Plastics in the ocean: micro- and macro-plastics as a threat to ocean life in Canada

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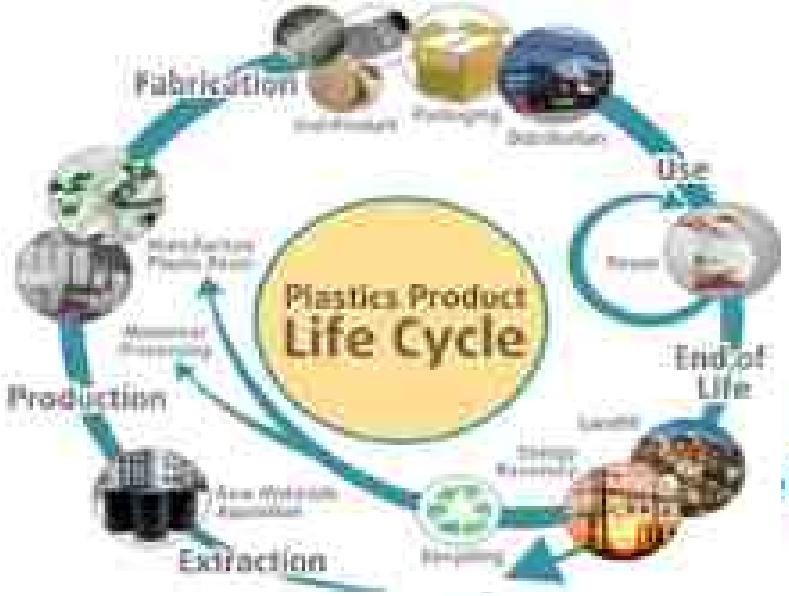
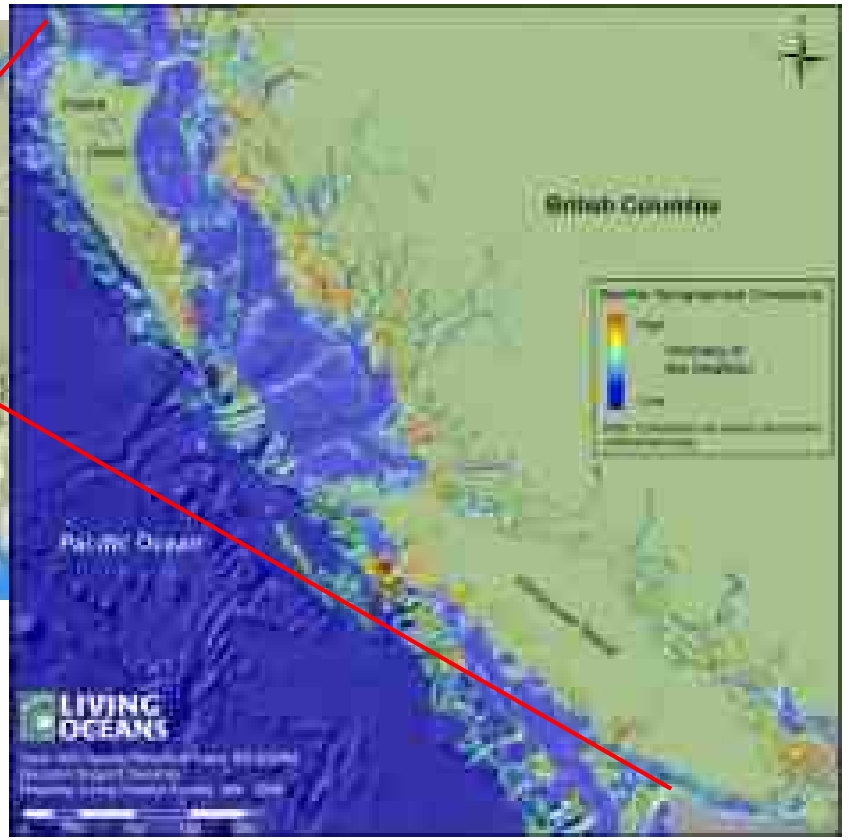
Plastic is everywhere

