Microplastics: Monitoring & Emergency Response

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premiam INTERSPILL
RAI, AMSTERDAM 21-23 JUNE 2022 | CONFERENCE & EXHIBITION

Together we are working for
a sustainable blue future

Centre for Environment Fisheries & Aquaculture Science

Cefas

Who we are

We are the government's marine and freshwater **science experts**.

We help keep our seas, oceans and rivers healthy and productive and our seafood **safe** and **sustainable**.

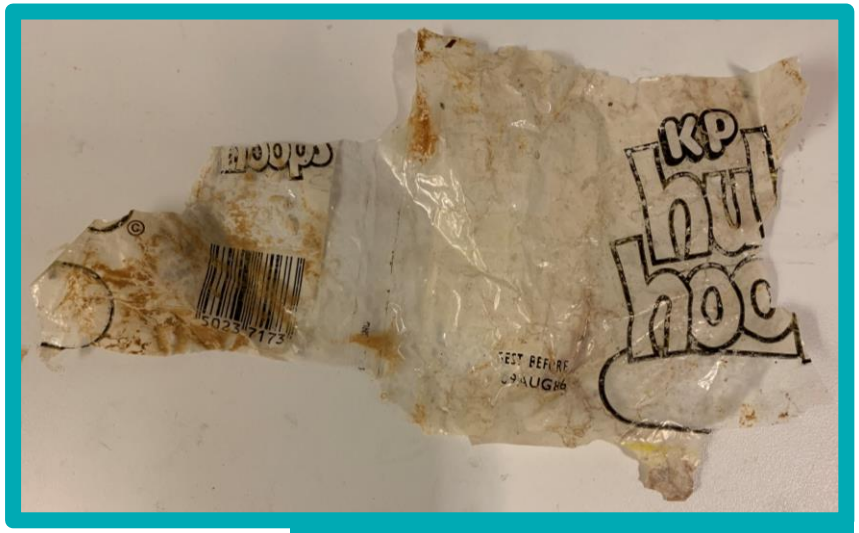
Our knowledge informs our **advice to governments** and international organisations such as OSPAR, in support of international commitments and programmes.

What we do


Technology and Data
Clean seas
Ocean processes
Ecosystem understanding
Marine biodiversity
Valuing nature
Climate change
Emergency response
Aquatic animal health
Assessment and advice
Sustainable fisheries
Food safety
Enabling food security
Supporting marine economies
Safeguarding human health

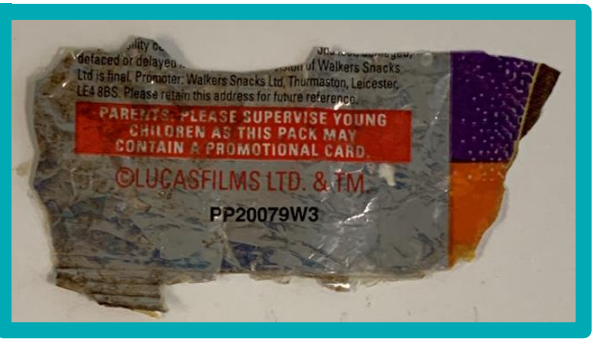
Plastic Pollution

- Plastic pollution is **persistent**, having a long-lasting impact on the environment.
- These crisp packets were recovered from the Thames Estuary, UK in 2018 and 2019. Each is over **20 years** old.



Best before date
1986

Lucas Film LTD
1999



Walkers
1970s-88

Macroplastics

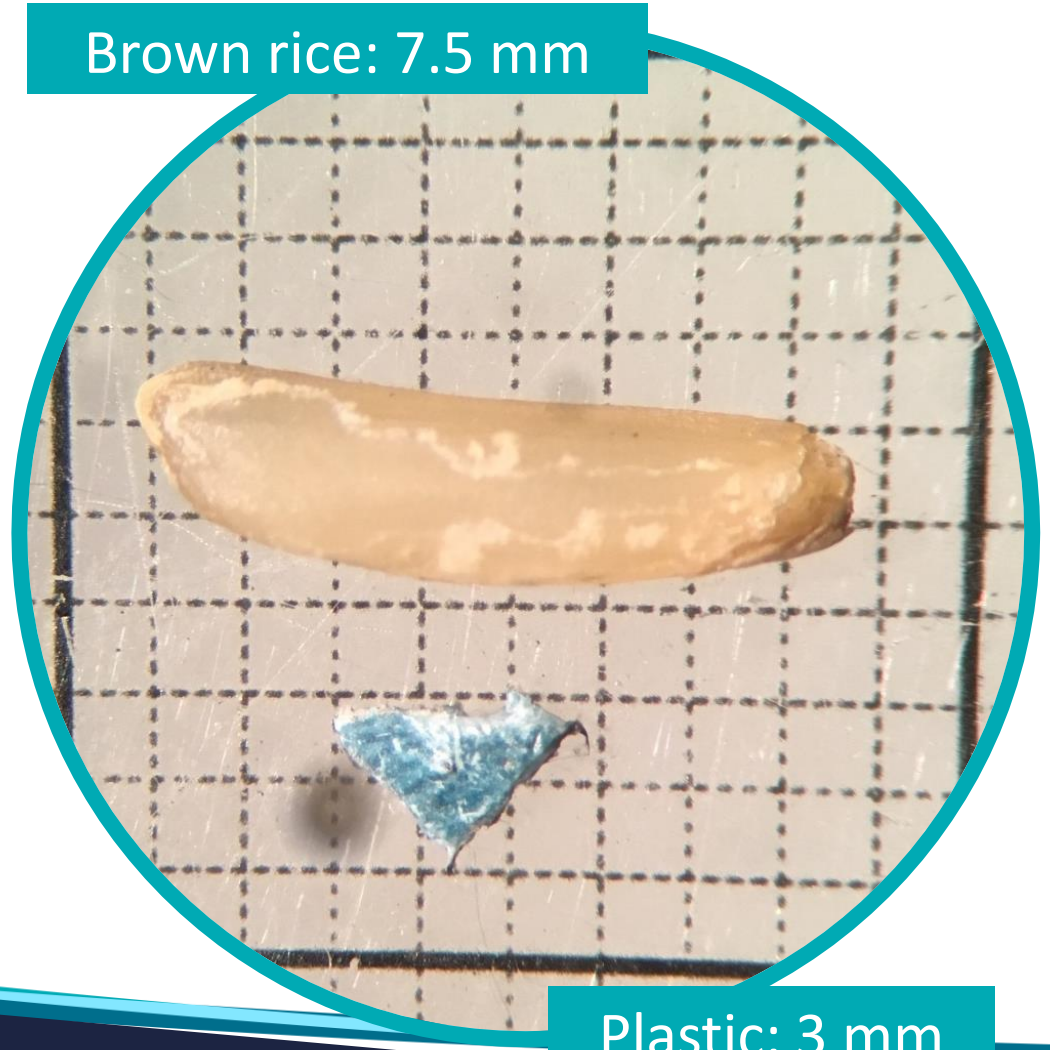
- Macroplastics can **entangle** wildlife and be **ingested**, which can result in lacerations, starvation and death.

