MICRO

International workshop

Fate and impact of microplastics in marine ecosystems

13-15 January 2014 — Plouzané - France

DETAILLED PROGRAM OF MICRO 2014

&

PRESENTATION ABSTRACTS

Editors : A.-L. Cassone & P. Soudant

Web site : http://micro2014.sciencesconf.org / Contact : micro2014@sciencesconf.org

Fate and impact of microplastics in marine ecosystems

13-15 January 2014

PROGRAM

Monday, January 13, 2014

08:30 - 09:00 : Welcoming participants – Distribution of badges

09:00 - 09:30 : Workshop introduction by *Yves-Marie Paulet* (dir. IUEM) *& Johan Robbens* (coord. MICRO)

09:30 - 12:30 : **Occurrence of microplastics in the marine environment** - *Myra Van Der Meulen & Lisbeth Van Cauwenberghe*

09:30 - 09:50 › Transport of plastic litter via the Meuse and Scheldt Rivers to the North Sea - *Myra van der Meulen, Deltares*

09:50 - 10:10 › Assessment of marine debris on the Belgian Continental Shelf - *Lisbeth Van Cauwenberghe, Laboratory of Environmental Toxicology and Aquatic Ecology - Ghent University*

10:10 - 10:30 › Fluctuating microplastic contamination in the Clyde Sea Area - *Natalie Welden, University Marine Biological Station Millport, University of Glasgow*

10:30 - 11:00 : *Coffee break*

11:00 - 11:20 › The ubiquitous nature of microplastics in the North Atlantic - *Amy Lusher, Galway-Mayo Institute of Technology*

11:20 - 11:40 › Microplastics and suspected microbeads in the Laurentian Great Lakes of North America – *Marcus Eriksen, 5 Gyres Institute*

11:40 - 12:00 › Occurrence and distribution of mesoplastics in beach sand from Corsica and the French Mediterranean coast using a simplified extraction method - *François Galgani, IFREMER*

12:00 - 12:20 › La participation des ONG et de l'éco-volontariat aux observations sur les microplastiques flottants en Méditerranée - *Hervé Thebault, Planète Urgence*

13:00 - 14:30 : *Lunch & poster session*

14:30 - 16:30 : Occurrence of microplastics in the marine environment - *Myra Van Der Meulen & Lisbeth Van Cauwenberghe*

14:30 - 14:50 › Micro-plastic pollution demonstrably threatens protected areas in the Atlantic: diagnosis of three islands in the Canary Current and next steps. - *Juan Baztan, Marine Sciences For Society & Observatoire de Versailles Saint-Quentin-en-Yvelines.*

14:50 - 15:10 › Rope degradation and microfibre formation – A benthic exposure trial - *Natalie Welden, University Marine Biological Station Millport, University of Glasgow*

15:10 - 15:30 › Fragmentation of polyethylene, polypropylene and expanded polystyrene with an accelerated mechanical abrasion experiment - *Won Joon Shim, Korea Institute of Ocean Science and Technology, University of Science and Technology*

15:30 - 15:50 › Can phytoplankton species impact microplastic behaviour within water column? - *Marc Long, Laboratoire des Sciences de l'Environnement Marin*

15:50 - 16:10 › FTIR analysis for monitoring marine microplastics - *Martin Löder, Alfred Wegener Institute for Polar and Marine Research - AWI (GERMANY)*

16:15 - 17:00 : *Coffee break*

17:00 - 17:40 : Impacts of microplastics on the marine life - *Lisa Devriese & Rossana Sussarellu & Charlotte Corporeau*

17:00 - 17:20 › Microplastics are taken up by marine invertebrates living in natural habitats - *Lisbeth Van Cauwenberghe, Laboratory of Environmental Toxicology and Aquatic Ecology - Ghent University*

17:20 - 17:40 › Translocation of microplastic in the circulatory system of the oyster *Crassostrea gigas* : Evidences and uncertainties : investigation to load. - *Christophe Lambert, Laboratoire des Sciences de l'Environnement Marin*

