Microplastics in the marine environment of coastal British Columbia

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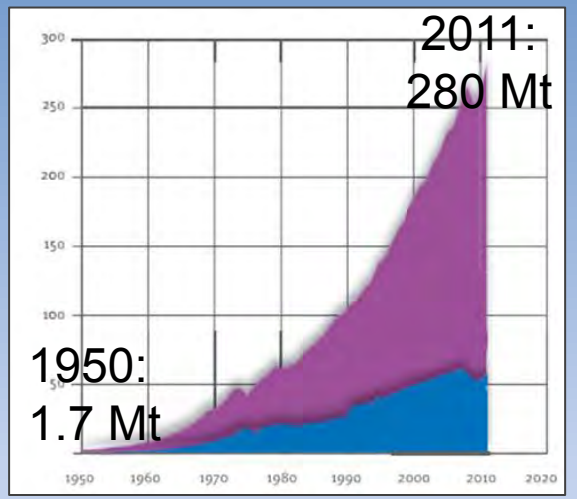
PICES

Marine Debris

- "*any persistent, manufactured or processed solid material discarded in the marine and coastal environment*"
- Majority of debris is plastic (~60-80%)
- Global plastic production increased by 9% per year since 1950's
- Estimated that there is 1.3 plastic pieces for every m^2 of shoreline worldwide



www.plasticseurope.org

NOAA photo library

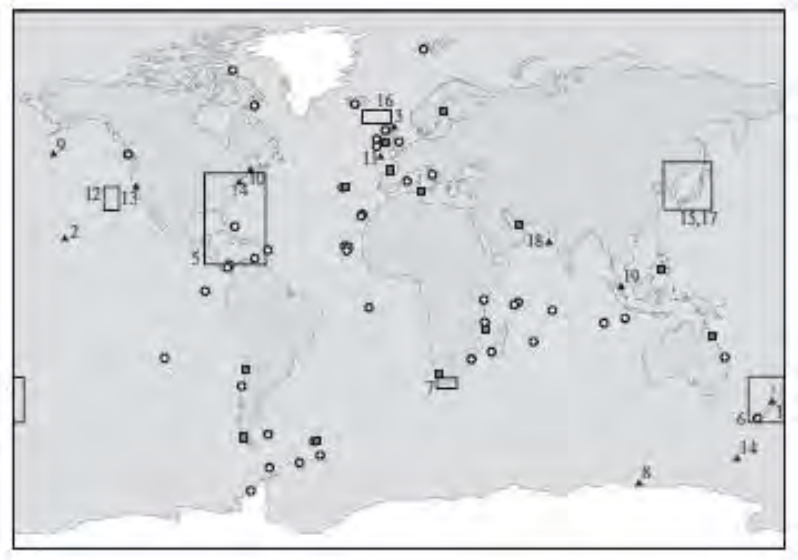
Threats of marine debris

- Entanglement and ingestion
  - over 267 species worldwide are affected
- Vector for persistent pollutants
  - PCBs, PBDEs, PAHs
- Leach toxic chemicals
- Vector for invasive species

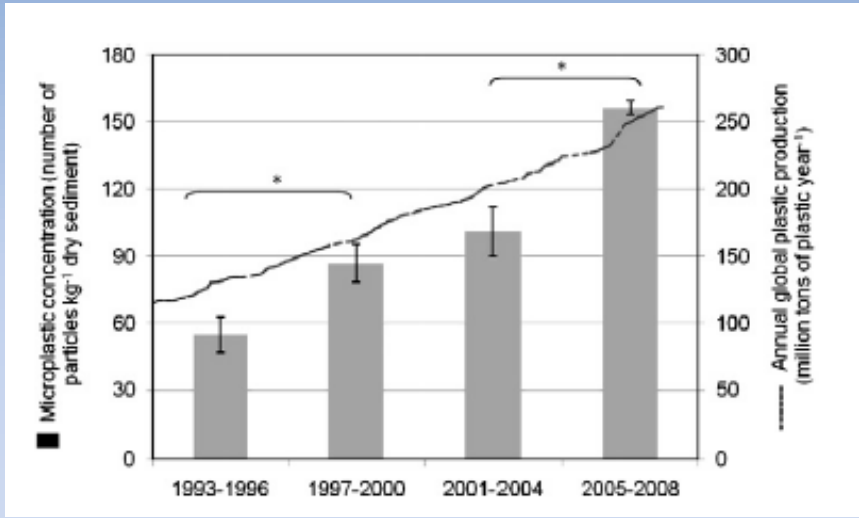
What are Microplastics?