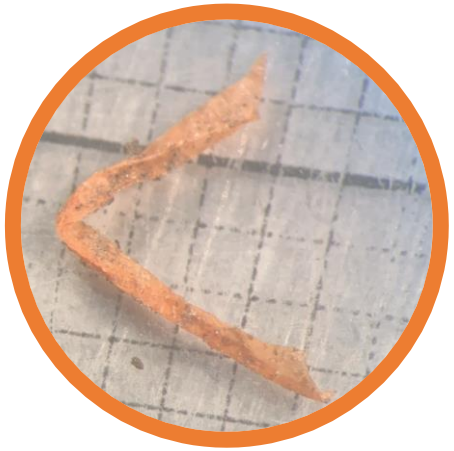
- Macroplastic also **litters the seafloor and riverbeds**. This can affect the **distribution** of biota and can impact **gaseous exchange**.

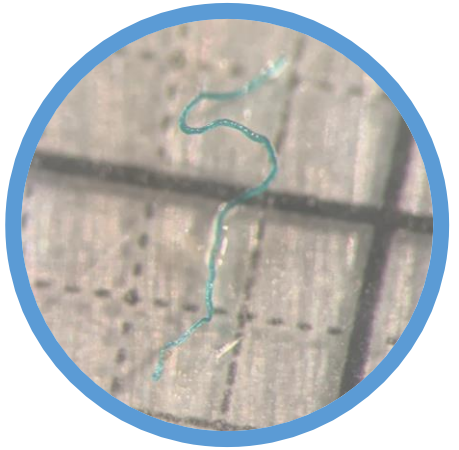
- Plastic can also act as **vectors** for non-native species, chemical pollutants (e.g., POPs, PAHs, PCBs) and pathogens.

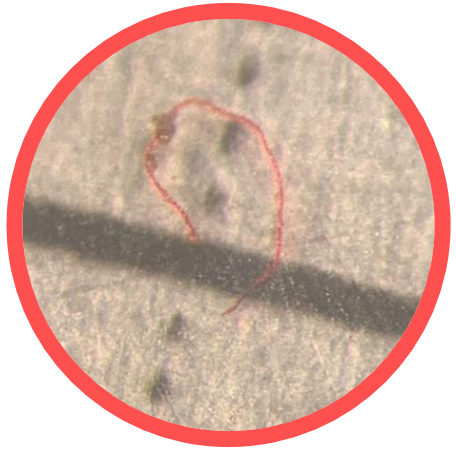
Image: NOAA

Microplastics









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X-Press Pearl (Sri Lanka)

- **May 2021:** X-Press Pearl cargo ship carrying **chemicals** and plastic **nurdles** catches fire off the coast of Sri Lanka.
- Tons of nurdles released into the sea and washing ashore at Negombo Bay.
- Many chemicals **hazardous** to aquatic life.
- **March 2022:** Volunteers are still removing nurdles from Negombo Bay.

Images: EPA, Sri Lanka Air Force

Ocean Country Partnership Programme (OCPP)

- Monitoring training following **standardised protocols**, including OSPAR beach cleans and microplastic sample collection.

- Collaboratively worked with various partners to develop **four microplastics labs** in Sri Lanka.

- Provided **training** and knowledge exchange: microplastic extraction **optimisation** for sediment, biota and water, FTIR microplastic **identification**.

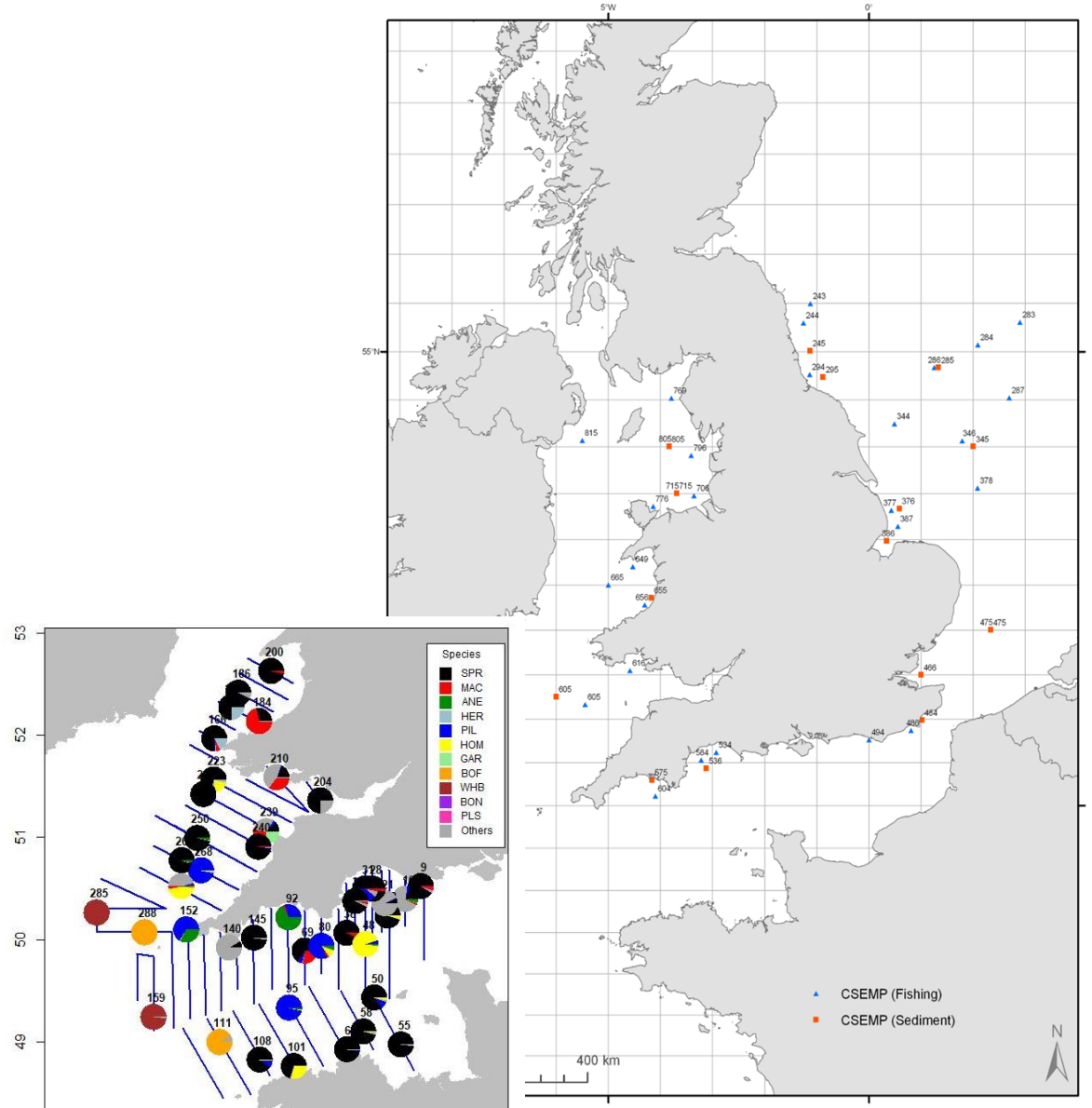
- Collaborating with media outreach initiatives.

MINIMISE

- **Monitoring** microplastics concentrations in **sediment** and **biota** from 2018 – 2021.