17:45 - 19:00 ***Poster session + hard worker reward***

Tuesday, January 14, 2014

09:00 - 12:30 : Impacts of microplastics on the marine life - *Lisa Devriese & Rossana Sussarellu*

09:00 - 09:20 › Two alternate mechanisms for uptake of microplastics into the Shore crab *Carcinus maenas*. Trophic transfer and direct exposure - *Andrew Watts, University of Exeter*

09:20 - 09:40 › Microplastics in our food: ingestion by commercially important fish species - *Amy Lusher, Galway-Mayo Institute of Technology*

09:40 - 10:00 › Ecotoxic effects of nano plastic on freshwater plankton (*Scenedesmus obliquus* and *Daphnia magna*) - *Ellen Besseling, Wageningen University, Institute for Marine Resources & Ecosystem Studies, Wageningen UR*

10:00 - 10:20 › Impact of microplastics on feeding, function and fecundity in the copepod *Calanus helgolandicus* - *Matthew Cole, University of Exeter, Plymouth Marine Laboratory*

10:30 - 11:00 : *Coffee break & photo of participants*

11:00 - 11:20 › Microplastics: effects on oyster physiology and reproduction - *Rossana Sussarellu, Ifremer*

11:20 - 11:40 › Microplastics are love-killers for Pacific oysters! - *Marc Suquet, Laboratoire de Physiologie des Invertébrés*

11:40 - 12:00 › Biological effects of exposure to plastic particles in the 3-spined Stickleback (*Gasterosteus aculeatus*) - *Tim Katzenberger, University of Portsmouth*

12:00 - 12:20 › The physical impacts of microplastics on marine worms – *Stephanie Wright, University of Exeter*

12:30 - 14:00 : *Lunch & poster session*

14:00 - 18:00 : Microplastics, as vectors of biological and chemical contaminants – *Ika Paul-Pont & Maria Cristina Fossi*

14:00 - 14:20 › The role of microplastics as a vector for PCBs through the marine trophic levels - *Lisa Devriese, Institute for Agricultural and Fisheries Research, Ostend, Belgium*

14:30 - 14:50 › Microplastics as vectors of chemical contaminants - *Albert Koelmans, Wageningen University*

14:50 - 15:10 › Plastic debris as a vector in transporting toxic additive chemicals in the marine environment: hexabromocyclododecanes in expanded polystyrene fragments - *Sang Hee Hong, University of Science and Technology, Korea Institute of Ocean Science and Technology*

15:10 - 15:30 › Relative importance of microplastics as a pathway for the transfer of persistent organic pollutants to marine life - *Adil Bakir, Plymouth University*

15:30 - 15:50 › Microplastics and trophic transfer of polycyclic aromatic hydrocarbons (PAHs) to marine organisms - *Carlo Giacomo Avio, Department of Life and Environment Sciences, University Polytechnic of Marche, Ancona, Italy*

16:30 - 17:00 : *Coffee break*

16:30 - 16:50 › Interactive effects of microplastics and fluoranthene on mussels *Mytilus sp.* - *Carmen González-Fernández, Spanish Institute of Oceanography - Centre of Murcia, Laboratoire des Sciences de l'Environnement Marin*

16:50 - 17:10 › Are baleen whales exposed to microplastics toxicological threat? The case study of the Mediterranean fin whale (*Balaenoptera physalus*) - *Maria Cristina Fossi, University of Siena*

17:10 - 17:30 › The plastic-associated microorganisms of the North Pacific Gyre - *Magnus Svendsen Nerheim, University of Bergen, University of Hawaii at Hilo*

17:45 - 19:00 : *Poster session + hard worker reward*

Wednesday 15 January 2014

09:00 - 13:00 : Outreach, awareness and mitigation regarding "microplastics" – & Place aux jeunes - *Marie-Amélie Néollier & Caroline Fabioux*

