

# Microfiber source characterization in the Northeastern Pacific Ocean

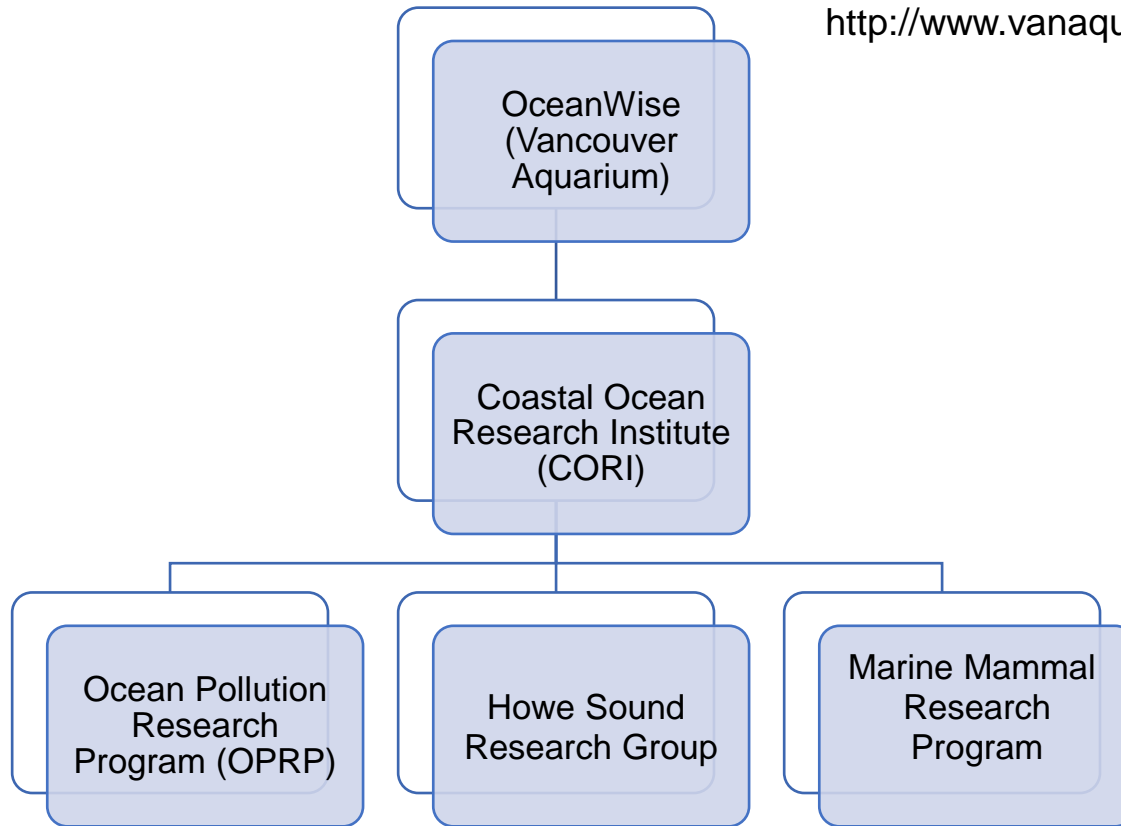


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# Who we are

<http://www.vanaqua.org/about/ocean-wise>



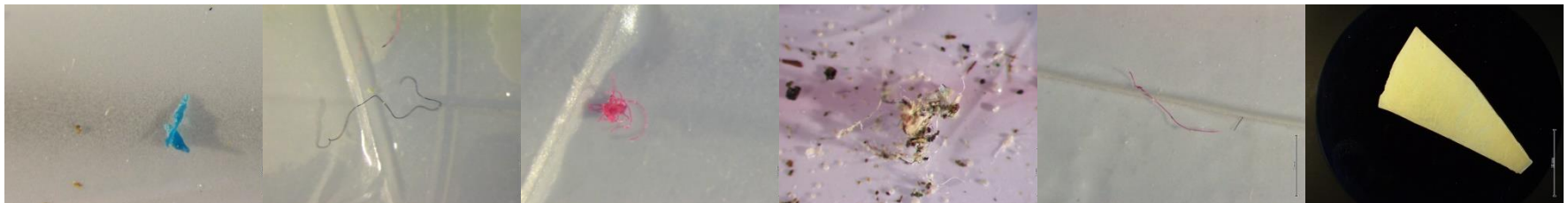
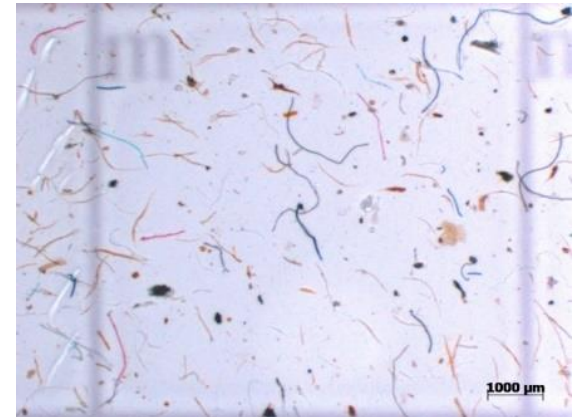
Our priorities:

- ❑ **Microplastics in the ocean**
- ❑ Pollution Tracker, a new coast-wide monitoring initiative
- ❑ Marine mammals as sentinels of ocean pollution
- ❑ Clean seafood for coastal aboriginal communities
- ❑ Oil spill science



# Plastics as an emerging threat to ocean life

- ❑ More than 25,000 formulations;
- ❑ Sometimes possesses endocrine-disrupting properties;
- ❑ Can cause acute or chronic toxicity;
- ❑ Fitness and reproduction effect;
- ❑ Documented in hundreds of species of invertebrates, fish, seabirds and marine mammals around the world;
- ❑ Is a pollutant class like no other...



300 million metric tons (MT) of plastics produced

in the world annually

only 5% is recycled

99.5 million MT plastic waste

was generated in coastal regions in 2010

4.8 to 12.7 million MT

entered the ocean in 2010 only

=

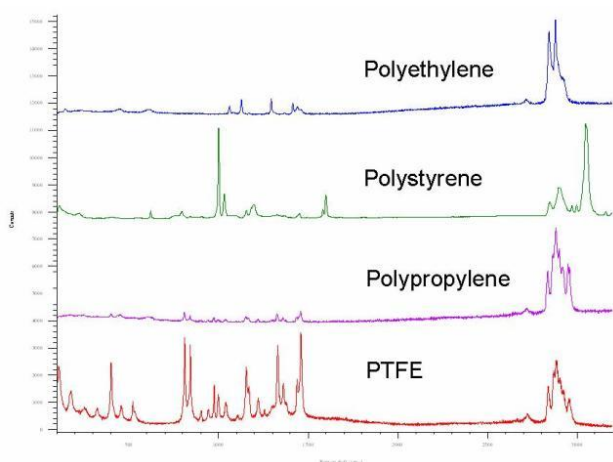


x 1000 000  
in 2010 only

# Protocol development

## Microplastic characterization in environmental samples

1. Sampling (< 5 mm)
2. Extraction & cleanup
  - a. Seawater
  - b. Sediments
  - c. Biota (zoop, mussels, fish & birds)
3. Quantification
4. Polymeric characterization using FTIR ( $\mu$ -ATR-FTIR)



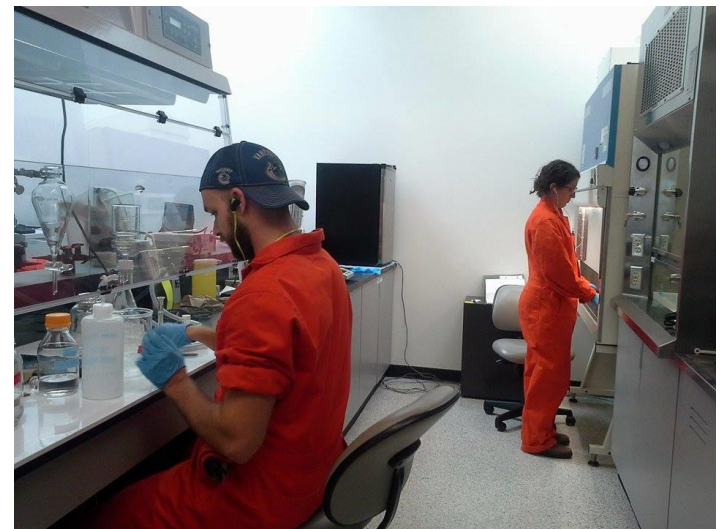
# Protocol development: oil extraction

*A novel, density-independent and FTIR-compatible approach for the rapid extraction of microplastics from aquatic sediments.*

