

CHARACTERISATION OF SEA-SURFACE MICROPLASTICS COLLECTED FROM COASTAL AND INLAND WATERS OF SCOTLAND

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INTRODUCTION

One of the many consequences of the unsustainable growth in production and wasteful overuse of plastics has been the proliferation of microplastics as globally distributed, pervasive and persistent pollutants in all parts of our environment, including in estuaries, coastal seas and open oceans.

Microplastics, commonly defined as pieces of plastic in the size range of 5mm diameter or less, include fragments of larger plastic items that have broken up into smaller pieces under a combination of the mechanical stress of wave action and sediment abrasion, and degradation in sunlight, among other processes as well as plastic particles deliberately manufactured to be in this size range, such as the microbeads included in cosmetics and personal care products that are increasingly coming under regulatory control.

OBJECTIVE

To provide a wider and higher resolution insight into the presence of sea surface microplastics in Scottish coastal waters than is currently available

SEPARATION OF MICROPLASTICS

IDENTIFICATION OF

ANALYSIS OF

SAMPLING

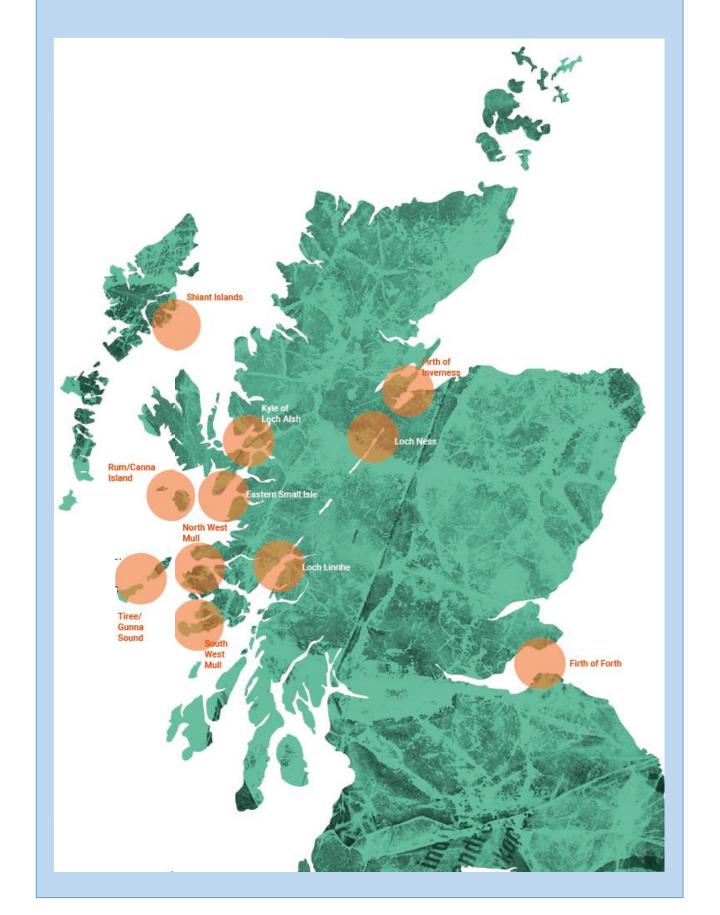
THE PLASTIC TYPE

CONTAMINANTS

WHERE AND WHEN Scotland, May – June 2017

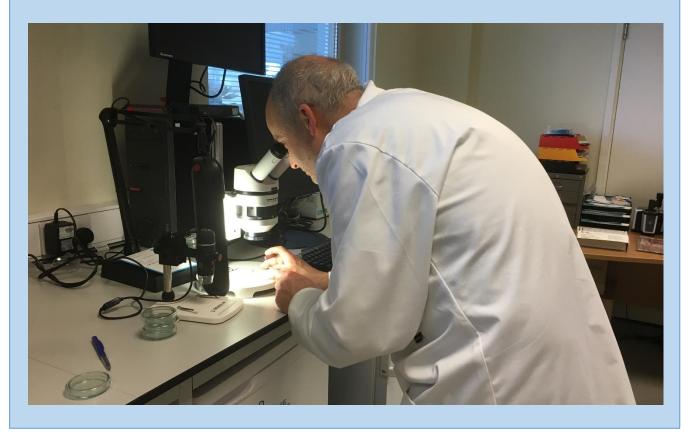
49 samples from 27 locations:

- East coast
- West coast
- Loch Ness



HOW

Dissecting microscope and lit magnifier lens Microplastic size range 0.50 – 5.00 mm diameter



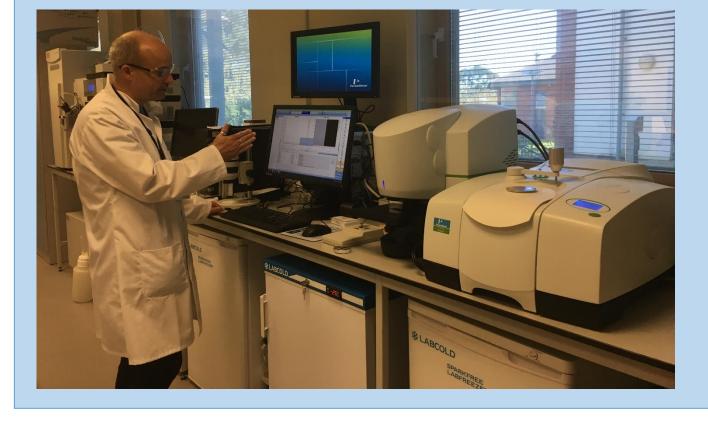
RESULTS

31 samples contained at least one piece of microplastic (63% of the samples) 4 samples contained 10+ pieces of microplastic Sampling duplicates were very different Microplastics are not uniformly distributed in seawater

HOW

RESULTS

Spotlight 400 microscope - Frontier FT-IR spectrometer (Perkin Elmer) Match with IR spectral databases



141 items identified as microplastic in total

600-12600 microplastic pieces/km²

1772 microplastics /km² in average

ORGANIC CONTAMINANTS Ultrasound assisted extraction (USAE) + GC-EI-Q-MS (Agilent) + LC-ESI-Q-Orbitrap-MS (Thermo Scientific)



95 organic compounds identified in total:

- 12 phthalate esters
- 4 pesticides
- 2 flame retardants
- 2 benzotriazole UV stabilizers
- 1 polycyclic musk
- PFOS -

${f Q}$ Spectrum search result 1	Chromatogram 171130004, 171130008	
Edit search options	RT :17.23-21.60	NL: 3.08E5
Hit: 1 Best Match: 95.3 Reference No: 31	100-1 2 80-1 19. <u>46.</u>	43 GNL: 3.526 m/z= 307.1910 M 5F F (100.00-390.0017)
Dipentyl phthalate Monoiso. Mass: 306.18311	Abunda 	NL: 3.5256 GNL: 3.526 M2= 307.1919 M5 F; F

WHY These waters are important feeding grounds for basking sharks and seabirds



HOW

Towed manta net (0.87 m wide x 0.155 m depth, mesh size 0.33 mm) Greenpeace ship Beluga II 2 time/location duplicate samples



Gavin Newman / Greenpeace

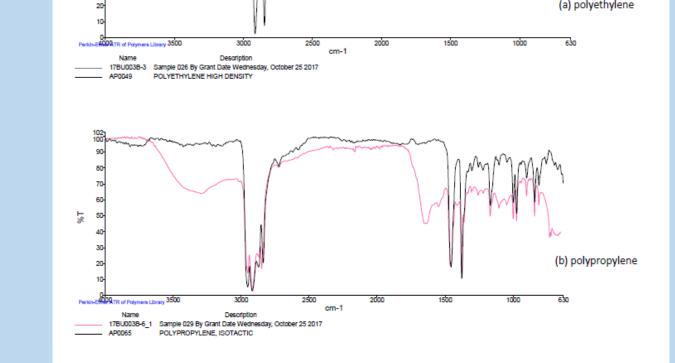
PV Stearate Vinyl acetate A soft, waxy polymer with copolymer some specialist industrial One of a family of applications, commonly mixed polymers used as a co-polymer with as adhesives and in other plastics. coatings, as well as Unidentified in synthetic foams

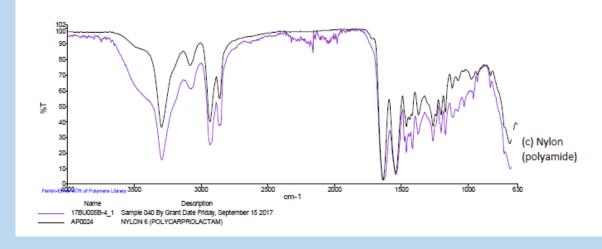
yoghurt pots and some other rigid food containers and as an expanded foam for packaging, insulation panels and some types of ishing floats and buoys Polyacrylate A family of flexible polymers used in textiles, leather finishing, paints and some synthetic rubbers, as well as in mixtures to increase the

flexibility of other plastics.