09:00 - 09:20 > Actions de terrain et sensibilisation du grand public comme outils de lobbying contre les microplastiques - *Marie-Amélie Néollier, Surfrider Foundation Europe*

09:30 - 10:00 : Place for young scientists - Master students – **The emerging scientists**

Master 2 students: (mini talks by mentors on posted posters)

- Study of microplastics depuration: the case of two filter feedind shellfish, the oyster (*Crassostrea gigas*) and the black scallops (*Mimachlamys varia*). *Champilou J.B. and Debretagne O.*
- Interspecific comparison of *in vitro* immune response of four molluscs to presence of microplastic beads. *Lucasson A. and Picot S.*
- Interspecific comparison of the concentration of microplastics in the faeces and the hemolymph of five Mollusc species. *Percelay I.and Sabatier E.*
- Microplastics: Food web transfer ? *Chauvin M. and Droual G*.

Master 1 students: (mini talks by mentors on posted posters)

Beach sampling:

- Micro - plastics sampling and sorting out technique apply on a beach in Brittany. *Allio N., Andro T., Castrec J. and Foulon V*.
- Microplastics on shorelines, a current issue: sampling methods. *Autret M., Bourdonnay L., De Wever L. and Toomey L.*
- In search of microplastics in the sand: Sampling on the beach and analysis in laboratory. *Coquillé V., Danielo M., Hulot V*.
- New approach for the collect and the detection of microplastic in the sediment. *Durand R., Fumeron R., Hermabessiere L. and James T.*

Water sampling:

- A Preliminary Assay to Assess Floating Litter Pollution in the Bay of Brest. *Langonne-augen R., Le Bot T., Long M. and Mahabrador D.*
- Microplastics: A New Problem. *Marchant J., Morel Q., Pantalos M. and Pouplard E.*
- Microplastics : macroproblems. *Traisnel G., Urvoy K., Van der Stegen T. and Weyand M.*

10:00 - 11:00 : *Coffee break* & the "petits débrouillards" demonstration/stand

Middle school student will deployed a "live" experimentation showing the fate of cosmetic microplastics using a homemade catchment basin - ecosystem model (maquette) and their impact on filter feeders.

11:00 - 12:00 > Place for young scientists - Middle school students – **The next scientist generation**

9 short oral presentations (some in English) by students including 1) a general presentation of their work 2) a microplastic glossary with latin etymology, 3) beach cleaning 4) microplastics: what is it? Where can we find them? What are their impacts? 5) The 7th continent 6) Interactions of microplastics with bivalve biology (in English) 7) Charles Moore and his foundation (in English) 8) awareness brochure 9) A short movie on microplastic issues (in English)

12:00 - 12:30 : Place for young scientists - Lab tour for middle school students

12:30 - 14:00 : *Lunch & poster session*

14:00 - 15:30 : **Outreach, awareness and mitigation regarding "microplastics"**

- Summary of days 1 and 2 by *Myra Van Der Meulen, Lisbeth Van Cauwenberghe, Lisa Devriese, Rossana Sussarellu & Ika Paul-Pont*
- Commitments to Move Forward, by the Micro Project Team and *J. Baztan* (OVSQ+MSFS)
- Discussion between scientists and stakeholders

15:30 - 16:45 : **Outreach, awareness and mitigation regarding "microplastics"** – *François Galgani* "grand public" lecture at Ifremer campus

15:30 - 16:45 : Excursion – lab tour for interested people upon registration at the organization desk

16:45 - 18:30 : **Outreach, awareness and mitigation regarding "microplastics" –** Discussion between scientists and stakeholders

18:30 - 21:00 : ***Crêpes***

Table of contents

Occurrence of microplastics in the marine environment

Assessment of marine debris on the Belgian Continental Shelf

Lisbeth Van Cauwenberghe *† [1], Michiel Claessens [1,2], Michiel Vandegehuchte [1], Jan Mees [3,4], Colin Janssen [1]