- “New and emerging issue” – GESAMP
- Plastic particles < 5mm
- Primary microplastics are deliberately manufactured
- Secondary microplastics are break-down products of larger debris
- Most plastic derives from land-based sources
  - Household and industrial waste + wastewater
  - Fishing, aquaculture, shipping, tourism, etc.

Microplastic abundance and distribution are increasing globally



Barnes et al. 2009



Claessens et al. 2011

Microplastics have been detected in seawater at the surface and at depth as well as in sediment from the equator to the poles

Rationale:

- Microplastics are a growing threat to marine biota capable of ingesting small plastic particles

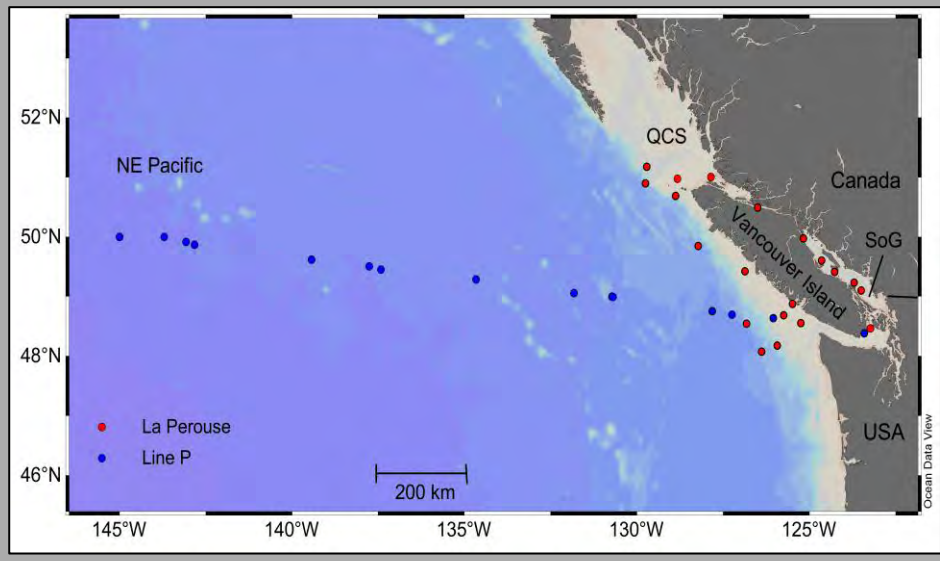
- This is particularly concerning given debris movement across the Pacific as a result of the 2011 Tohoku earthquake and tsunami

Our goal:

Investigate the abundance, composition and distribution of subsurface microplastics in the NE Pacific Ocean and areas near the coastal waters of British Columbia, Canada

Sampling

- Collected subsurface seawater from 2 cruises (Aug/Sept 2012)
  - Line P + La Pérouse
- Water was filtered prior to intake (5mm) and sieved (250, 125, 62.5 µm)
- Fractions collected and stored refrigerated with 5-10% HCl