- Bottom-dwelling and midwater biota: dab (flatfish), anchovy and sardines (small midwater species).

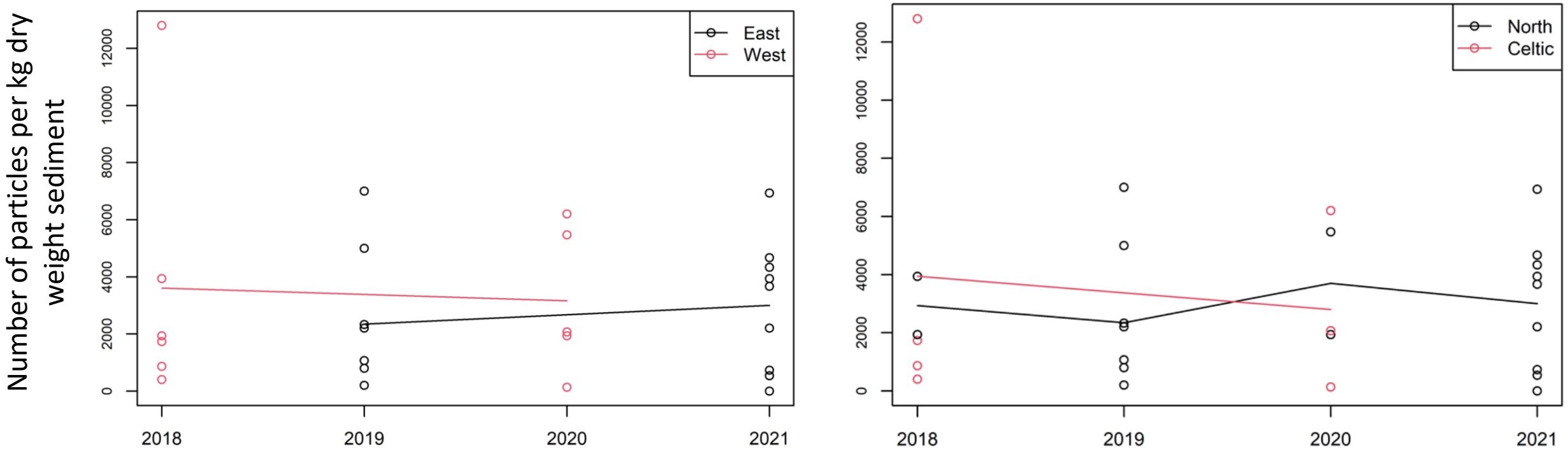
- Microplastic in **surface water** in 2022.



Sediment

- **No significant difference** year-on-year between east and west coast (linear regression & Mann-Kendall).
- **No significant difference** year-on-year between North Sea and Celtic Sea.

- Figures: Square root of microplastic count plotted against year with lines linking the means of the square root counts.

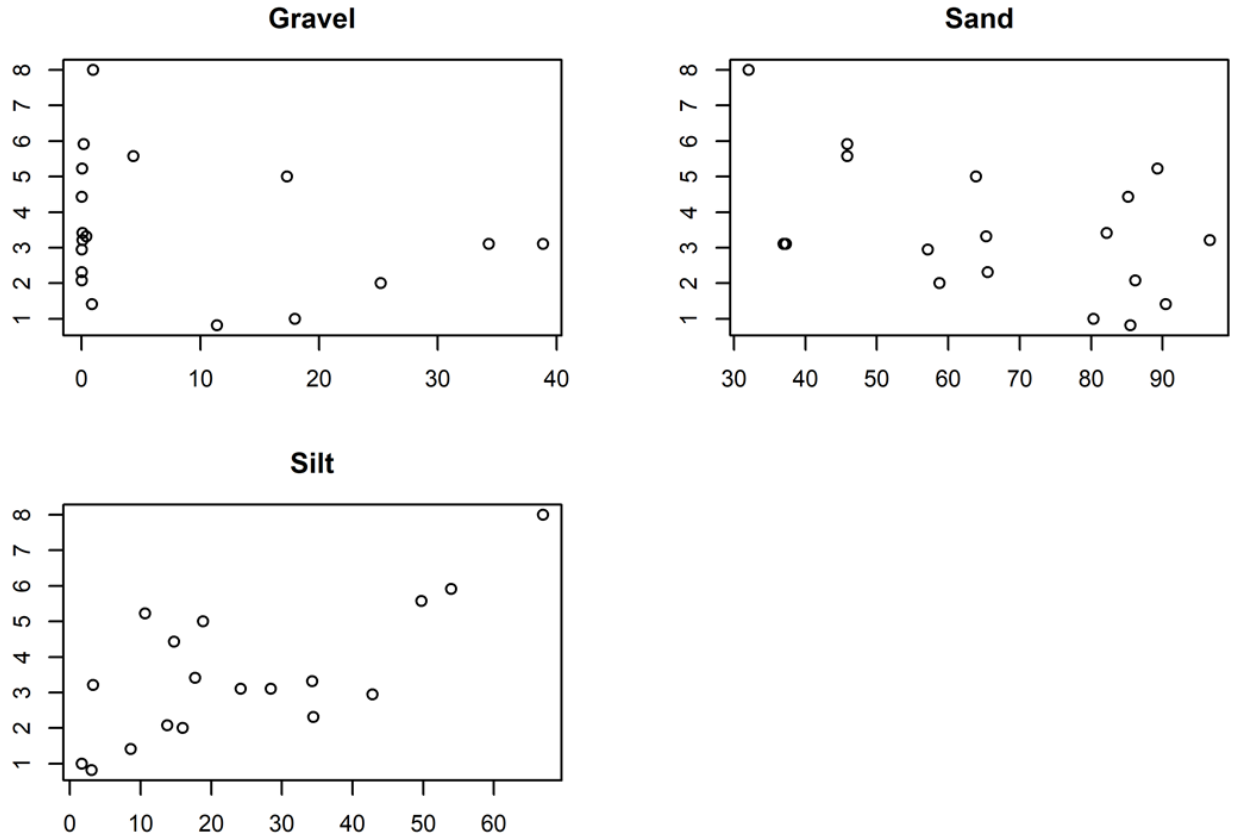


Footnote: East linear regression (p=0.63) Mann-Kendall (p=0.79); west LR (p=0.96) MK (p=0.71); North LR (p=0.82) MK (p=0.85); Celtic LR (p=0.83) MK (p=1.0).

Sediment (Particle Size Analysis)

- **Positive relationship** between portion of silt/clay in sample and amount of microplastics (Mann-Kendall analysis; p=0.01). This is also where most concerning chemicals accumulate in a spill scenario.

