THE USE OF EXPEDITION CRUISE SHIPS AND CITIZEN SCIENCE TO BRIDGE THE GAPS IN PLASTIC MARINE LITTER KNOWLEDGE IN REMOTE AREAS

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OMNIPRESENT PLASTIC LITTER

Data on spatial and temporal dynamics of plastic litter in remote areas is required

- Only limited data on occurrence is available
- Long-term data series are required to address changes in occurrence related to other factors such as season, weather and hydrological conditions
- Ships of opportunity are an ideal platform to collect replicable data on established transects
- New, advanced technologies allow assessment of microplastic abundance and simultaneous collection of oceanographic meta-data: FerryBox on MS Roald Amundsen

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MODERN RESEARCH PLATFORM OF OPPORTUNITY

Modul 6. Console for Ocean Literacy
Touch screens displaying observational data and ocean related "key stories"

Modul x: Towed/hull-mounted observations
Towed plankton collector (CPR) profiling sensors (XBT), acoustic current meters (ADCP). Ofte 3dje part

Modul 7: Metrological and atmospheric observations
Metrological variables of wind direction and strength

Modul 8: Advanced above water observations
Light sensors, sea surface skin temperature, downwardfacing sensors for Ocean Colour

Modul 5. Laboratory
Ranging from proper labs, small lab benches, to citizen science labs. Used for advanced sensors (Flowcytometry, Nutrients)

Modul 0: FerryBox system
Clean seawater intake, pipes, pumps, computer, electronics, network

Modul 1: FerryBox standard sensors
Inlet temperature, Salinity, temperature, Oxygen

Modul 2: FerryBox optical sensors
Chlorophyll a, cDOM, turbidity, Phycocyanin

Modul 3. FerryBox carbon sensors
pCO_2, pH, Alkalinity,

Modul 4: FerryBox advanced samplers
Water sampler, microplastics, contaminants, sample filter collector

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MICROPLASTIC SAMPLER

- Sampling volume: up to 15’000 L
- Samples transferred to GfA filter on board and sent to NIVA for analysis

Filters:

500µm

300µm

100µm

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BEACH CLEAN-UPS

United Nations Clean Seas campaign

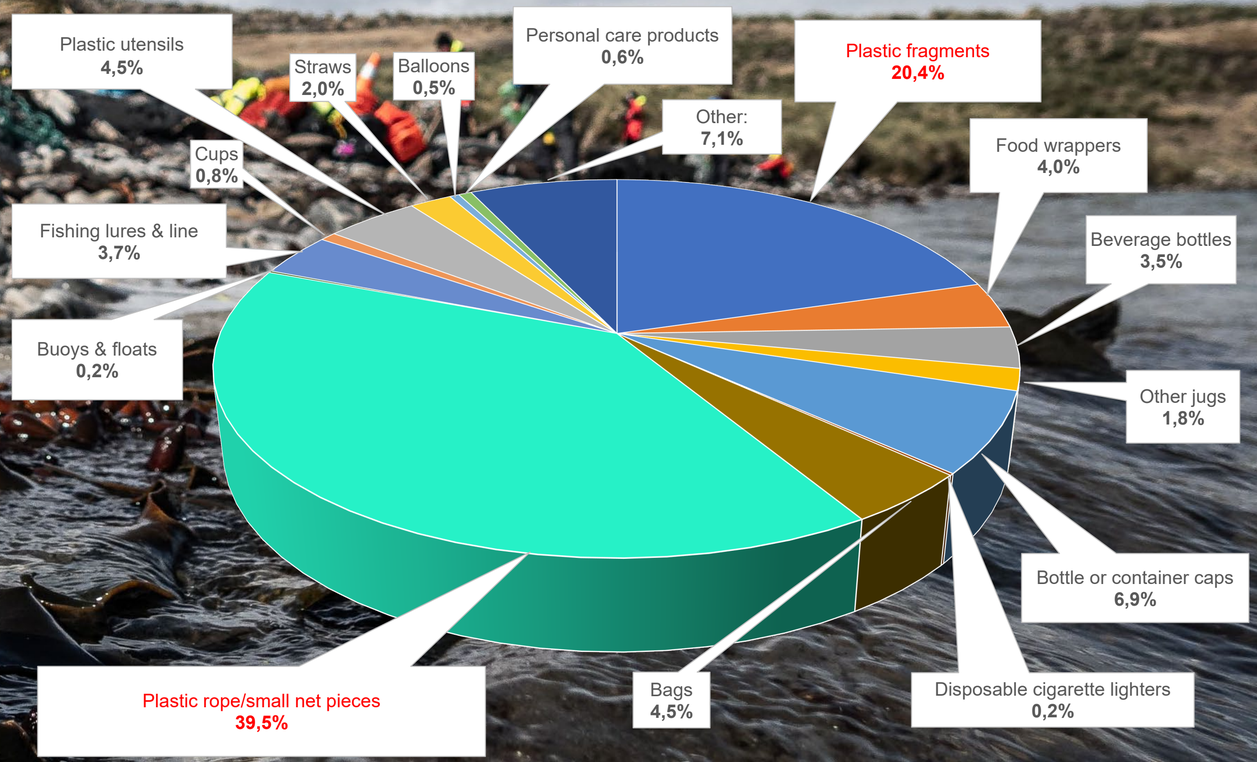
We are working to combat marine plastic pollution by adhering to the Clean Seas campaign four goals:

- Significantly reduce the use of single-use plastics onboard expedition cruise vessels
- Enhance cleanup efforts in the Arctic – very active in Svalbard (Clean Up Svalbard and SALT)
- Educate and motivate passengers, staff and crew – developing Citizen Science project related to plastic waste
  Share knowledge and best practices

CITIZEN SCIENCE

Use Beach Clean-ups and Citizen Science to identify sources of plastic into pristine environments

- In this example, plastic samples were collected in Carcass Island, west Falkland/Malvinas Islands following the NOAA Marine Debris Shoreline Survey Guide and analysed on board
- Smaller fragments were taken on board for analysis



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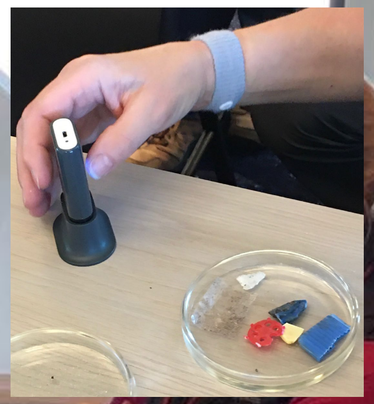
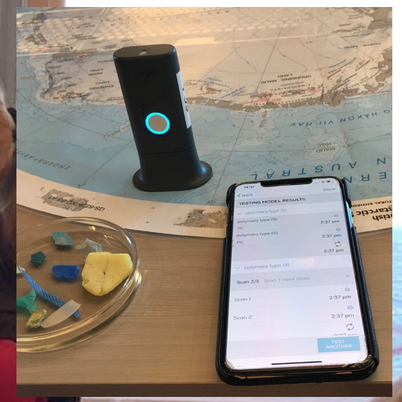
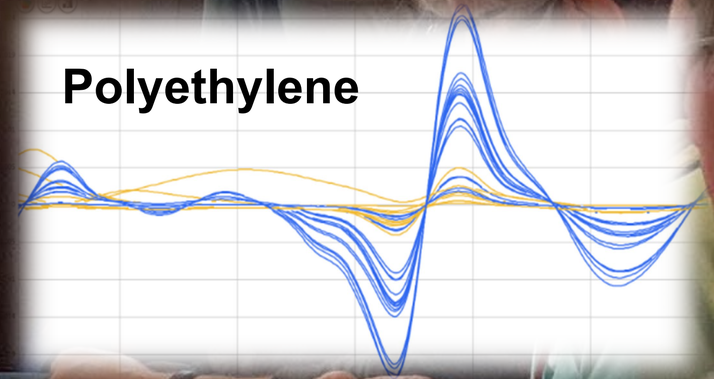
ANALYSIS WITH GUESTS





On board identification

- Identification of plastics by guests using a pocket Near Infra Red scanners linked to NIVAs data cloud, increased awareness of the extent and type of plastics in the marine environment
- One missing link in plastic litter research is the fragmentation of macro plastic into micro plastic
- Guests are able to identify meso plastics (particles of a few mm) and fill the gap between macro data from beach cleanings and micro data from on board analysis (research data)