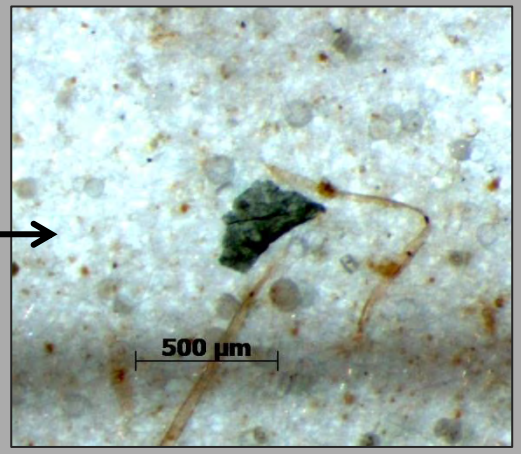


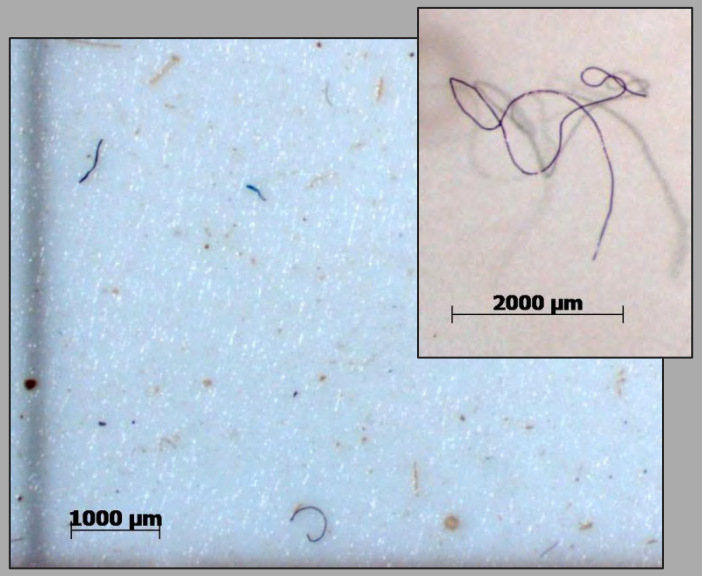
Sample analysis

Acid digestion → Vacuum filter → Visual examination

Visual examination → Particle count

Particle count → Categorize (shape and size)