*Ellika M. Crichton, Marie Noëel, Esther A. Gies and Peter S. Ross*

*Anal. Methods, 2017, 1–10*

Particles recovery	Oil (%)	NaI (%)	CaCl <sub>2</sub> (%)
Mean ± SD	96.2 ± 2.2	83.3 ± 5.8	69.0 ± 3.6



*Crichton et al., 2017*

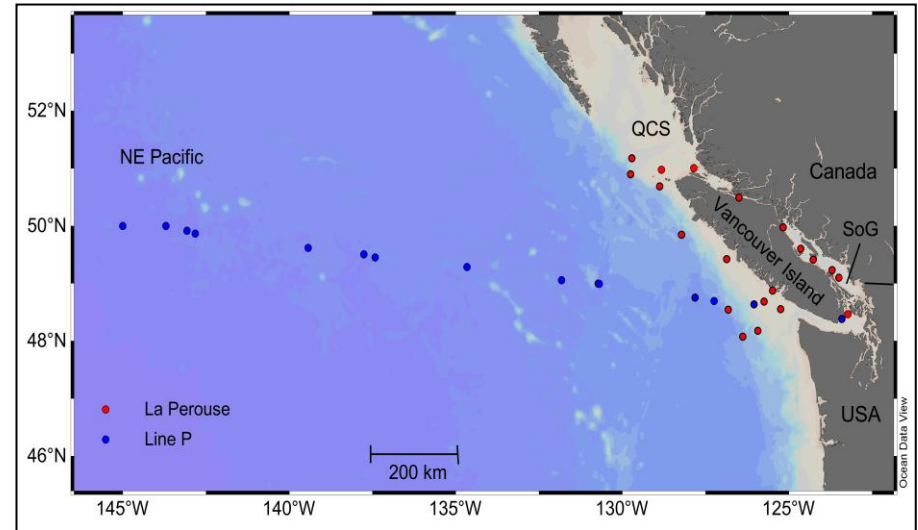
- **MP pathways in the environment**
- Source identification
  - Water
    - Arctic
    - NE Pacific and British Columbia
  - Sediments
    - Coastal British Columbia
  - Biota analysis
    - Zooplankton
    - Mussels
    - Fish



# Microplastics in seawater and zooplankton

NE Pacific, Line P and the La Perouse Monitoring Programs cruises (2012)

- Sub-surface seawater in the NE Pacific from seawater intake
- Zooplankton samples collected from vertical tows