[1] Laboratory of Environmental Toxicology and Aquatic Ecology - Ghent University (UGent) – Jozef Plateaustraat 22 9000 Ghent, Belgium
[2] DuPont Coordination Center – Antoon Spinoystraat 6 2800 Mechelen, Belgium
[3] Marine biology research group - Ghent University (UGent) – Krijgslaan 281/S8 9000 Ghent, Belgium
[4] Flanders Marine Institute (VLIZ) – Wandelaarkaai 7 8400 Ostend, Belgium

Despite many research and monitoring actions, the (quantitative) distribution of marine litter remains unclear. There are three main reasons for this: (1) there is a lack of standard methods and units used to quantify the debris, (2) studies focus almost always on litter in one marine compartment only, and (3) to date, only a few studies have examined concurrently the occurrence of both macro- microplastics in these compartments.

In a unique research effort, marine litter was monitored in three environmental compartments of Belgian coastal waters. Abundance, weight and composition of both macro- and microplastic debris was assessed by performing beach, sea surface and seafloor monitoring.
Plastic items were the dominant type of macrodebris recorded (> 95%). On the beaches, the quantity of macroplastic ranged from 0.5kg/km to more than 50kg/km. The seafloor monitoring revealed the presence of 3125 items per km on average. On the sea surface, roughly 3900 items/km were found. Expressed in mass units, this amounts to, on average, 0.4 kg/km on the seafloor and at the sea surface 0.25 kg/km.
Although microplastic presence is not as obvious as macrolitter, it is an important part of the overall plastic pollution problem. On beaches, an average concentration of 13 ± 9 microplastics per kg of dry sediment was detected. This corresponds to an abundance of around 2.1 10ˆ7 particles per 100 m of beach (upper 5 cm of the sediment). Using an average weight of 5 μg per particle, the weight of microplastics on Belgian beaches is on average 0.1 kg per 100m. Seawater concentrations of microplastic were on average 10 microplastics/L. This means that concentrations of microplastics are on average 5 10ˆ9 microplastics per km, or, in terms of weight 25 kg per km (top 0.5 m of the water column). Microplastic concentrations in the BCS seafloor sediments were not assessed, but a previous study by Claessens et al. (2011) reported an average concentration of 126 particles per kg dry sediment or, in terms of weight, 1.1 mg/kg dry sediment. Hence, per km there are 0.6 10ˆ10 microplastic particles present (upper 10 cm of the seabed). This high microplastic concentration corresponds to a weight of 143 kg per km.

In conclusion, this first monitoring exercise of macro- and microplastics in the Belgian coastal zone revealed that in the water column and in the sediment, microplastics represent a much larger mass of plastic than the macrodebris. Here, microplastic weight is approximately 100 to

*Speaker
†Corresponding author: lisbeth.vancauwenberghe@ugent.be

400 times higher, respectively, than macrodebris weight.

Keywords: Southern North Sea, Macrodebris, Microplastics, Abundance, Beach, Seafloor, Sea surface

Can phytoplankton species impact microplastic behaviour within water column?

Marc Long * [1], Hélène Hégaret† [1], Christophe Lambert [1], Nelly Le Goic [1], Arnaud Huvet [1], Johan Robbens [2], Rossana Sussarellu [1], Caroline Fabioux [1], Philippe Soudant [1]

[1] Laboratoire des Sciences de l'Environnement Marin (LEMAR) – CNRS : UMR6539, Université de Bretagne Occidentale (UBO), Institut Universitaire Européen de la Mer (IUEM), Institut de Recherche pour le Développement, Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – Technopôle Brest-Iroise, Place Nicolas Copernic, 29280 Plouzané, France

[2] Institute for Agricultural and Fisheries Research (ILVO) – Burgemeester Van Gansberghelaan 96, box 1, 9820 Merelbeke, Belgium, Belgium