(Kate Le Souef, Great Canadian Shoreline Cleanup)



Plastics and debris along the British Columbia coast come from a variety of local and international sources

NOAA



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The Vancouver Aquarium's Great Canadian Shoreline Cleanup: A chance to clean up, teach and learn

- Cleanup sites: 1,950
- Distance cleaned: 3,035 km
- Garbage bags filled: 10,891
- Weight of garbage:

  99,280kg
- Volunteers: 58,500

Top 10 shoreline cleanup items in Canada: A story of abundance, physical properties and environment processes

Rank in 2013	Item	Number collected
1	Cigarette filters (cellulose acetate)	310,994
2	Food containers	81,971
3	Bottle caps (plastic)	32,892
4	Bottles (plastic)	32,405
5	Cans	25,867
6	Straws and stir-sticks	23,528
7	Other plastic bags	22,012
8	Bottle caps (metal)	21,871
9	Plastic or foam packaging	19,634
10	Grocery bags (plastic)	18,189

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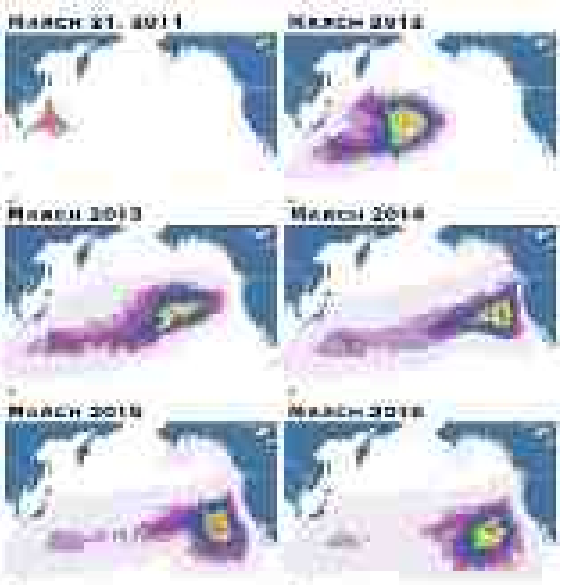
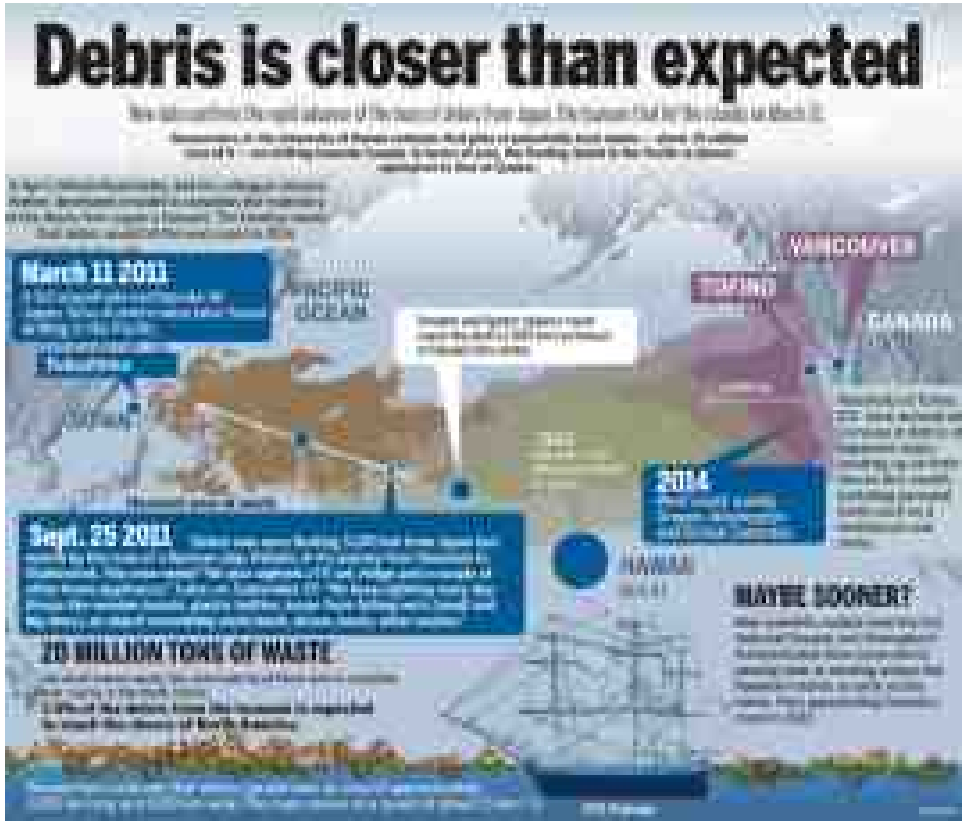
Tohoku earthquake and tsunami (March 11, 2011): some buoyant debris traversed the Pacific Ocean: recent Japan-Canada cleanup operation through the Vancouver Aquarium





