# Down by the Bay, where the Microplastics Flow:

# Sources and Sinks of Microplastics in Lake Ontario

### **Paul Helm**

**Ontario Ministry of the Environment and Climate Change** 

# **Microplastics in the Great Lakes**

- Pellets washing up on L. Huron beaches

   Since 2007, most years since
  - Raw material "nurdles"



Lake Huron Centre for Coastal Conservation, 2010

Water Air Soil Pollut (2011) 220:365-372 DOI 10.1007/s11270-011-0760-6 Shores of Lake Huron awash in plastic pellets PATRICK WHITE The Globe and Mail

Published Wednesday, Oct. 13 2010, 10:22 PM EDT

#### Distribution and Degradation of Fresh Water Plastic Particles Along the Beaches of Lake Huron, Canada

Maciej Zbyszewski · Patricia L. Corcoran

## **Microplastics in Great Lakes Waters**

# Surface water sampling in Lakes Superior, Huron, Erie (2012)

Eriksen, Mason et al. 2013 Mar. Pollut. Bull.





# **Questions for Managing Microplastics**

- 1) What and how much microplastics are in our waters?
- 2) Where are the microplastics coming from?
  - Specific sources; pathways
- 3) What harm do the microplastics cause?
- 4) What can be done to reduce the presence of microplastics in the environment?
  - <u>Microbeads</u> a first step; variety of sources will mean a broad range of solutions to address <u>microplastics</u>
  - Can we track reductions? Can we fingerprint sources?



### **Sampling for Microplastics**



### **Sample Processing**

#### **Collection:**

Water – Plankton Nets (363µm), Sieves, Filtration

Sediment – Bulk Collections

### Processing (NOAA):

Sieve out larger pieces Digest using hydrogen peroxide Wash & sieve (<4.75 mm; <1 mm) Dry in oven







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### **Microscope and IR Analyses**

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#### **Analysis:**

Count, categorize under microscope Infrared analysis for polymer type



 Fragment, Microbead, Foam, Fiber, Film, Pre-production Pellet



### **Microplastics in Nearshore Waters**





### **2014 Great Lakes Nearshore Results**





# **Microplastic Categories**

### **Challenges Counting / Apportioning by Category**

#### Microbeads:

- spherical, multi-colour









**Broad Categories:** - beads / pellets represent different sources



- wide range sources of fragments (catch-all category)









# Fragment "Morphology" / "Taxonomy"



- Information in structure of fragments
  - Cuttings, shavings, trimmings
    (Curled, twisted, corrugated)
  - Melted plastic, droplets
    (Cooled, oozed with pressure)
  - Both indicative of industrial / commercial sources?

(Moldings, construction [plastic lumber, foam boards/stucco])

 Indicates potential stakeholders to engage with on best practices



### **2015 Microplastics Sampling**



### **2015 Microplastic Abundance**





### **2015 Microplastic Abundance**





### **2015 Microplastic Abundance**



Trawl tracks



### **Distributions - Source Specific Categories**





### **Microplastics in Nearshore Sediments**



### **Plastics Industry Sector - Locations**



### **Microplastics in L. Ontario Nearshore Fish**



### **Microplastics in WWTP Effluent**









### **Microplastics in WWTP Effluent**





## **Microplastic Profiles – WWTPs**



#### Fragments

- Commercial Fragments
- Spherical Microbeads
- Irregular Microbeads
- Foam
- Fibers
- Film
- Pre-Production Pellets

- Fibres, Microbeads and Fragments are the most important categories in WWTP effluent
- Commercial fragments present in greater proportions
  in effluent from WWTP in western Toronto



# **Summary of Observations; Response**

- There are a wide variety of sources contributing microplastics to Lake Ontario and the Great Lakes
- Fibers, fragments (commercial and post-consumer), and microbeads are the dominant types present in samples
- The greatest abundances are found close near wastewater discharges, urban rivers (run-off) and the regions where commercial activities and population are focussed

#### **MOECC Response on Microplastics:**

- Input on management of microbeads
- Spill response & related abatement
- Monitoring & supporting research
- > Waste-Free Ontario Act; circular economy, etc
- Considering further approaches to address microplastics







# **Microplastics Initiatives**

### **Monitoring**

- WWTPs 2015-2019; evaluate ban on microbeads (MOECC)
- Lake Ontario nearshore, urban streams (MOECC)
- Great Lakes sediments, track through time (UWO/ECCC/MOECC)

### <u>Effects</u>

- Life cycle exposures of fathead minnows (UT, MOECC, DFO)
  - Variety of microplastic types, including fibres

### Exposure

• "Am I eating plastic?" "Are they poisoning our fish?" (UT, MOECC)

### <u>Methods</u>

- Tracing sources (fingerprinting) (MOECC)
- Smaller particles, trace quantities (for exposure) (UT, MOECC)



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