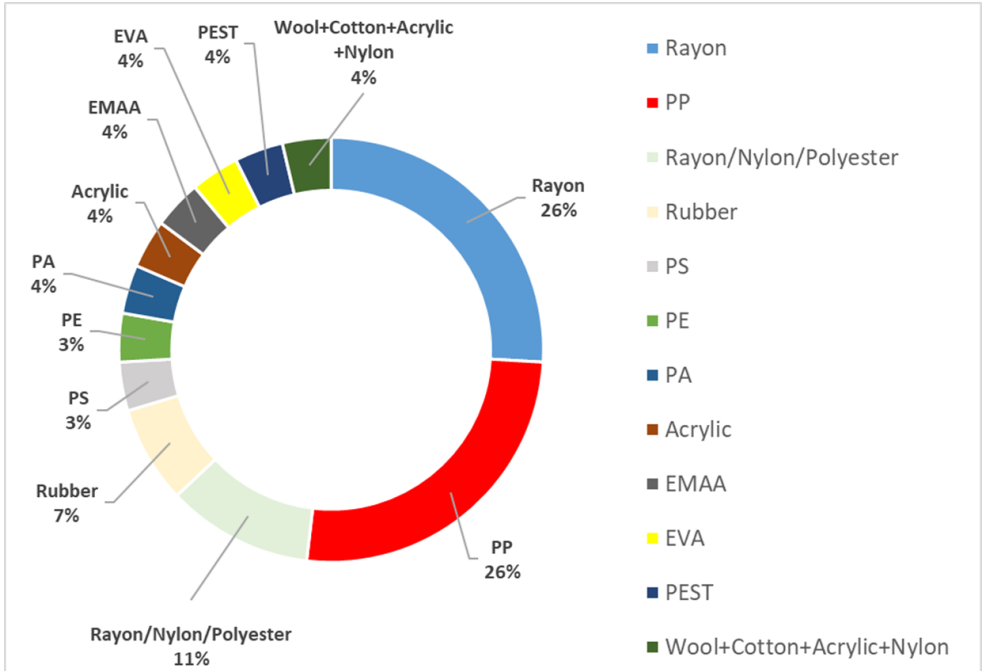
- Figure : Square root of the station means plotted against the three substrate variables: %Gravel, %Sand and %Silt/Clay.



Sediment

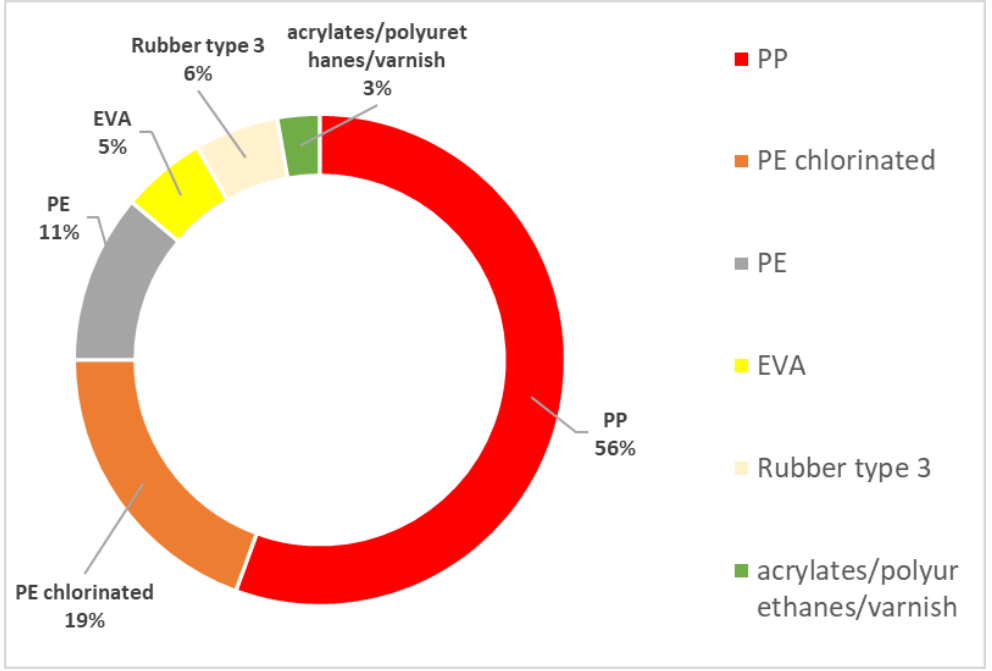
Micro-FTIR

- **78% fragments**, 10% fibres, 11% spheres and 1% microbeads.
- Particles detected in the size range **50 – 3276.63 µm**.
- Figure: Particles identified and confirmed as microplastics using micro-FTIR classified per category (n=27).



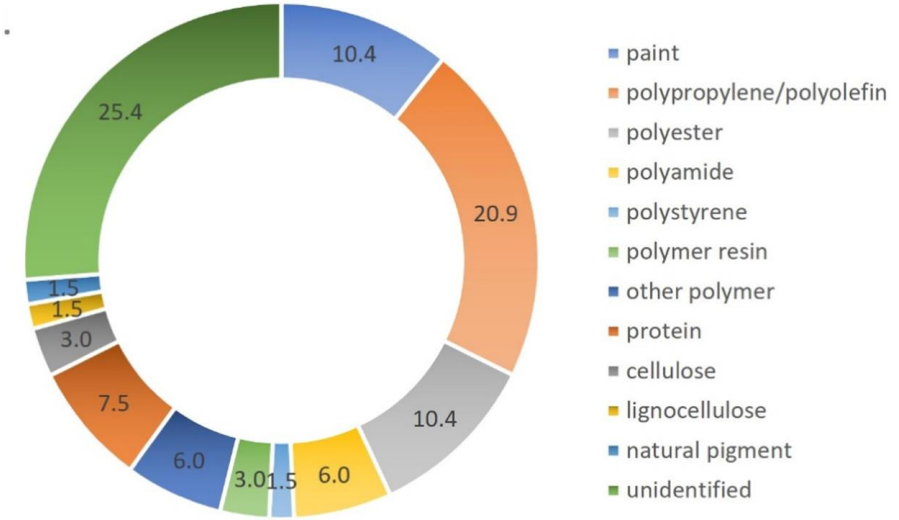
Focal Plane Array (FTIR)

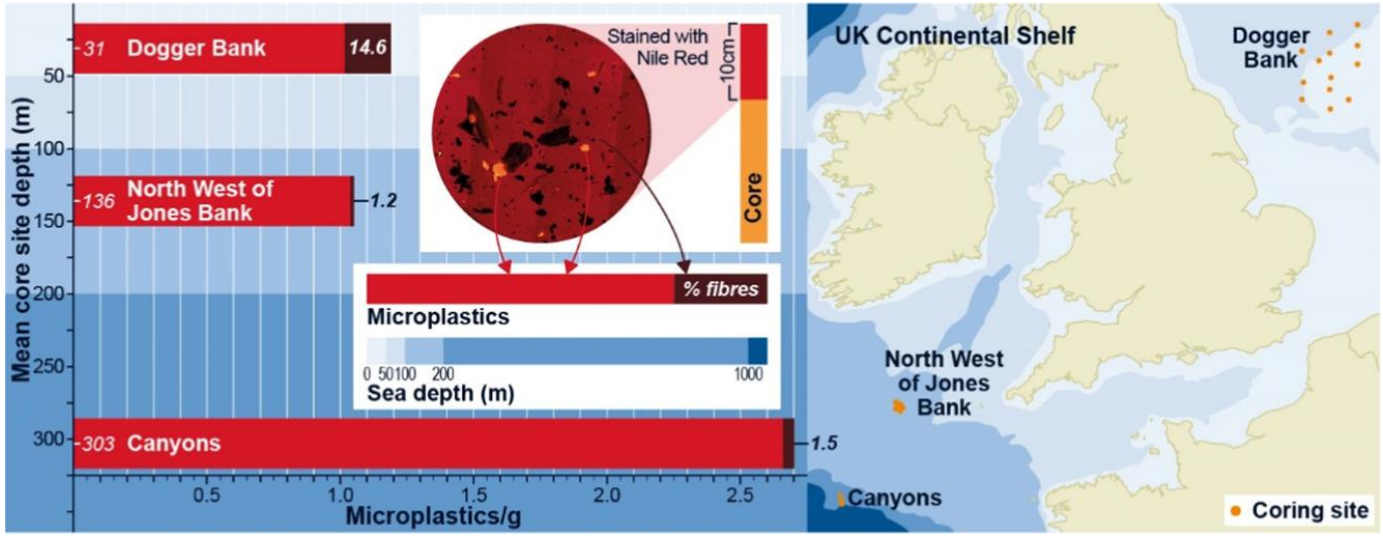
- Data based on 4 stations (more stations in progress).
- Particles detected in the size range **23 – 1920 µm**.
- Most items **below 100 µm** in size.
- Figure: Particles identified and confirmed as microplastics using micro-FTIR FPA classified per category (n=36).