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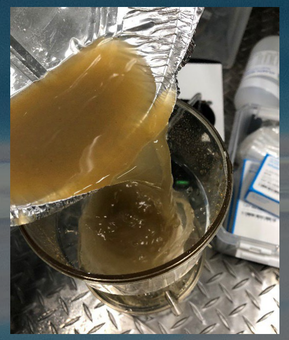
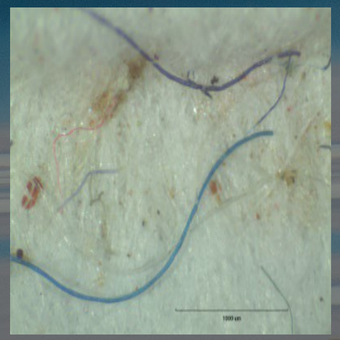
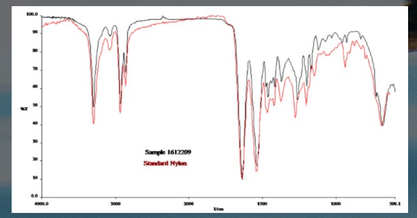
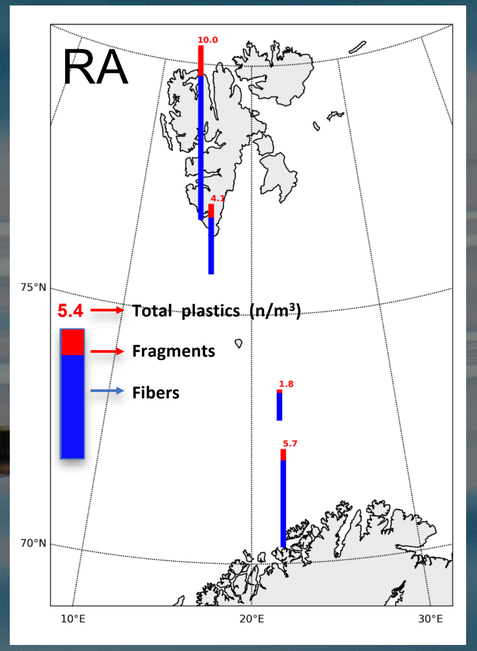
MICROPLASTIC IN THE ARCTIC

- Results obtained during MS Roald Amundsen's (RA) first operation in the Arctic are in agreement with published data, validating the system









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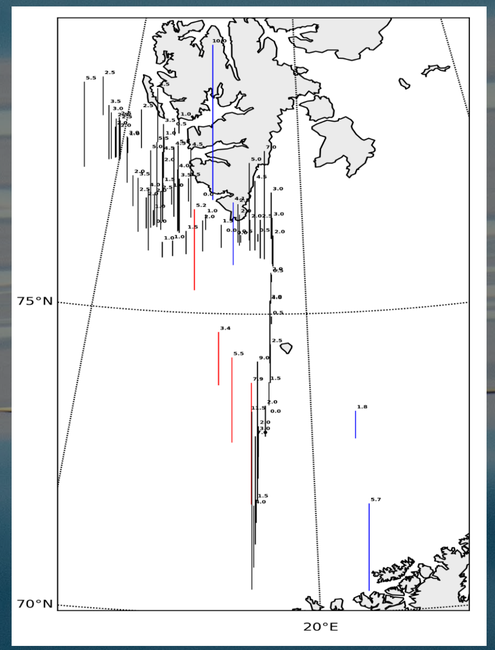
Microplastics in Arctic polar waters: the first reported values of particles in surface and sub-surface samples

Amy L. Lusher[1], Valentina Tirelli[2], Ian O'Connor[1] & Rick Officer[1]

Plastic, as a form of marine litter, is found in varying quantities and sizes around the globe from surface waters to deep-sea sediments. Identifying patterns of microplastic distribution will benefit an understanding of the scale of their potential effect on the environment and organisms. As sea

Total number of plastics (n/m³)

Tromsø-Svalbard - av 5.4, min 1.8, max 10.0
Tromsø-Svalbard - av 5.5, min 3.4, max 7.9
Research Vessel (Lusher et al.) - av 2.7, min 0, max 11.5
Russian Arctic - av 1.6, min 0.2, max 3.6