As plastic debris are becoming more and more ubiquitous in the ocean throughout the years, plastic particles and their degradations are becoming a growing issue. Modelling their transport and looking for hotspots of microplastics is becoming important to evaluate their impact on the environment. But only few data are available on their repartition due to their sampling difficulties. Most of the data on microplastics are limited to size larger than 333 μm. Scientists are trying to modelize microplastic repartition in the ocean using data on macro and microplastics, oceanic gyres and currents. The ocean being a complex environment with a lot of parameters that could influence a change in microplastic repartition. Plastic particle are becoming a non-negligible part of the plankton with plastic which can represent six times the mass of plankton in some oceanic gyres (MOORE et al. 2001). Taking into account these high levels, it appears important to better identify and characterize the type of "interaction" occurring between plankton and microplastics. As a preliminary approach we focused on phytoplankton species. The aim of this study was thus to assess if microalgae could have an impact on microplastics distribution within the water column.

Four different species (Isochrysis galbana clone Tahitian (Prymnesiophycae), Heterocapsa triquetra (dinophyceae), Rhodomonas salina (cryptophyceae), Chaetoceros neogracile (diatom)) of microalgae were exposed to 2μm yellow-green fluorescent polystyrene microspheres. Two concentrations were tested (5.105 and 5.106 beads/ml). Microsphere repartition was quantified as free beads and as beads attached to microalgae. Microspheres stuck on glassware or on the bottom were also estimated as the difference between added beads to those free or attached to microalgae. Results showed different patterns of microsphere repartition depending on the species. Interaction with the diatom C. neogracile resulted in the highest concentrations of beads attached to microalgae while we obtained the highest levels of beads stuck to the glassware or on the bottom with R. salina. These results highlight the importance of phytoplankton community in microplastics distribution in the water column. Depending on blooms and species

*Speaker

†Corresponding author: helene.hegaret@univ-brest.fr

present in the water we could observe a sink of microplastics towards the benthic compartment or a transport of microplastics towards the surface for those stuck on microalgae. These results also suggest a potential impact of phytoplankton community on the distribution of microplatics within the food web as microplastics attached to microalgae are assumed to be more easily captured by filter feeders than free microplastics in the water column.

Keywords: microplastic, phytoplankton, microplastic distribution, transfert, water column, chaetoceros

FTIR analysis for monitoring marine microplastics

Martin Löder * [1]

[1] Alfred Wegener Institute for Polar and Marine Research - AWI (GERMANY) (AWI) – Alfred Wegener Institute for Polar and Marine Research Biological Station Helgoland Kurpromenade 201 27498 Helgoland, Germany

Persistent plastics are hardly degraded and accumulate in the marine environment. Together with primary microplastics the fragmentation of larger plastic litter leads to an increasing amount of small plastic particles, so-called microplastics in the oceans. Due to their size (< 5 mm), these have the potential of entering marine food webs. For a reliable evaluation and an assessment of food web effects, a detailed quantitative and qualitative monitoring of microplastics in the marine environment is highly required.

Fourier transform infrared (FTIR) spectroscopy offers the possibility of the urgendly needed proper identification of microplastic particles in environmental samples. However, standard FTIR spectroscopy still requires time- and labour-consuming pre-sorting of particles by hand. Hence, small or less abundant microplastics are potentially overlooked. A highly promising FTIR extension - FTIR imaging - allows for detailed and unbiased high throughput analysis of especially the small fraction of microplastics in a given sample without prior pre-sorting by hand.

We show first result of the project MICROPLAST which aims at (1) the development/optimisation of appropriate methods for the extraction of microplastic particles from complex matrices (e.g. sediment, plankton, tissue), (2) the evaluation of FTIR imaging for the analysis of microplastics and the development of procedures for its routine application, (3) the generation of data on the pollution of the pelagic and benthic zone with microplastic particles of verified polymer origin in German coastal waters.