I.D. based on morphological and physical characteristics

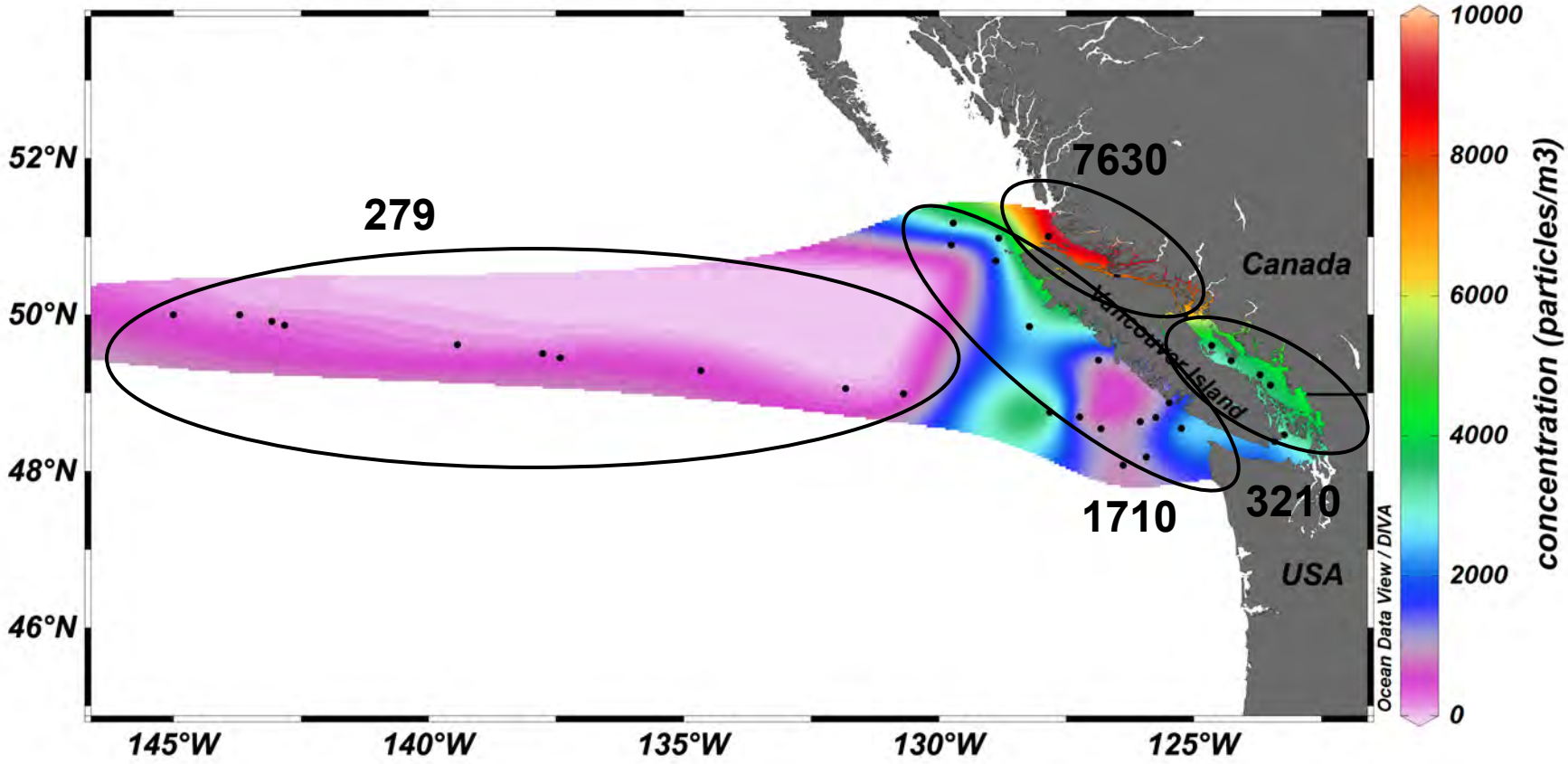
Summary results

	Conc.	Particle shape	Particle size (µm) composition (%)			
	(#/m^3)	(% fibre)	<100	100-500	500-1000	>1000
all sites	**2080**	**72.7**	**5.92**	**57.7**	**21.5**	**14.9**
min	8.51	16	0.00	23.1	0.00	0.00
max	9180	100	30.8	84.2	48.0	33.3

Other studies in Pacific Gyre: <0.1 - 8 particles/m^3

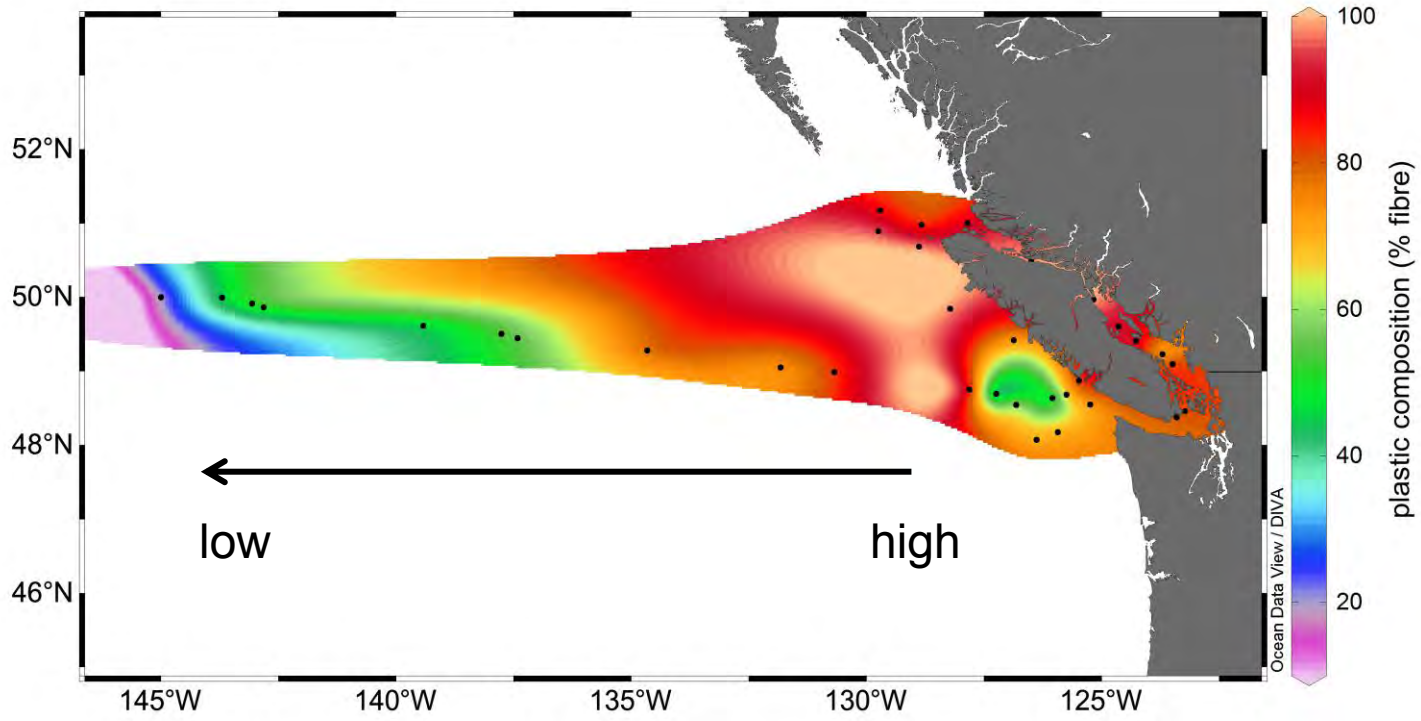
Typical sampling uses neuston net with 333 µm, while we detected particles between ~62-5000 µm