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Macro-plastic pollution represents a highly visible threat to sea life

- 558 entanglements recorded in Pacific Rim National Park Reserve on the West Coast of Vancouver Island between 2005 and 2012.
- This represents approximately 300 different entangled animals.
- an estimated 1,200 sea lions are entangled across coastal British Columbia.

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Sea lions in British Columbia are being entangled by different types of macro-plastic debris and fishing gear

- 30% plastic packing bands;
- 3% rubber bands (from crab traps);
- 15% fishing lures (primarily flashers);
- 51% were so severe that the material could not be identified.

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Rescue efforts can help in isolated cases, but this is dangerous, difficult and costly

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Plastic does not only threaten charismatic marine mammals and birds

- Plastic from the stomach of a steelhead salmon;
- This fish was captured by a fisherman on the Vedder River as it returned to its natal stream from the ocean;
- Large pieces, visible & harmful: the stomach was ulcerated by sharp pieces.

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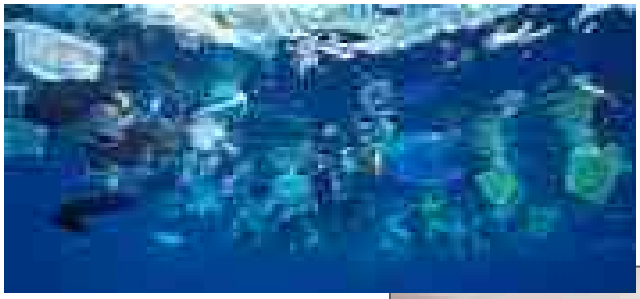
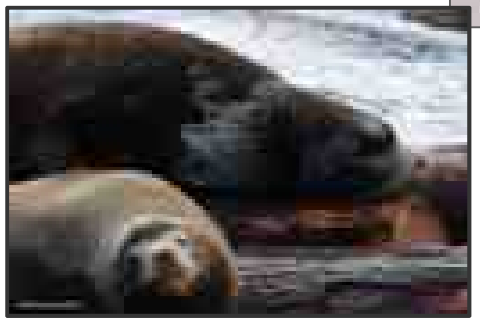
Labels can be found on some consumer plastic products, but not on most plastics found in the ocean

Type of Plastic	It starts as...	It gets made into...
1 PET Polyethylene Terephalate	Peanut Butter Jars Water Bottles Soda Bottles	Carpeting Tennis Balls Paint Brushes
2 HDPE High-Density Polyethylene	Juice Bottles Liquid Detergent Bottles Plastic Grocery Bags	Plastic Lumber Trash Cans Toys
3 PVC Polyvinyl Chloride	Shampoo Bottles Cooking Oil Bottles Salad Dressing Bottles	Floor Mats Hoses Computer Cords
4 LDPE Low-Density Polyethylene	Food Storage Containers Dairy Container Lids Dry Cleaning Bags	Frisbees® Lawn Furniture Toys
5 PP Polypropylene	Medicine Bottles Yogurt Containers Flower Pots	Brooms Toothbrushes Sleeping Bags
6 PS Polystyrene	Dairy Containers Vitamin Bottles Flower Pots	Building Insulation Rulers Food Service Trays
7 Other Other Plastics	Ketchup Bottles Window Cleaner Bottles Water Coolers	Street Signs Pens Concrete Supports