Keywords: Microplastic detection, FTIR spectroscopy, FTIR Imaging

*Speaker

Fluctuating microplastic contamination in the Clyde Sea Area

Natalie Welden *† [1,2], Phillip Cowie [1]

[1] University Marine Biological Station Millport (UMBSM) – Marine Parade, Isle of Cumbrae, KA28 0EF, United Kingdom
[2] University of Glasgow (Glasgow Univ.) – Glasgow G12 8QQ Scotland, United Kingdom

Microplastics, < 5mm, have been recovered from marine environments worldwide. While microplastic distribution is highly heterogeneous, increases have been observed in areas of high anthropogenic activity. The Clyde Sea Area (CSA), on the west coast of Scotland, has a densely urbanised and industrialised catchment, and microplastic ingestion has been observed in both invertebrates and fish. In this extensive study we examine the type and distribution of microplastics in both sediments and surface waters of the CSA over an eight month period.

Samples were collected monthly from sites in the Firth of Clyde. Day grabs were used to obtain sediments samples up to 5cm dept. Granulometry, silt fraction, and water content were recorded at each location. Water samples were taken using 333μm mesh plankton nets towed at 1-2 knots for ten minutes. Plastics were removed from samples using the NaCl density separation method, before being dried and counted.

Filaments were the most commonly recovered plastics, found in all samples, followed by fragments, recovered from 34.4% of samples. All water samples also contained plastic, mainly filaments. For both sediment and water column samples a high variation in the number of filaments was recorded at each location and sampling event.

A GLM was used to analyse the impact of environmental variables on microplastic distribution. Variation observed in both spatial and temporal plastic distribution was unrelated to location or sampling date; this indicates that variation was not due to a single contamination source or re-dispersal event. Sediment contamination was also not significantly related to the level of microplastic in the water column indicating that localised environmental factors influence both settlement rates and eventual distribution. This is supported by the high variation seen between monthly replicates at each station. The temporal and local variability in microplastic distribution demonstrates that single sampling events, reported in previous studies, are unsuitable for accurately assessing long term microplastic pollution. The results of this study illustrate that a replication is vital for monitoring contamination in both the sediment and water column. This is of particularly high importance in relation to the upcoming implementation of the Marine Strategy Framework Directive.

Keywords: Sediment, Water Column, Grab, Distribution

*Speaker
†Corresponding author: n.welden.1@research.gla.ac.uk

Fragmentation of polyethylene, polypropylene and expanded polystyrene with an accelerated mechanical abrasion experiment

Won Joon Shim *† [1,2], Young Kyoung Song [1,2], Sang Hee Hong [1,2], Mi Jang [1,2], Gi Myung Han [1]

[1] Korea Institute of Ocean Science and Technology (KIOST) – South Korea
[2] University of Science and Technology (UST) – South Korea

Microplastics are world widely found from beach to open ocean and from sea surface to deep-sea bed. They are manufactured as small plastic particles (primary microplastics) to produce resin pellets, scrubbers for cosmetics, or blasting materials or they are generated by the fragmentation of larger plastic products (secondary microplastics). Fragmented secondary microplastic particles account for the majority of microplastics and have various origins, which makes proper control difficult. Photo-oxidation and mechanical abrasion on beaches and (or) sea surface are thought to be major weathering and fragmentation process for generating secondary microplastic particles. None of scientific information is, however, available where and how secondary microplastics are produced.