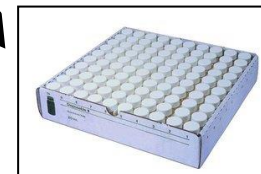


Canadian Coast Guard Ship (CCGS) John P. Tully

63  $\mu$ m sieve

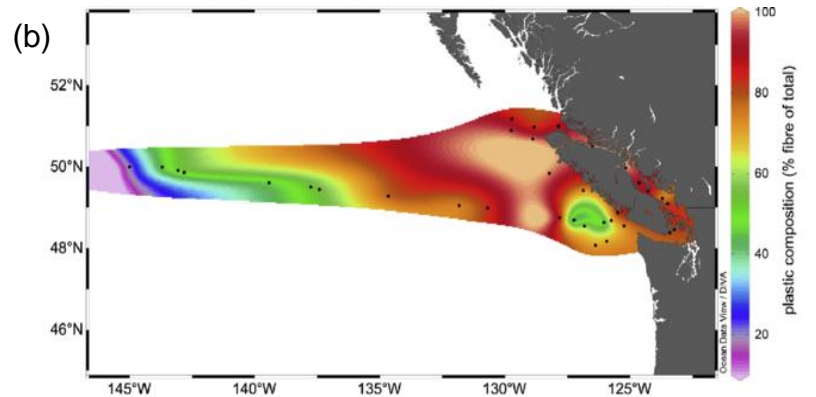
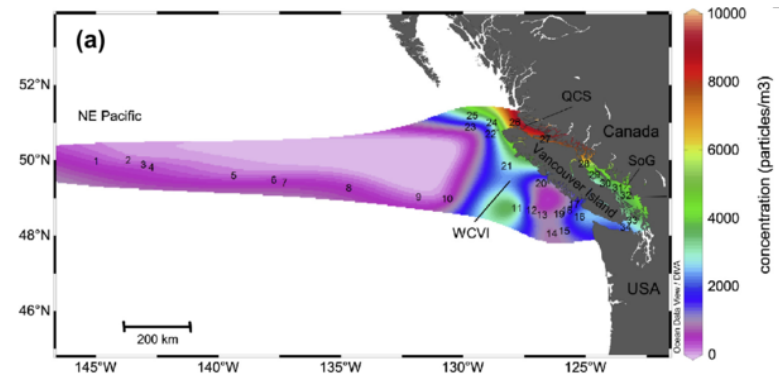
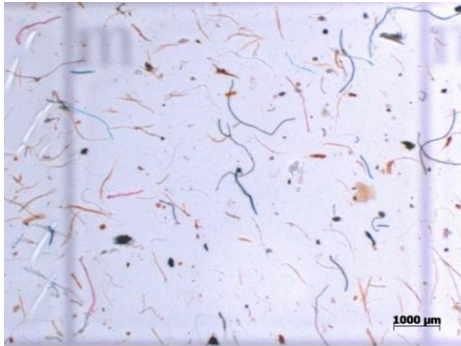


Bongo nets  
236  $\mu$ m mesh



# Seawater

Up to 9,200 particles (fibres and fragments) per cubic meter in the NE Pacific Ocean



(a) Total microplastic concentrations (particles/m<sup>3</sup>), detected particles >62 µm

(b) Map of microplastic composition, defined here as a percentage fibre of the total plastics detected.

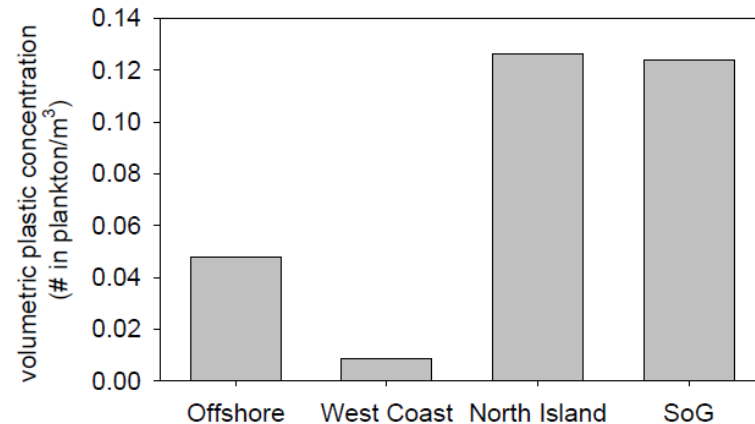
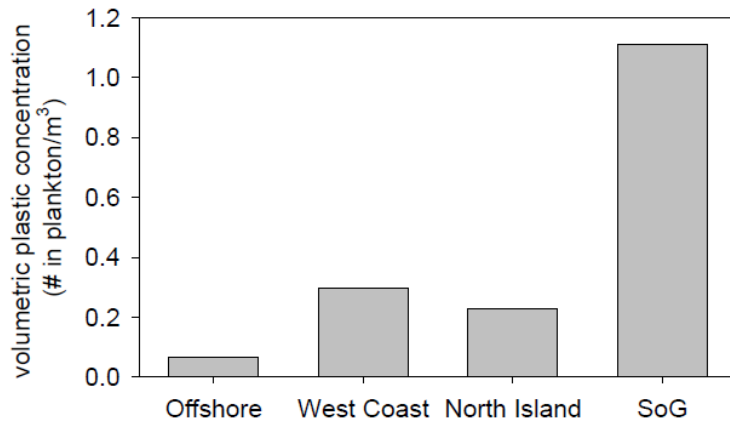
# Zooplankton

- ❑ Zooplankton are mistaking microplastics for food
- ❑ Highest levels of MP near the coast