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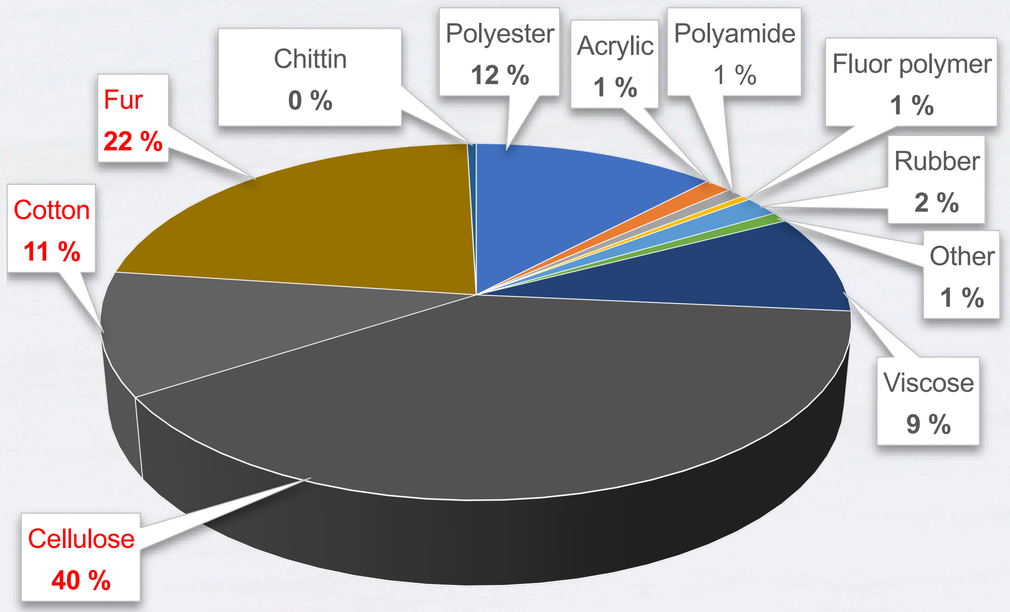
MICROPLASTIC IN ANTARCTICA 300-2000 µm



Most fibres from natural origin

- Cellulose based fibres
- Cotton fibres
- Biological fur fibres

Plastics

- Polyester fibres
- Viscose fibres
- Rubber particles

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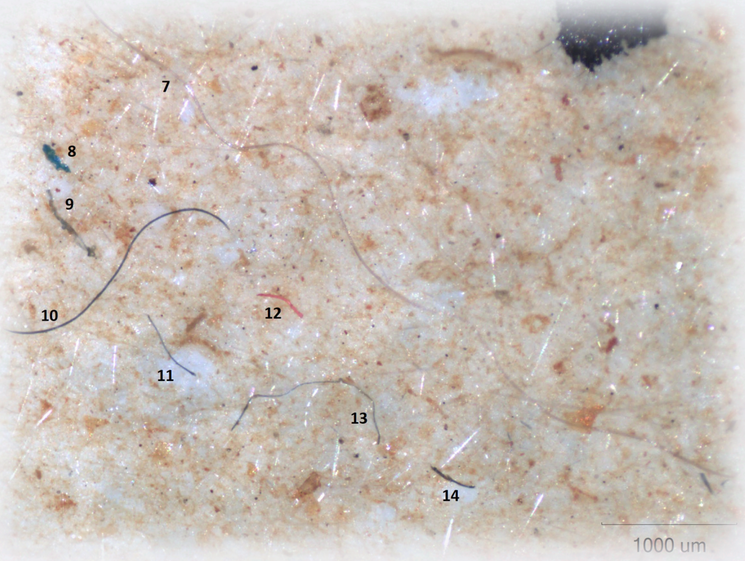
MICROPLASTIC IN ANTARCTICA 300-2000 µm

Fibres

Date	n/m³
Feb 8th, 2020	2,39
Feb 7th, 2020	1,79
Feb 6th, 2020	4,55
Jan 11th, 2020	2,32
Jan 6th, 2020	3,70
Jan 1st, 2020	3,55
Average	3,05

Microplastics

Date	n/m³
Feb 8th, 2020	0,00041
Feb 7th, 2020	0,00041
Feb 6th, 2020	0,00089
Jan 11th, 2020	0,00017
Jan 6th, 2020	0,00077
Jan 1st, 2020	0,00044
Average	0,00051



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CONCLUSIONS AND WAY FORWARD

- Partnership between Hurtigruten and The Norwegian Institute for Water Research successfully launched a research platform for microplastic research: we will expand this work
- Beach clean-up and onboard analysis of macro- and meso seized litter is an excellent way to both, create awareness and collect ‘citizen science’ data
- Preliminary results in the Arctic show that microplastic levels were higher around Svalbard and the coast of Norway (Tromsø), samples contained significantly more fibers than fragments and varied from 1.8 to 10 particles per m^3
- In the Antarctic samples, cellulose and cotton-based fibers dominate and polyester is the predominant polymer fibre
- Over 50 samples taken over a period of 4 months are being analyzed and correlated to the meta-data from the FerryBox
- When operations resume, further long-term sampling of different trajectories in the Arctic, Norwegian coast and Antarctica will be conducted

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