UK Sediment Cores

- **Sediment cores** collected from three locations in the UK.
- Average abundance in the top 10 cm was **1050–2700** MP kg^{-1}.
- Decreased with **increasing sediment depth.**
- Increased with **increasing water depth**.





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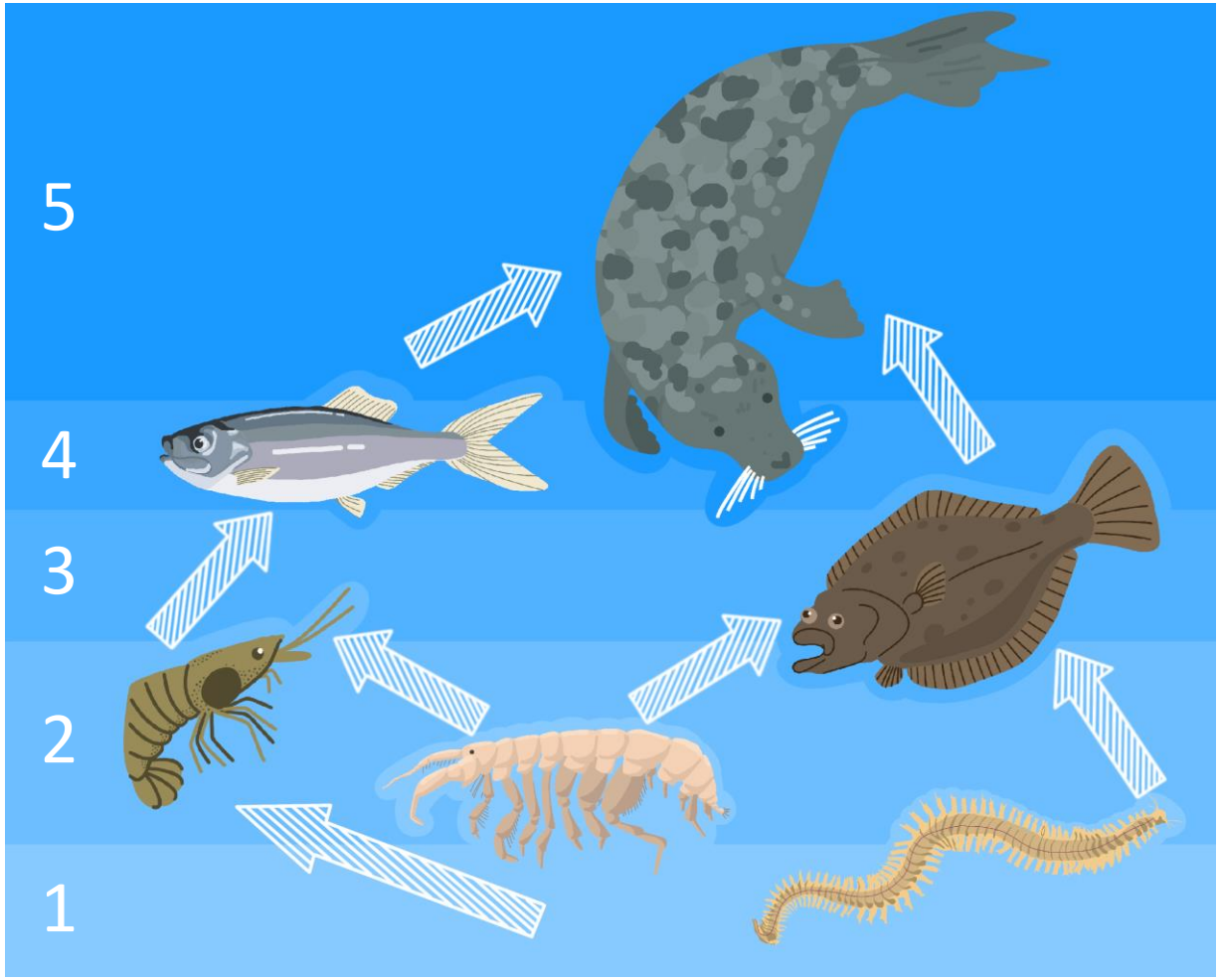
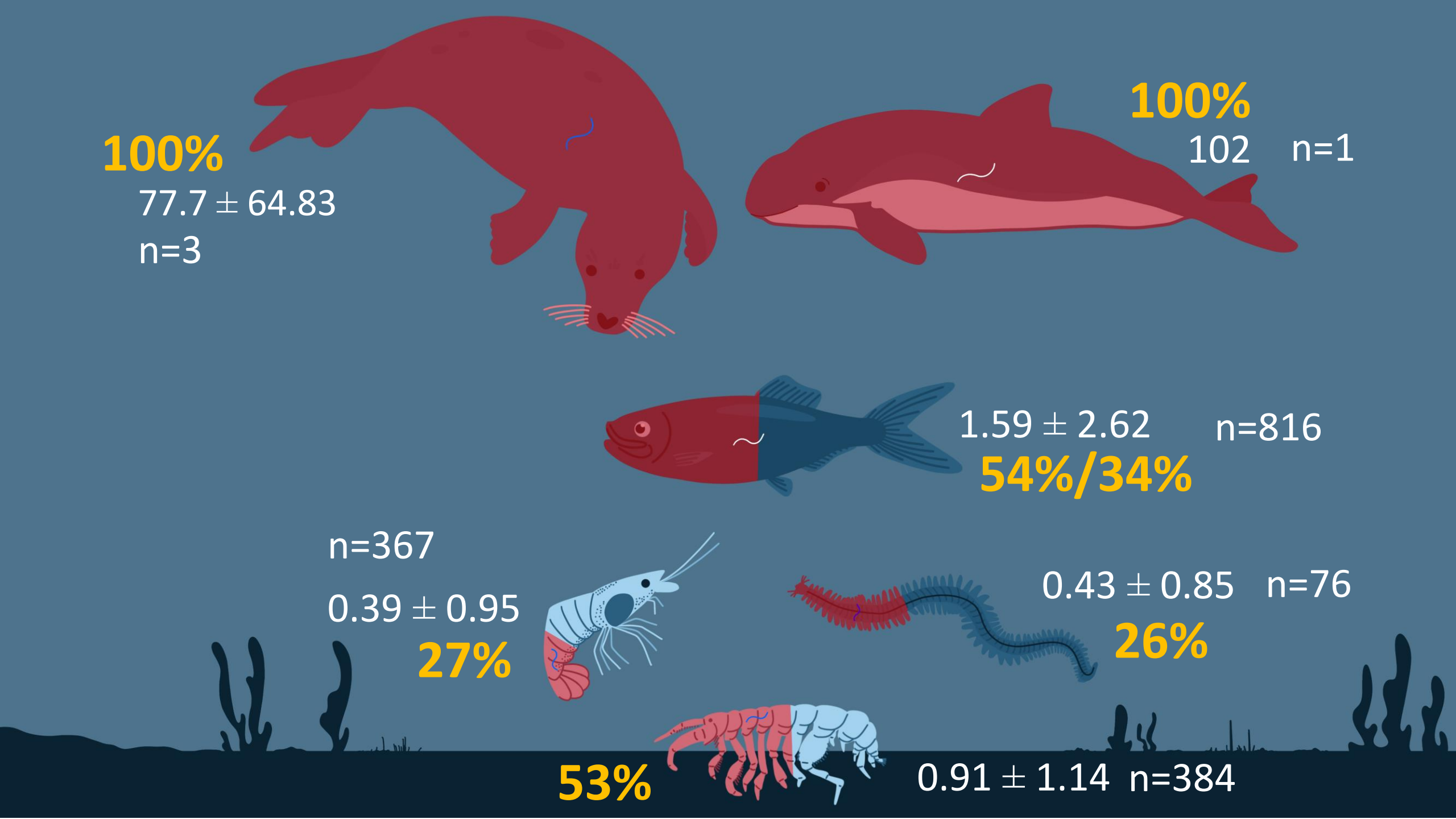
Kukkola et al. (2022)
Doi: 10.1016/j.marpolbul.2022.113554