*Neocalanus  
cristata*



*Euphausia  
pacifica*



# Estimated trophic transfer of microplastics

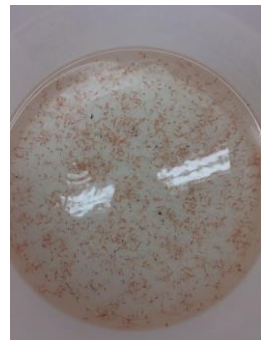
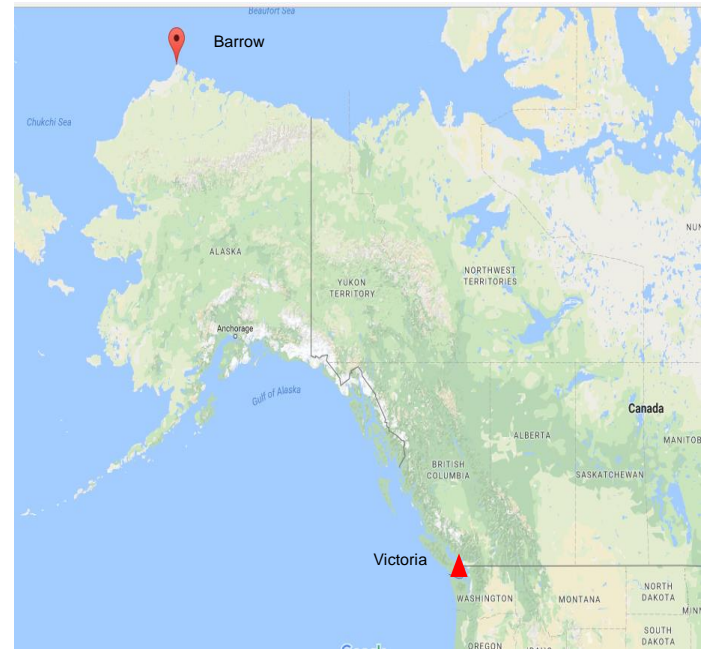
Salmon and whale predation on zooplankton in the Strait of Georgia

	Number of particles per day
Juvenile salmon	2-7
Adult salmon	39 – 91
Humpback whale	>300,000 (only from zooplankton)

# Microplastics in zooplankton 2017

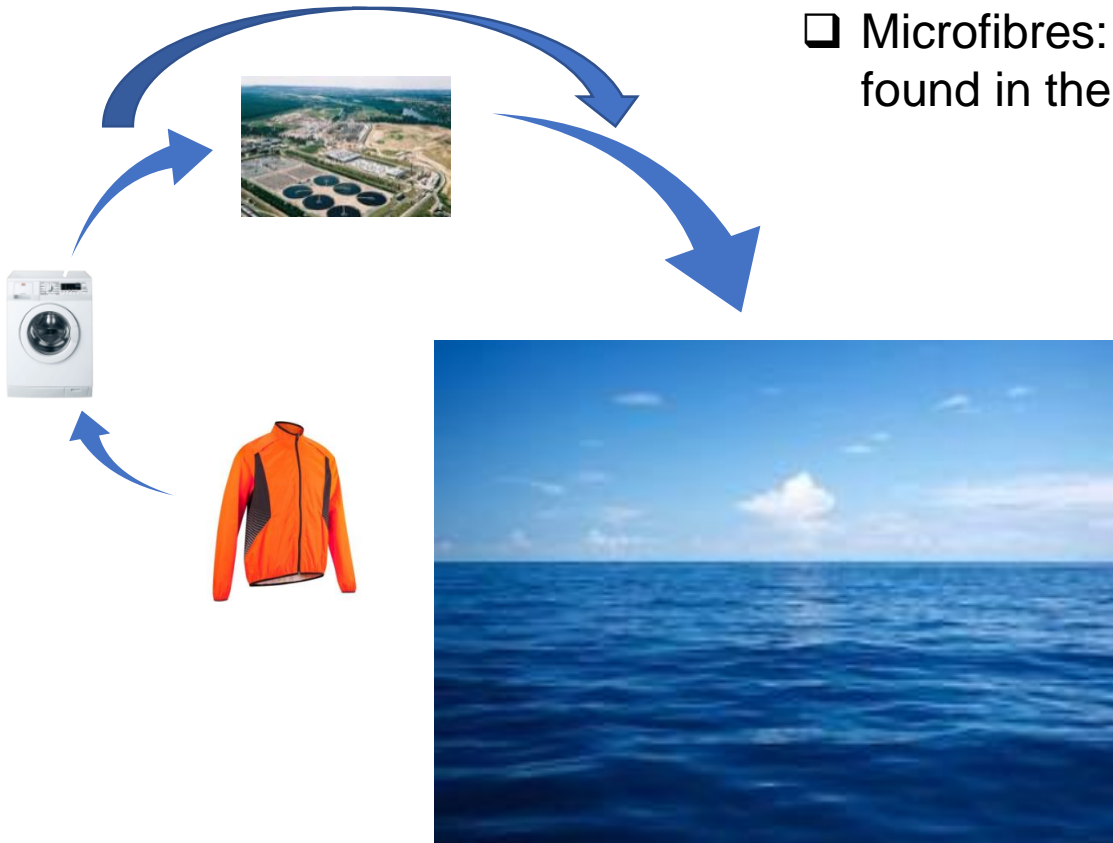
Collaboration of Ocean Wise and Fisheries and Ocean Canada

