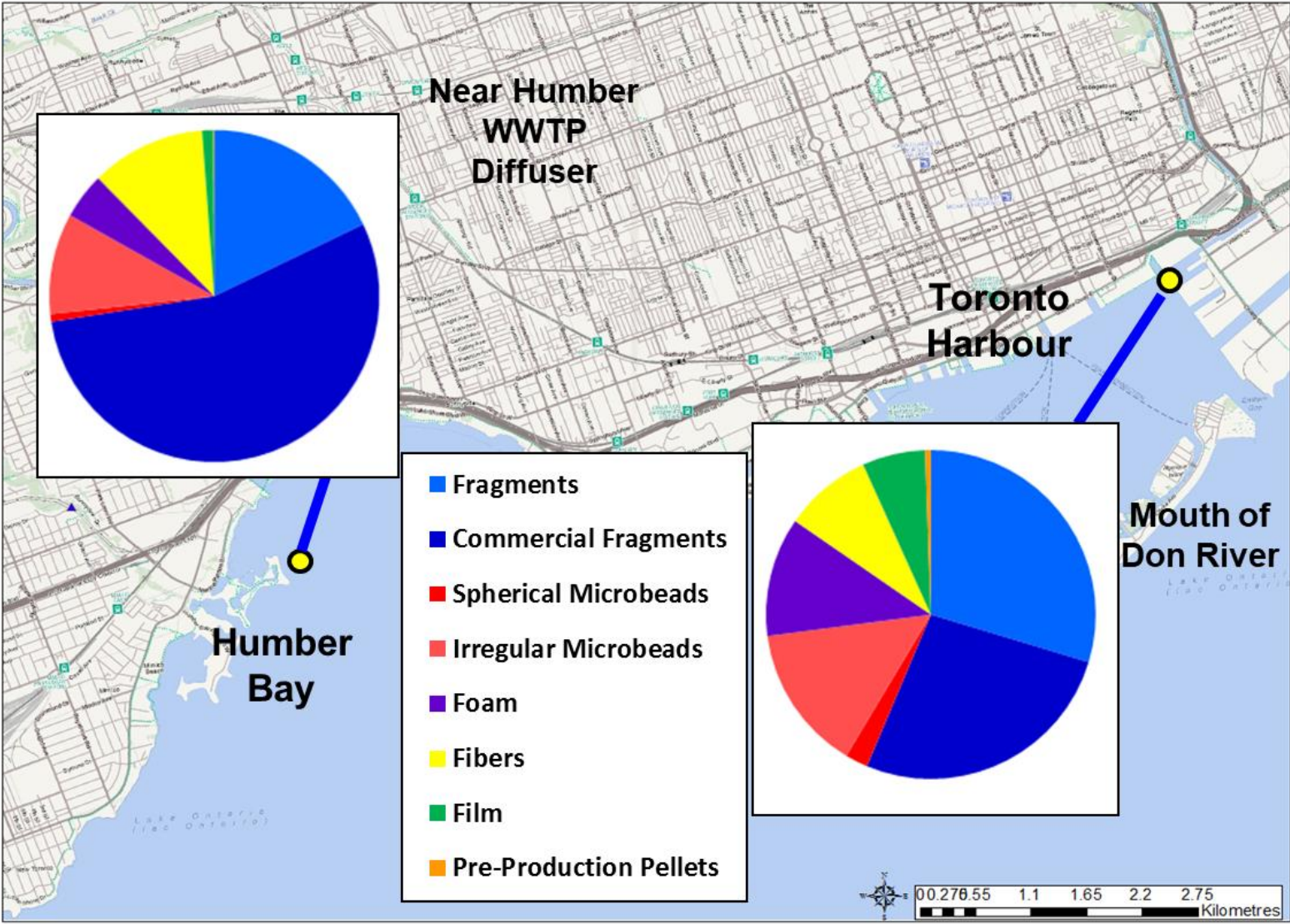
## Commercial Fragments:

Plastic product manufacture/recycling, building material cutting



## Fragments: Litter/debris-derived & “other” polymeric material

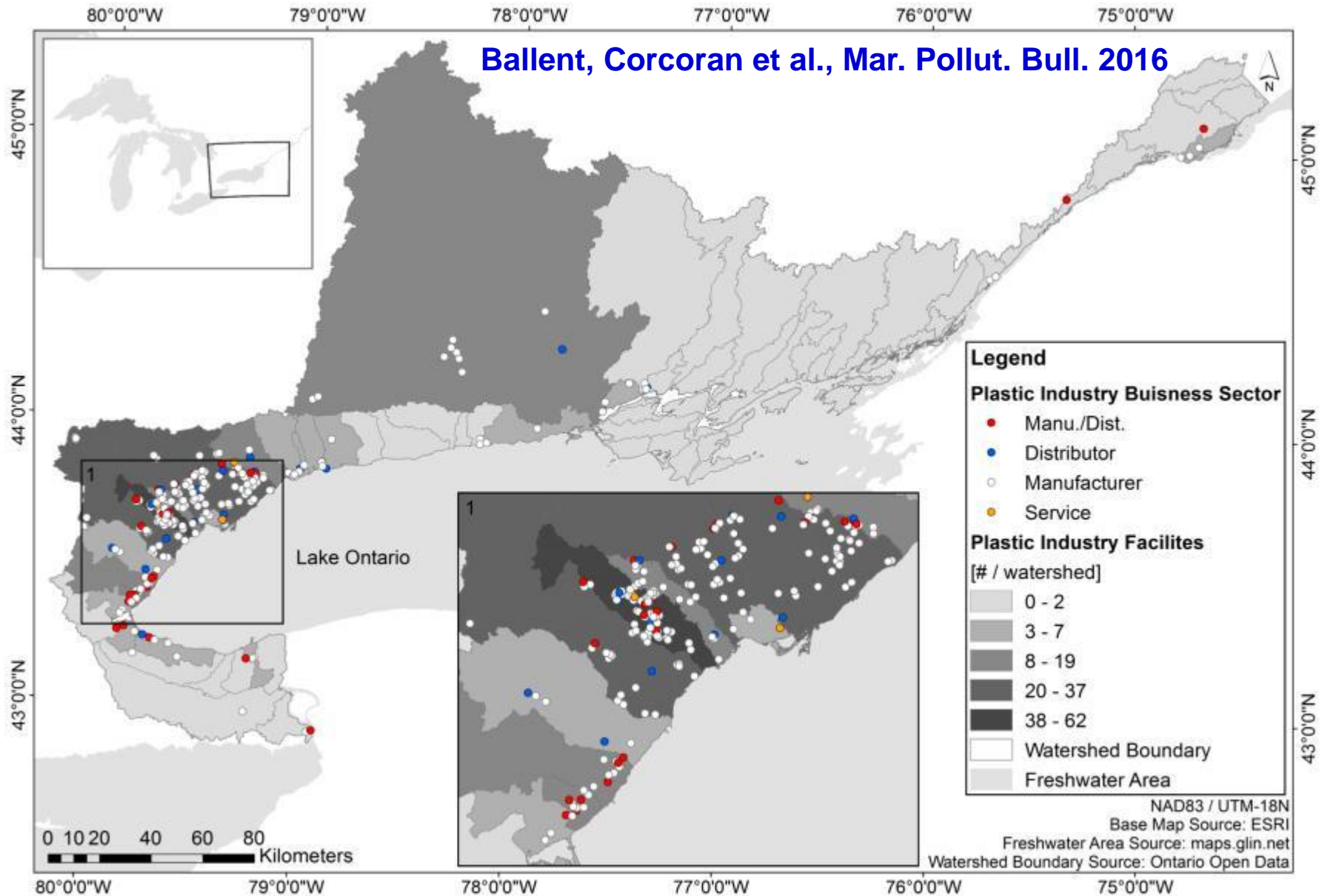
# Refined fragment category indicates commercial contributions





# Locations of plastics-based businesses align with abundance and particle type observations

Ballent, Corcoran et al., Mar. Pollut. Bull. 2016



# Acknowledgments



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