Microplastic concentrations vary by oceanographic region



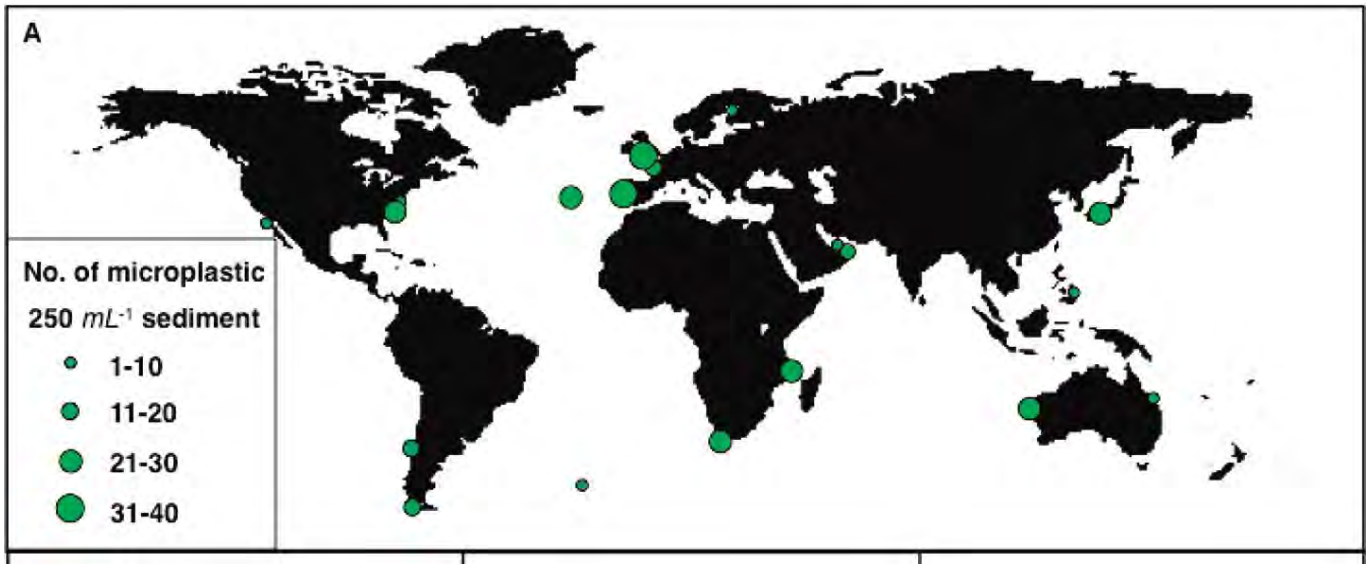
Land-based human activities are a major source of microplastic particles