Exposure, ingestion, and health effects in zooplankton



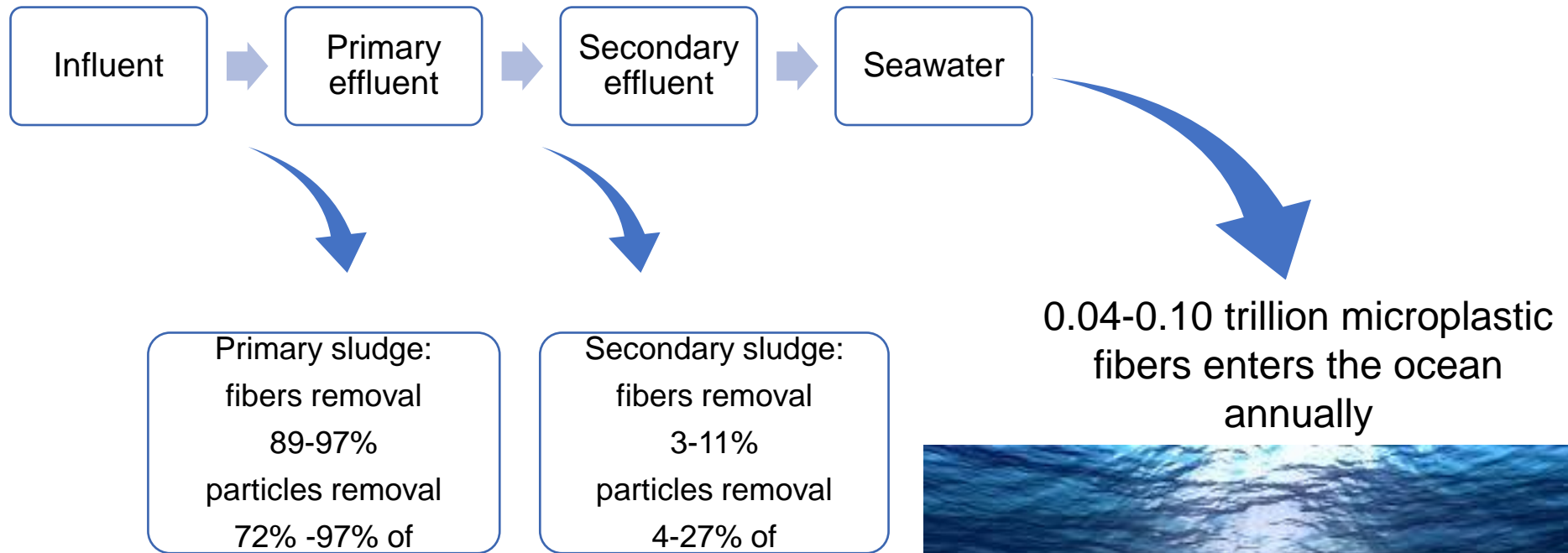
- MP pathways in the environment
  - **Source identification**
- Collaboration with Metro Vancouver: microplastics in wastewater treatment facilities
- Wastewater is a major source of microplastic fibres in the marine environment

- ❑ Microfibres: up to 75% of microplastics found in the Strait of Georgia



# Microplastics in wastewater (pilot study)

Used sieve 63  $\mu\text{m}$   
Mass balance:

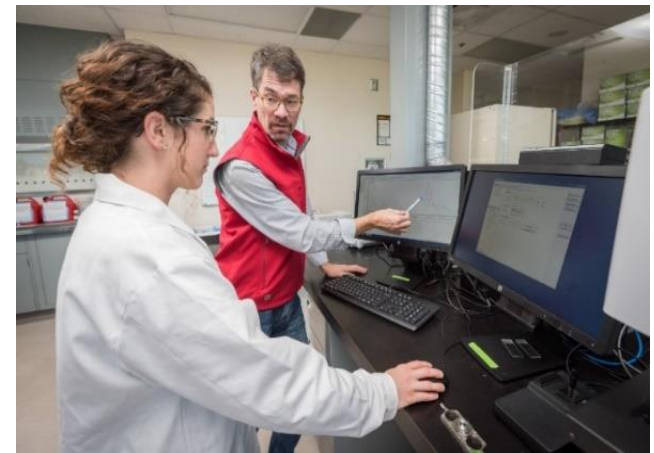


- MP pathways in the environment
- **Source identification**

What are the main components of microplastics?

- ❑ FT-IR signature library
  - ❑ Parental materials (as made)
  - ❑ Weathering modifications (UV, O<sub>2</sub>, temperature, biofouling)
  - ❑ FT-IR signature from textile to microplastic contaminant

Collaboration with the three major outdoor apparel retailers:





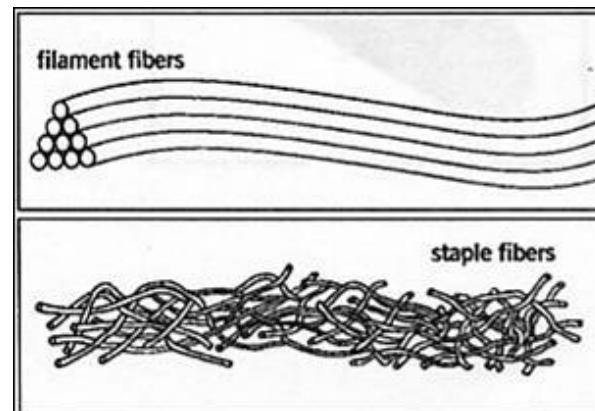
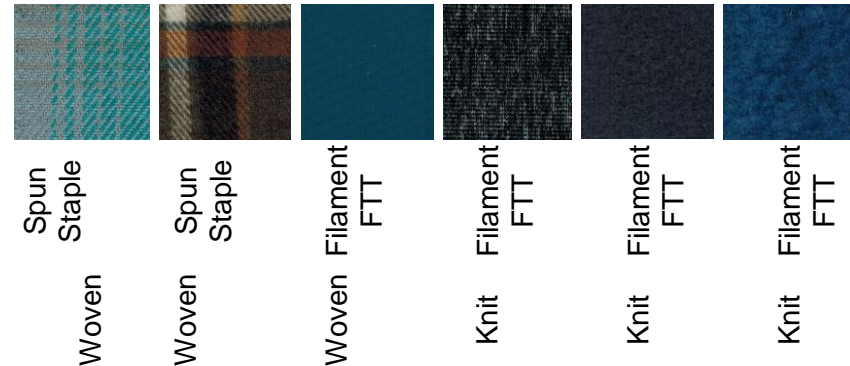
# Microplastic fibres from textiles

❑ One fleece jacket can release up to 600 000 fibres or 0.3 g per wash

Project goal:

Fiber design changes to reduce textile fibre shedding:

- ❑ Yarn type
- ❑ Mechanical finishing
- ❑ Composite
- ❑ Weathering effect



# What is next?

- ❑ Urgent call to reduce the input of the synthetic fibres into the ocean
- ❑ Ensure standardisation and congruence of terminology, methodology and findings
- ❑ Bring together environmental and textile sciences
- ❑ Only multiple perspective approach will be able to develop sensible mitigation measures and management options.

# Thank you

*Staff:* Marie Noel, Anahita Etmadifar, Kelsey Delisle, Esther Gies, Jessica LeNoble; *Stephen Chastain, Megane Neauport*

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“We must learn to think in a new way...”

- *Bertrand Russell and Albert Einstein*  
1955