Fragmentation of top three polymer types (polyethylene; PE; polypropylene, PP, and expanded polystyrene, EPS) in marine debris monitoring study were done with an accelerated mechanical abrasion experiment in a laboratory. Twenty of each PE and PP resin pellets and forty EPS spherules detached from a EPS float were placed in an amber bottle with glass bead (3 mm in diameter) or natural sand (pre-combusted at 450 C), respectively. The bottles were rotated with a tumbler for a month at 113 rpm. Fragmented polymer particles were extracted by density separation with deionized water and identified with microscopic FT-IR, SEM and fluorescence microscope after Nile Red staining. After mechanical abrasion, apparent surface damage of PE and PP pellets and EPS spherules were observed by SEM analysis. Small sand particles were incorporated into polymer surface and polymers were torn-off or fragmented on their surfaces. The hundreds of micron scale PE, PP and EPS particles were identified with FT-IR or SEM-EDS analysis. Number of polymer particles produced were in order of EPS $>$ PP $>$ PE. But, the tens of micron scale polymer particles were difficult to identify and quantify with FT-IR and SEM-EDS analyses. Thus, polymer particles were stained with Nile Red and subsequently identified and quantified under a fluorescent microscope. The number of PE particles produced was hard to discriminate with the control (sand without plastic), and PP particles were slightly higher than that of the control. EPS particles obviously outnumbered the control and were quantifiable. Number of EPS particles was about 515,000/bottle. About 85% of the EPS particles were within size range of 1-25 micrometer in maximum length.

*Speaker
†Corresponding author: wjshim@kiost.ac

Keywords: microplastics, fragmentation, mechanical abrasion, accelerated weathering

La participation des ONG et de l'éco-volontariat aux observations sur les microplastiques flottants en Méditerranée

Hervé Thebault * [1], Valérie Giordano [1], Claude Escarguel [1]

[1] Planète Urgence – ONG – Le Brusc 83140 Six-Fours, France

L'étude des microplastiques flottants à la surface a pris récemment une importance particulière mise en évidence par les nombreuses publications scientifiques sur le sujet. Plusieurs équipes en Méditerranée étudient désormais la quantification des micro-plastiques, leur distribution en mer, leur composition chimique et leur évolution dans le temps, autant de paramètres qui constituent désormais l'un des descripteurs du Bon Etat Ecologique de la DSCMM.

Les premiers résultats de la campagne 2010 associant l'ONG Méditerranée En Danger et l'Ifremer suggèrent une concentration importante de microplastiques en Méditerranée Occidentale. Cependant, cette thématique émergente nécessite de multiplier les observations l'abondance et la distribution des microplastiques. Or l'accès aux navires océanographiques par les équipes scientifiques est toujours limité, ce qui réduit les possibilités d'échantillonnage.

C'est un sujet typiquement favorable pour la contribution des ONG à l'acquisition de données fiables en accord avec le développement de la " science participative ". En effet, ces observations ne nécessitent que des moyens nautiques légers et un faible investissement matériel qui permettent par l'accueil d'éco-volontaires d'effectuer un grand nombre de jours de mer et un échantillonnage représentatif d'une région marine.

L'ONG Planète Urgence organise depuis plusieurs années des missions d'éco-volontariat encadrées par des scientifiques. Le protocole de prélèvement et de comptage des microplastiques a été élaboré et validé pour être appliqué par les éco-volontaires moyennant une formation de moins d'une journée. Le programme à 5 ans prévoit des prélèvements réguliers de microplastiques sur un trajet entre Toulon et Calvi. La première campagne a eu lieu juin 2011 et la plus récente en octobre 2013, représentant un total de plus de 60 jours de mer.

Les résultats des comptages montrent que les microplastiques inférieurs à 5 mm sont présents dans tous les échantillons récoltés en Méditerranée Nord Occidentale, soit plus de 150 prélèvements, confirmant une présence généralisée y compris dans la zone du large. Les quantités moyennes de microplastiques par ha sont supérieurs à 1000 particules en 2011 avec une grande variabilité spatiale et en 2012 les quantités avoisinent 400 particules par ha, indiquant une grande variabilité inter-annuelle. La distribution des quantités de microplastiques le long du transect Toulon-Calvi montre des quantités plus importantes près des côtes de la Provence et de la Corse mais également au centre de la zone étudiée, la plus éloignée des côtes. Cette répartition est mise en relation avec le schéma de circulation sur la zone, issu des résultats du système PREVIMER,

*Speaker

qui montre l'existence d'un tourbillon anti-cyclonique centré sur le milieu de transect.