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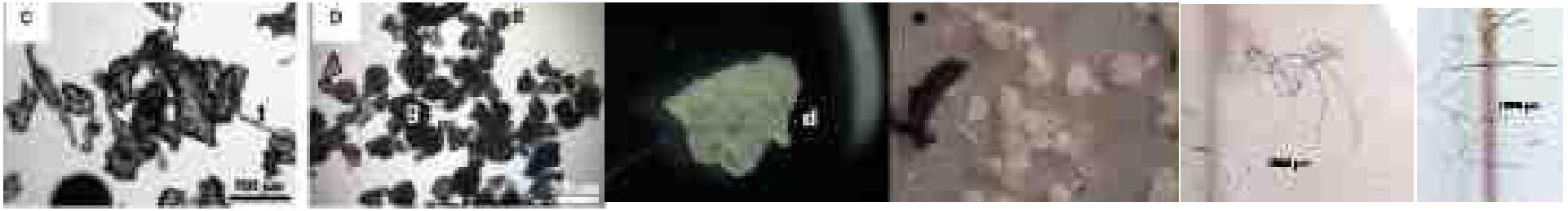
… this is particularly true for microplastics, which remain largely non-descript and ill-defined



- Microplastic particles are < 5mm (variable minimum sizes, depending on the reporting lab);
- Two basic categories:
  - *Primary* microplastics are deliberately manufactured;
  - *Secondary* microplastics are break-down products of larger debris.
- Most microplastics are derived from land-based or coastal sources:
  - Household and industrial waste + wastewater;
  - Fishing, aquaculture, shipping.

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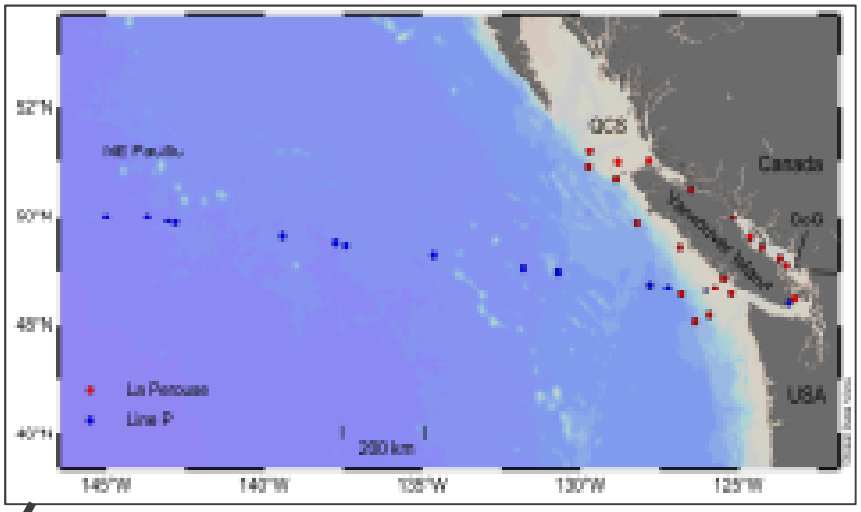
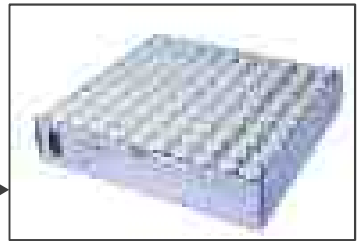
Microplastics in seawater and zooplankton in the NE Pacific

- Sub-surface seawater in the NE Pacific from salt water intake;
- Zooplankton samples collected from vertical tows during different cruises;
- Both sets of samples were stored for later clean-up and enumeration.