The composition pattern matches the plastic concentration pattern

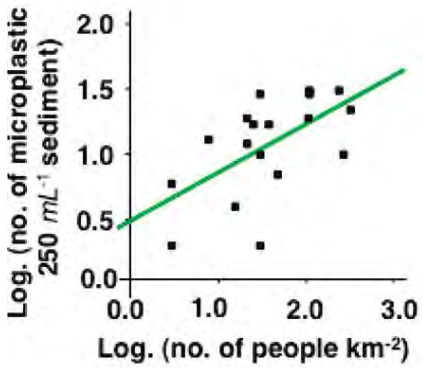


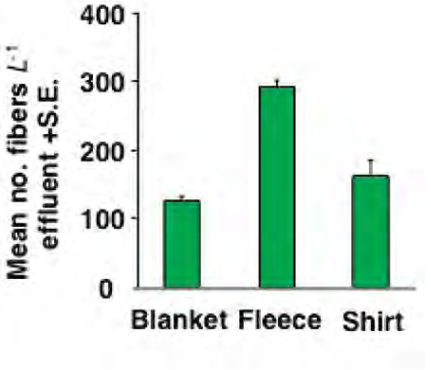
High fibre content at nearshore stations and decrease with distance offshore

Microplastic abundance in sediment from 18 sites worldwide correlates with population size