Microplastic Ingestion

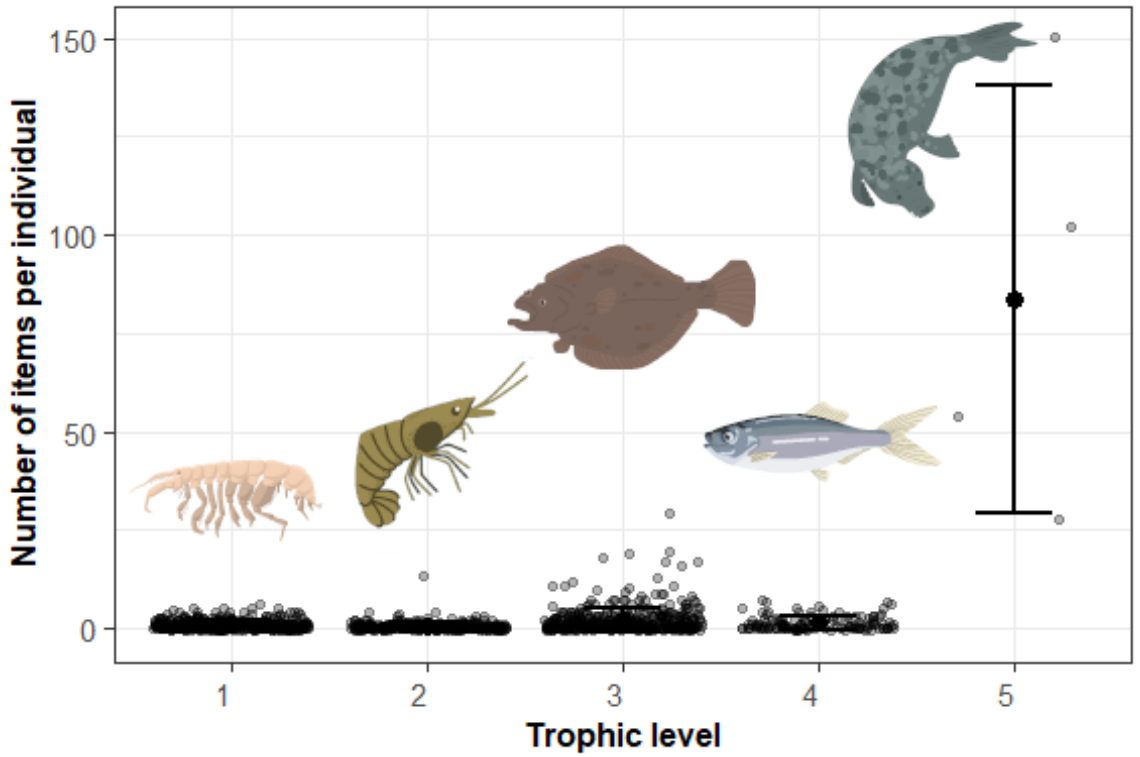
- Microplastics are readily ingested by biota on **all trophic levels**.
- Monitoring typically focuses on a few key species.
- Assessing contamination in a food web can provide insight into **trophic transfer** and **bioaccumulation**.




100%
77.7 ± 64.83
n=3
100%
102
n=1
1.59 ± 2.62
n=816
54%/34%
n=367
0.39 ± 0.95
27%
0.43 ± 0.85
n=76
26%
53%
0.91 ± 1.14
n=384