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Seawater and zooplankton sample clean-up and microplastics enumeration

Seawater:
- acid digestion
- Vacuum filter
- Visual exam
- Count
- Shape, size and colour

Zooplankton:
- Storage in formalin
- Placed in plate wells
- Acid digestion
- Visual exam
- Count
- Shape, size and colour

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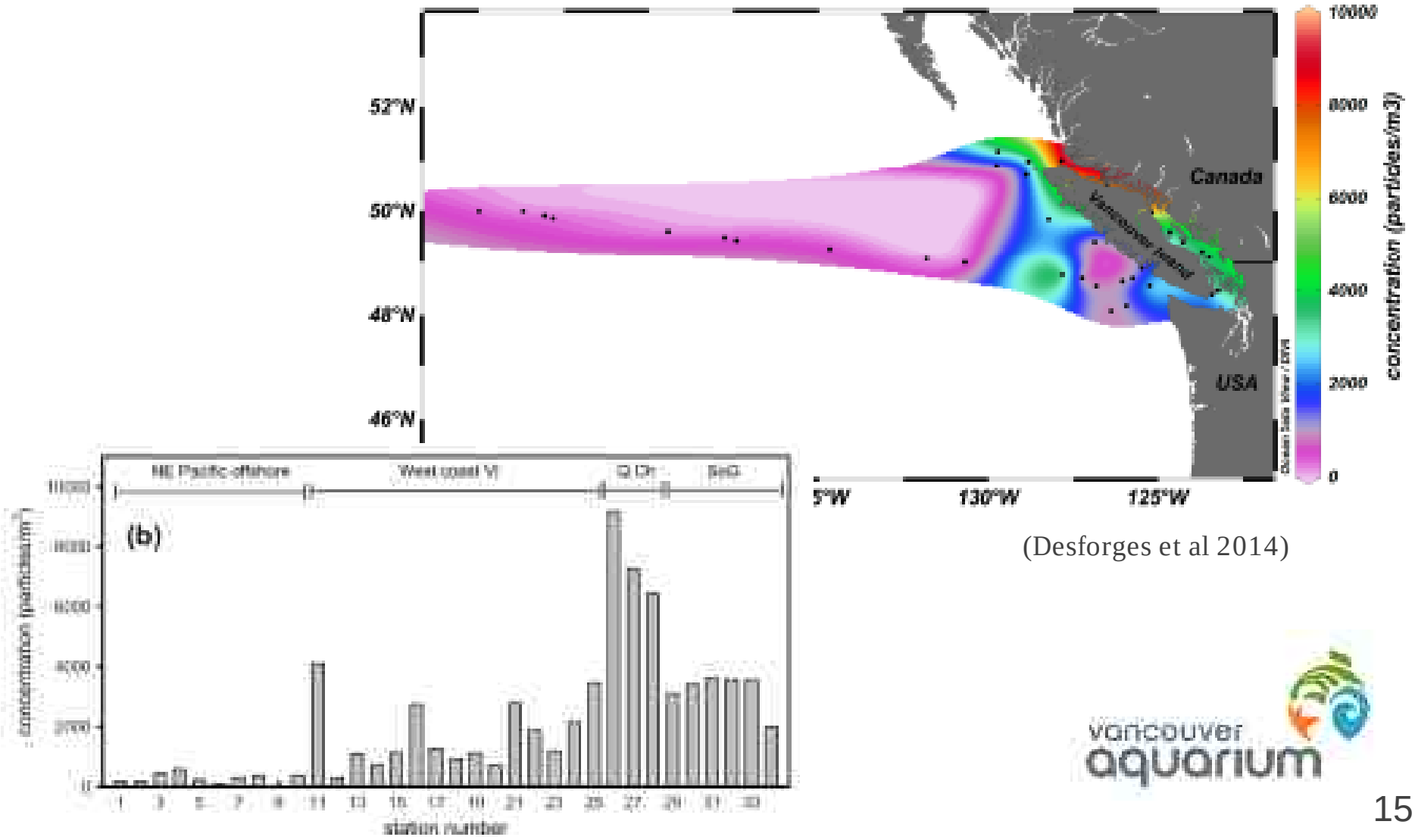
Seawater: up to 9,000 particles (fibers and 'chunks') per cubic meter of seawater: only secondary microplastics found