Browne et al. 2011

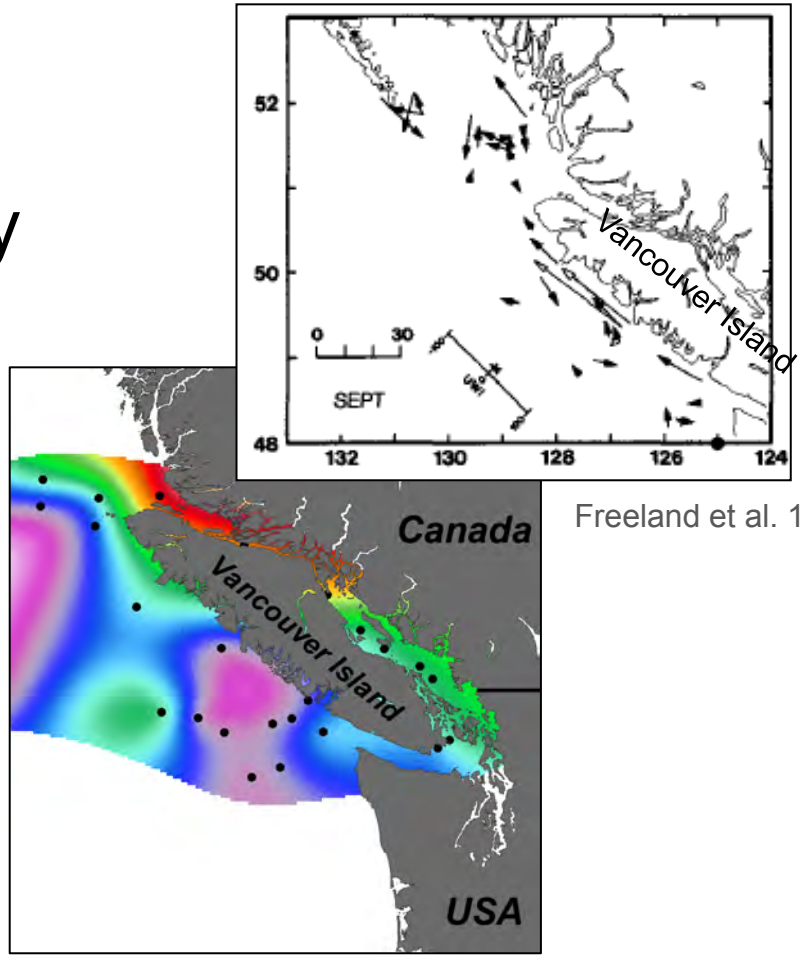




→ Fibres dominate plastic composition

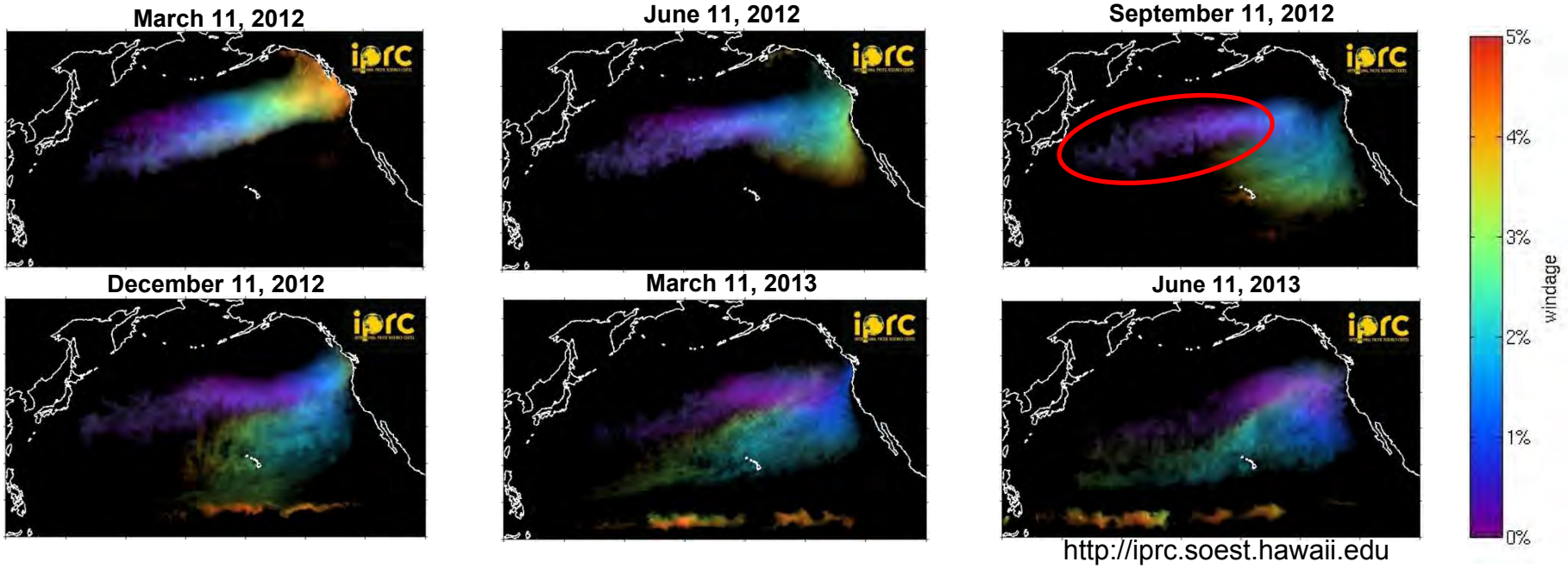
<u>Sewage</u> contaminated with fibres from <u>washing clothes</u> is a major source of microplastics

- High concentrations in Queen Charlotte Sound was unexpected
  - Currents, tides, and weather systems trap debris
  - Aquaculture
  - Local harbors
- Strait of Georgia is strongly industrialized
  - Vancouver + Victoria sewage outfall
- Low levels at La Pérouse upwelling
  - Clean deep waters?



Freeland et al. 1984

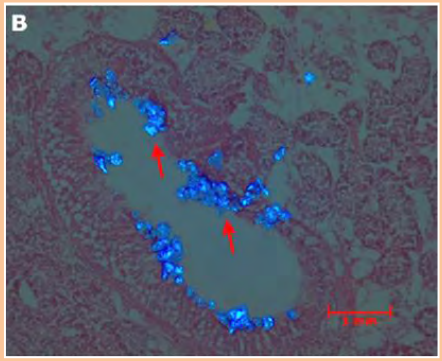
Debris from 2011 Tohoku tsunami transported by currents towards N-A and coastal BC



- Microplastic front was near middle of Pacific during our sampling (zero windage)
- Expected to hit BC coast summer 2013-2014

Conclusions

- Widespread distribution of microplastics in NE Pacific Ocean
- Proximity to urban centres as well as oceanographic features shape microplastic profiles
- Microplastic debris front from 2011 Tohoku tsunami likely to arrive 2013/2014
- These results are troubling given evidence of microplastic ingestion in marine biota



Cole et al. 2013; von Moos et al. 2012

Acknowledgement

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- Scientific staff on ship, specially Doug Yelland and Marie Robert
- Participants of the workshop on Trends in marine contaminants held at the 2011 annual PICES conference

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