Microplastic Ingestion

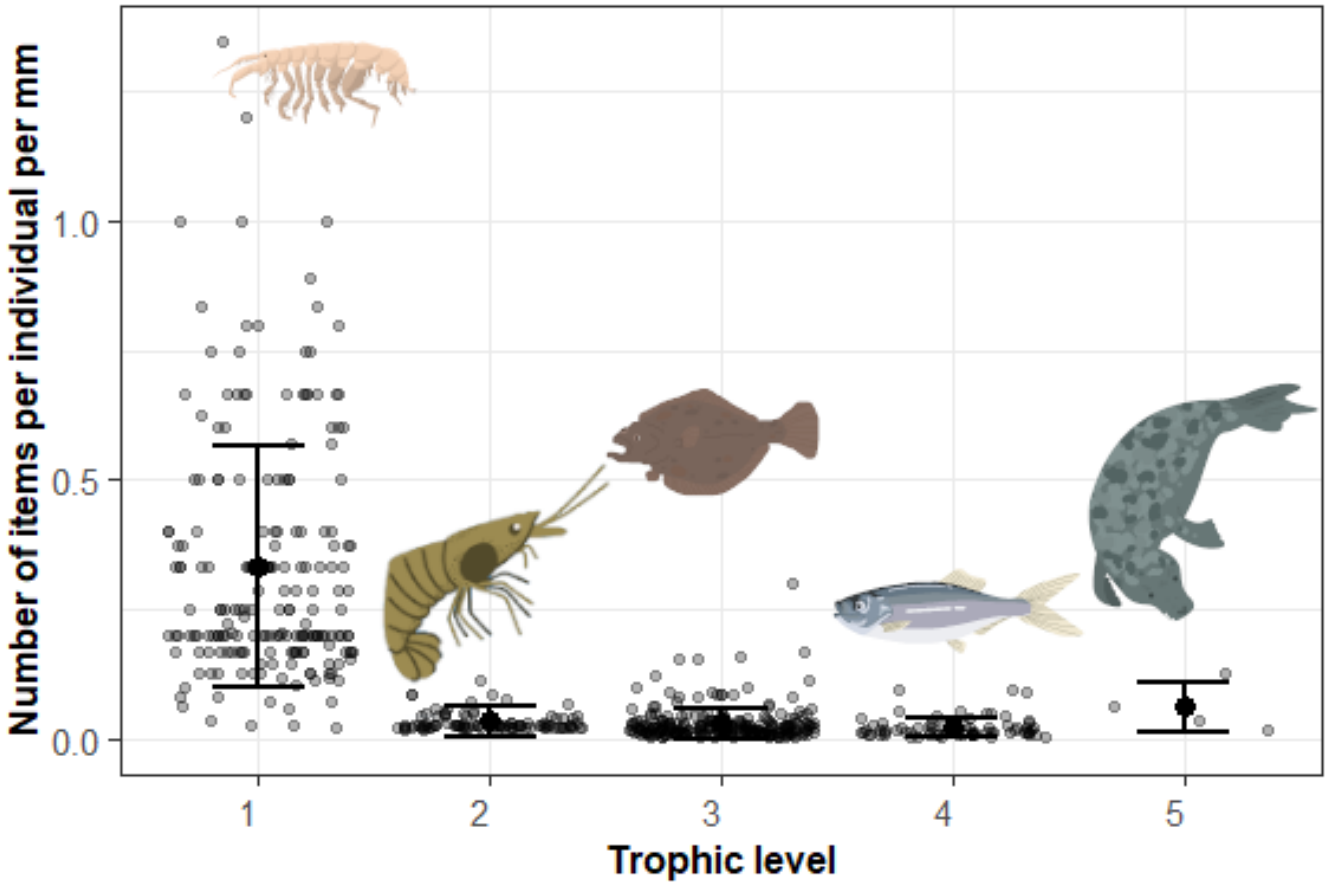
- **Top predators** consume more microplastics.
- **Trophic transfer** likely occurs in the environment
  - contaminated prey recovered from fish predators.
- Size of plastic affects bioavailability
  - trophic level 1 biota mainly ingested particles **smaller than 1 mm**.
- Similar size pieces of plastic recovered between levels 3 – 5.
- **Blue fibres** were more abundant in biota than in sediment.



- It is possible that some organisms **preferentially feed** on blue fibres and these are transferred up the food chain.
  - (Ory et al., 2017, 2018; Xiong et al., 2018; Zantis et al., 2022)

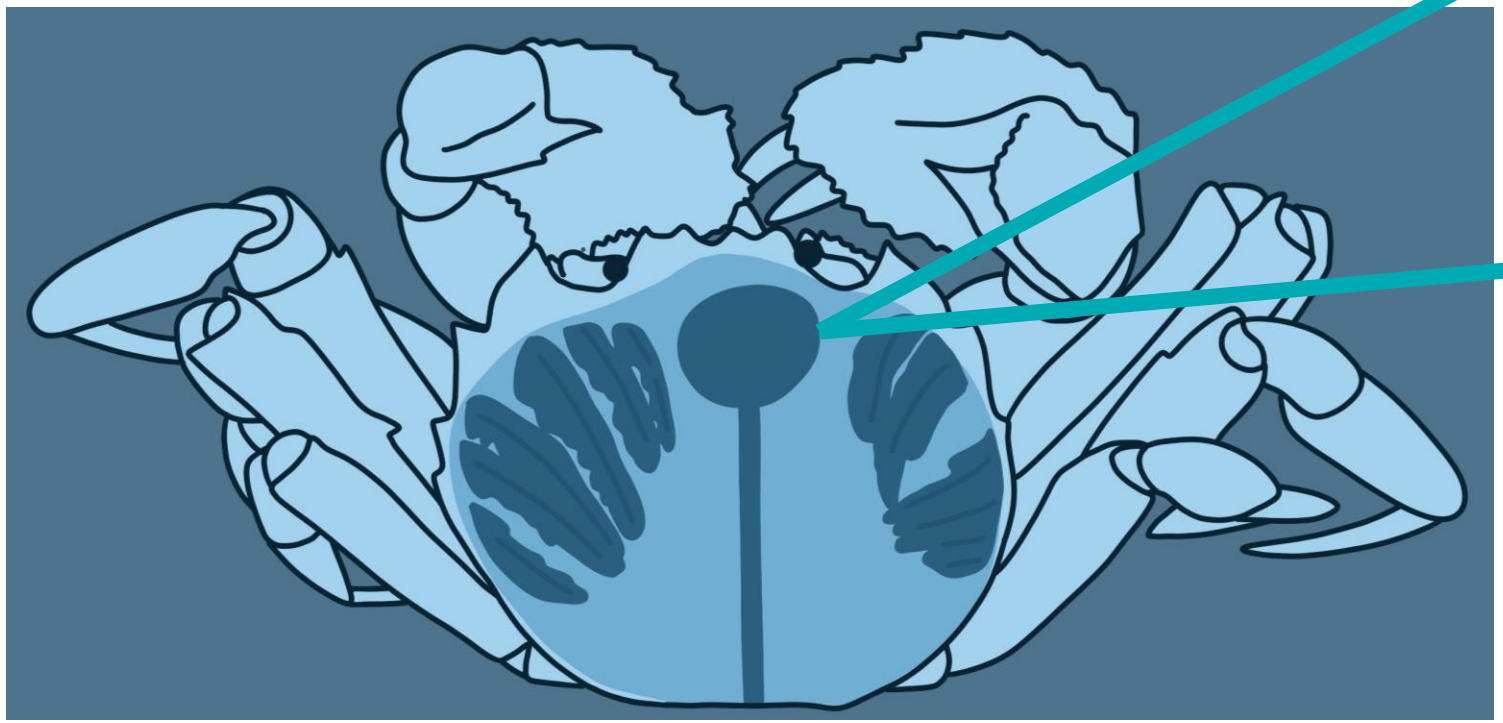
Microplastic Ingestion

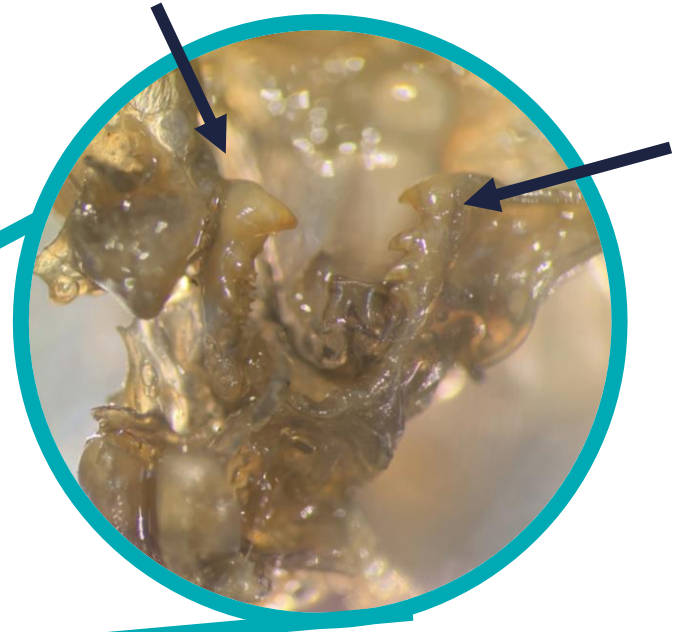
- When size is controlled for, **benthic invertebrates** are more at risk of ingesting microplastics.