(Desforges et al 2014)

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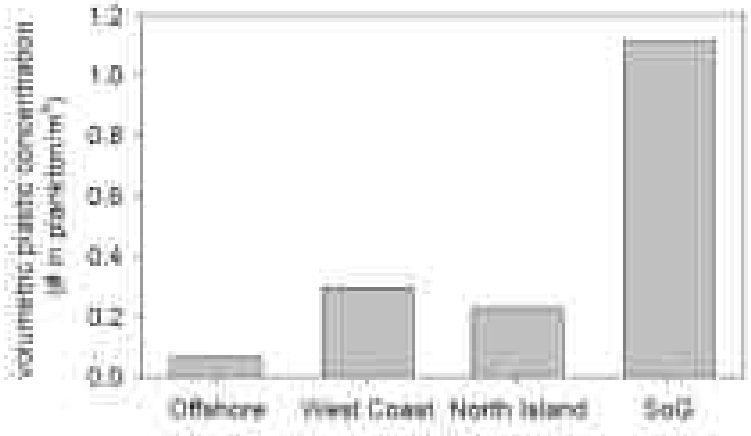
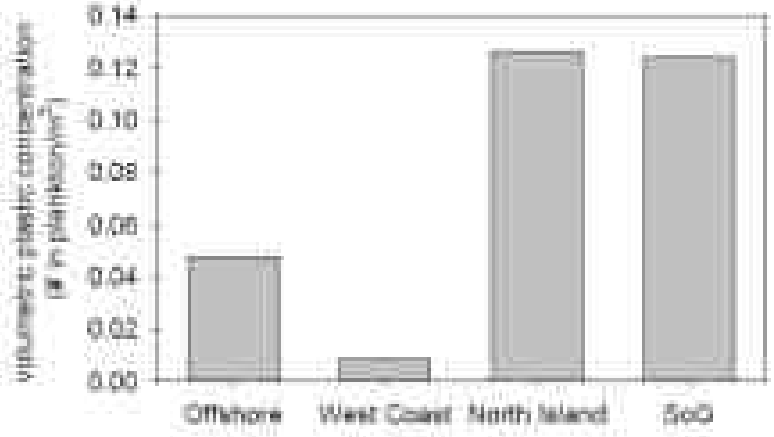
1000 µm

Zooplankton: Highest microplastic levels found near the coast of North America

Neocalanus cristata

Euphausia pacifica





(Desforges et al in prep 2015)

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Microplastics in zooplankton consisted of both fibers and particles

	Neocalanus	Euphausia	P-value
Plastic particle every X individuals	38 +/- 7.3	17 +/- 2.9	0.011 *
Plastic size	556 ± 149 µm	816 ± 108 µm	0.014 *
% fiber	44% ± 12	68% ± 13	0.19 ns

(Desforges et al 2015)