Polystyrene (PS) Used as a rigid plastic for





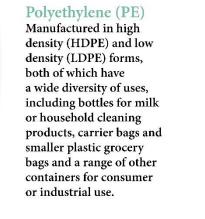




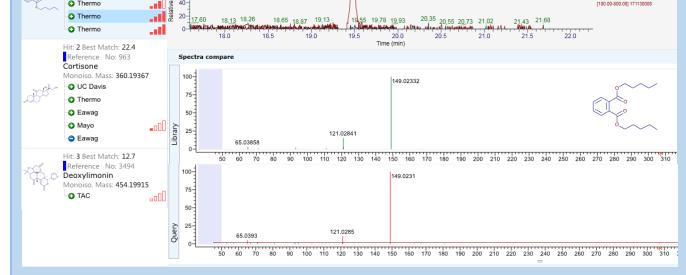
Examples of microplastic

tow samples

pieces found in manta net







HEAVY METALS Microwave assisted extraction (MAE) + ICP-MS (Agilent)



High concentrations in three samples:

- Firth of Forth; lead 171 mg/kg, copper 73.2 mg/kg and chromium 35.9 mg/kg
- Gunna Sound; lead 686 mg/kg, chromium 129 mg/kg and manganese 141 mg/kg
- Canna Island; lead 205 mg/kg and chromium 49.6 mg/kg

Vinyl Acetates:



Polyamide (PA) Polyester Including polybutylene including Nylon terephthalate (PBT), Tough, water-resistant a high strength and polymers most electrically insulating commonly made polyester used in a range into fibres for use as of electrical goods, a component of clothin as well as in some carpets, ropes and clothing and as fibres on toothbrushes.

Polypropylene (PP) A high strength plastic, resistant to chemical and emperature degradation, used for rigid containers, bottle caps and some ypes of rope used on hips and in fishing gear

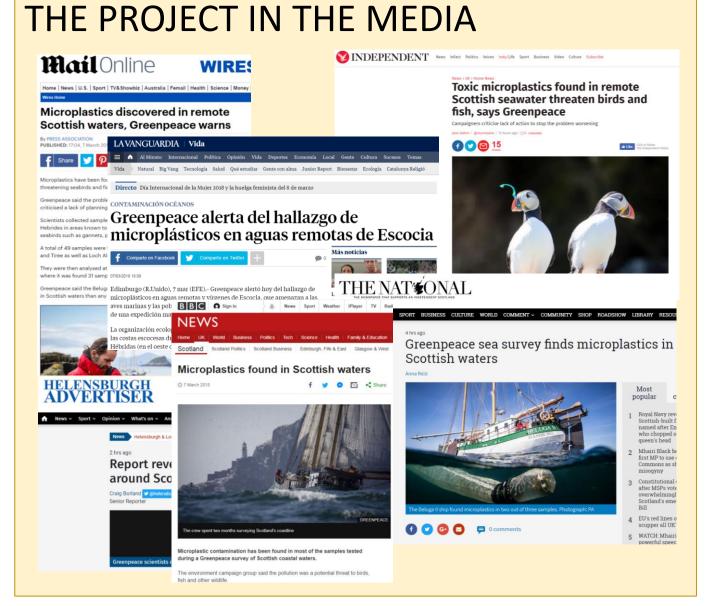
Proportions of different plastic types for the total number of plastic pieces found in all net tow samples.

CONCLUSIONS

High variability of abundances and types of microplastics, as well as, pollutants carried by microplastics. It is not possible to identify particular mciroplastic hotspots. Microplastic hotspots are very dynamic. Microplastics are the mean of transport of different emerging contaminants including endocrine disruptors.

Even in the remote waters around the Hebrides (NW of Scotland) microplastics are present.

This work would not have been possible without the hard work of the crew of the Greenpeace's ship Beluga II. Access to the PerkinElmer Frontier FT-IR spectrometer and Spotlight 400 imaging FT-IR microscopy system was made possible under a Research Partnership Agreement between the Greenpeace Research Laboratories and PerkinElmer.



Shiant Islands; cadmium 195 mg/kg

No correlation between chemicals and type/size of microplastic

No correlation between chemicals and sampling

location



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