Microplastic Ingestion

- **71%** of *Carcinus maenas* contained microplastics: **10% contained tangles** of plastic.
- **100%** of *Eriocheir sinensis* contained plastic: **95% contained tangles** of plastic.



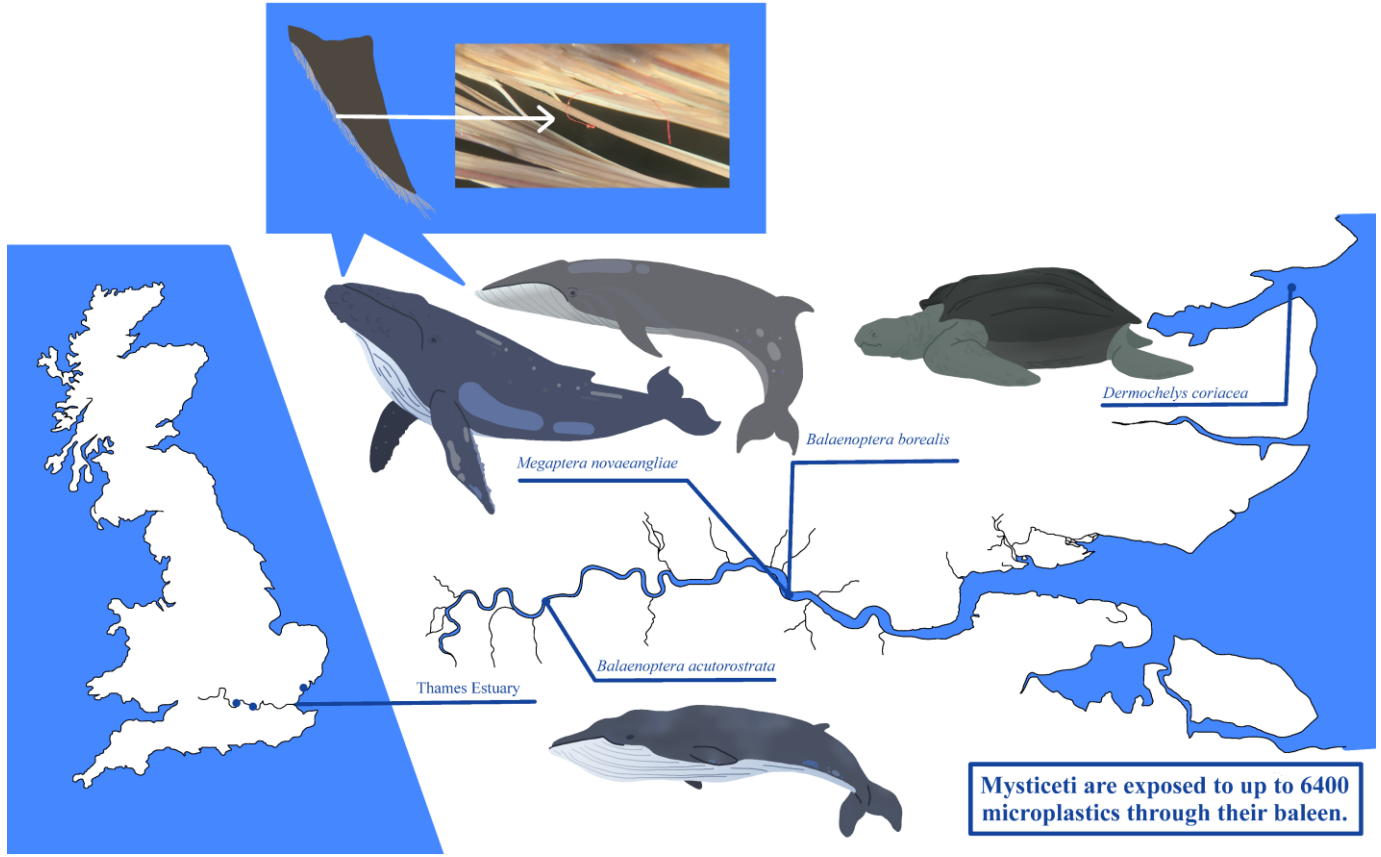


McGoran et al. (2020)
Doi: 10.1016/j.envpol.2020.114972

Microplastic Ingestion

- Megafauna strandings in the UK were investigated for microplastic ingestion.

- Baleen from **two juvenile Mysticeti** whales was examined.



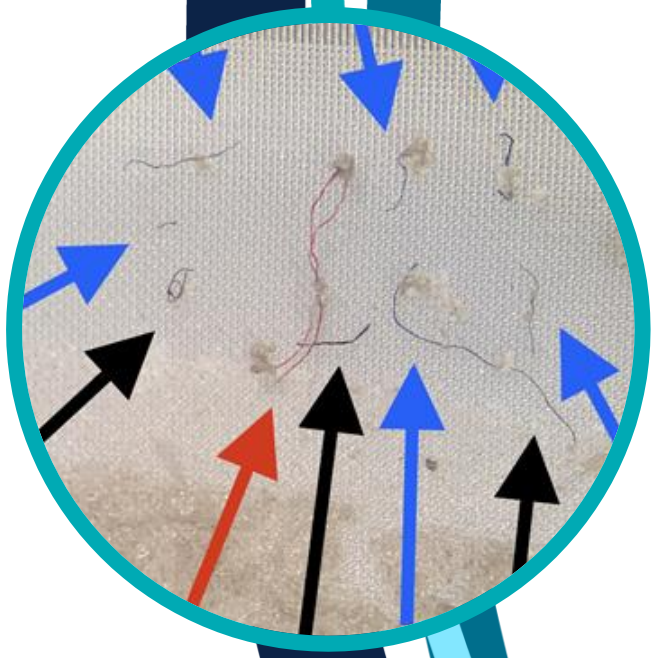
Microplastic Ingestion

Megaptera novaeangliae

- Average **12.33 ± 6.38 MPs per baleen** plate (mean ± SD).
- Have between 270 and 400 baleen plates.
- Estimated exposure per individual is **1,607 – 7,484**.

Balaenoptera borealis

- Average **9 ± 6.57 MPs per baleen** plate (mean ± SD).
- Have between 219 and 410 baleen plates.
- Estimated exposure per individual is **532 – 6,384**.



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Closing Remarks

- Plastic pollution is a serious environmental threat and spills will have political consequences.
- Plastic leaks can have severe impacts on ecosystem health and impact local livelihoods and national economy.
- Estimating the impacts of a spill scenario is hard to do in the absence of baseline data for the area from before the spill (e.g., X-Press Pearl)
- The smaller the items are, the harder they are to clean up and the more species they are likely to impact.
- Micro and nanoplastics can impact the entire food web and species selection for monitoring should be carefully considered.

Thank you for listening

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