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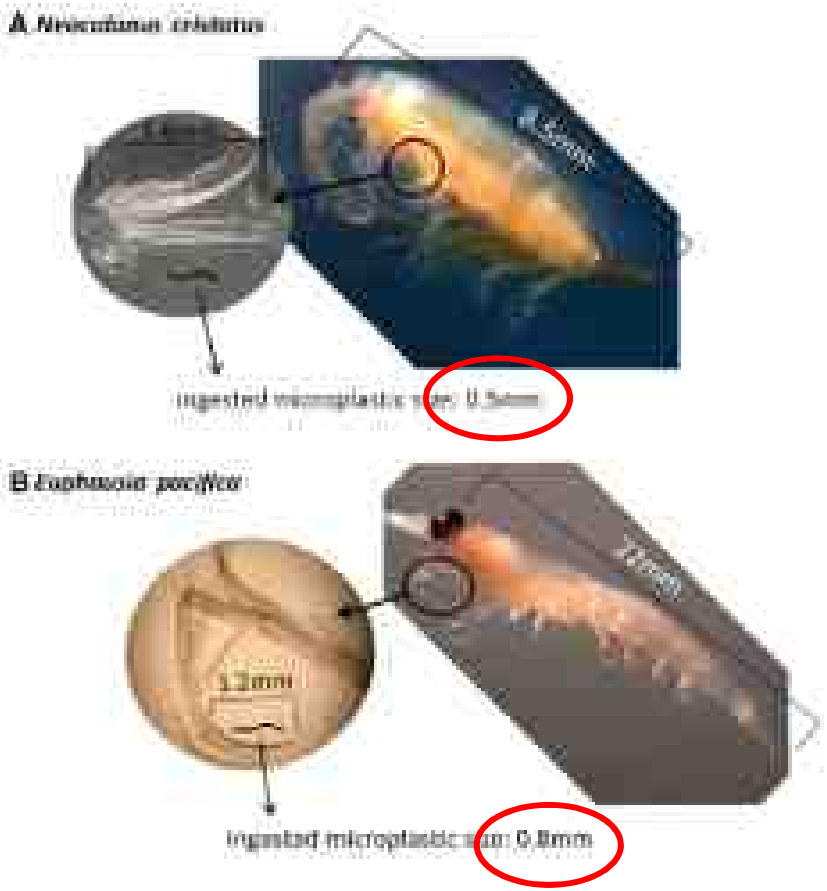
Zooplankton mistake plastic for food - Size of particles differed between Neocalanus sp. and Euphausia sp., consistent with their feeding strategies



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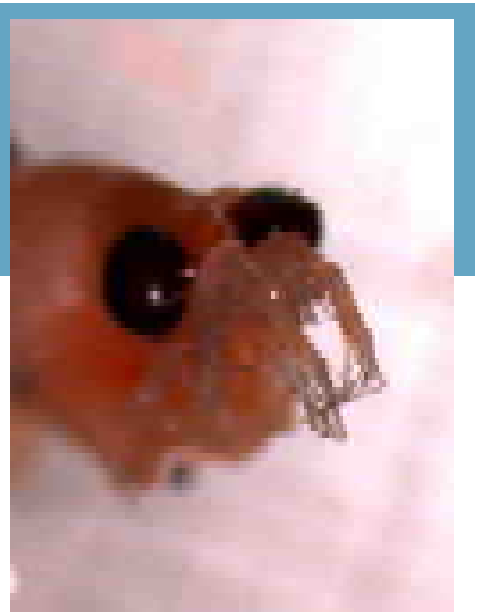
A troubling conservation threat for sea creatures of all shapes and sizes



- Where are the straps and nets coming from that are entangling marine mammals?
- Where are the microplastics coming from that are found in coastal seawater?
- Do microplastics represent a similar threat to small creatures (zooplankton or baby fish) that larger plastics present to marine mammals and seabirds?

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A small step: Microbeads in personal care products are being banned in Canada

- Unanimous vote in the Canadian Parliament on March 24, 2015;
- Formal Government announcement on August 1, 2015, adding ‘microbeads’ to the list of Toxic Substances under the Canadian Environmental Protection Act (CEPA);
- Public consultations closed in October 2015;
- Final government deliberations underway; formal announcement expected spring 2016;
- In parallel, a plan is being now developed for associated ‘Management options’ on how to implement the ban and eliminate microbead releases.
- *This does not address nurdles or secondary microplastics!*

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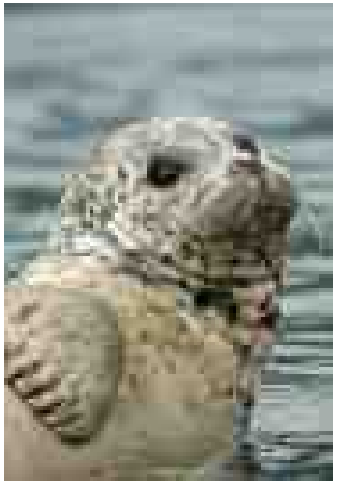
Research, engagement and action goals: Healthy oceans



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