Micro-plastic pollution demonstrably threatens protected areas in the Atlantic: diagnosis of three islands in the Canary Current and next steps.

Juan Baztan * [1]

[1] Marine Sciences For Society Observatoire de Versailles Saint-Quentin-en-Yvelines. (OVSQMSFS) – Marine Sciences For Society Observatoire de Versailles Saint-Quentin-en-Yvelines. – France

Globally, coastal zones and the biosphere as a whole show signs of cumulative degradation due to the use and disposal of plastics. To better understand the situation of plastic pollution in the Atlantic Ocean, we partnered with local communities to determine the concentrations of micro-plastics in the intertidal zones of 125 beaches on three islands in the Canary Current: Lanzarote, La Graciosa, and Fuerteventura. We found that, in spite of being located in highly protected natural areas, all beaches in our study area are exceedingly vulnerable to micro-plastic pollution, with pollution levels reaching concentrations greater than 100g/l.

This work contributes to ongoing efforts to develop and implement solutions to plastic pollution by addressing the questions:

- (i) Where does this pollution come from?;
- (ii) How much plastic pollution is in the world's oceans and coastal zones?;
- (iii) What are the consequences for the biosphere?; and
- (iv) What are possible solutions?

Keywords: Plastics, micro, plastic, Protected Areas, Atlantic, Canary Current

*Speaker

Microplastics and suspected microbeads in the Laurentian Great Lakes of North America

Marcus Eriksen * [1], Sherri Mason * †

[1] 5 Gyres Institute – 2122 S. Spaulding Ave. Los Angeles, CA 90016, United States

Neuston samples were collected at 21 stations during an ~700 nautical mile (~1300 km) expedition in July 2012 in the Laurentian Great Lakes of the United States using a 333μm mesh manta trawl and analyzed for plastic debris. Although the average abundance was approximately 43,000 microplastic particles/km2, station 20, downstream from two major cities, contained over 466,000 particles/km2, greater than all other stations combined. SEM analysis determined nearly 20% of particles less than 1mm, which were initially identified as microplastic by visual observation, were aluminum silicate from coal ash. Many microplastic particles were multi-colored spheres, which were compared to, and are suspected to be, microbeads from consumer products containing microplastic particles of similar size, shape, texture and composition.

Keywords: microbeads, Great Lakes

*Speaker

†Corresponding author: mason@fredonia.edu

Occurrence and distribution of mesoplastics in beach sand from Corsica and the French Mediterranean coast using a simplified extraction method

François Galgani *† [1], Florian Klosterman , Elke Fries‡

[1] IFREMER – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – LER/PAC, Bastia, Corsica, France

In this study, a total of 12 beaches located at the Mediterranean island Corsica and at the French coastline were analysed for the occurrence of mesoplastics (size > 1 mm). The beaches are characterised by the impact of tourism and a great number of beach visitors. Beach sediments were analysed by visual sorting. The items visually resemble microplastics were added to a saturated solution of sodium iodide (NaI) with a density of 1.8 g/cm to sort out sediment items by density separation. The remaining items were treated by hydrogen peroxide (H2O2) (30%) to distinguish between biological organic material and polymers. From 124 items collected during the visual sorting, 34 items were discarded through density separation since their density did not match the characteristic density of plastics. Dissolution tests demonstrated that H2O2 was suitable because it did not react with the most common synthetic polymers, whereas a great number of various organic items clearly did. 18 more items showed a strong reaction with H2O2 and were discarded since they were likely to be organic material and no plastics. A total of 72 mesoplastic items remained. Considerable portions of the extracted mesoplastics are represented by plastic fibres, fragmented plastics and resin pellets. Concerning the spatial distribution of mesoplastics among within both study areas the abundances of mesoplastic particles did not vary significantly. However, the mesoplastic particles were distributed rather heterogenous within the sampling locations with amounts ranging from 0 to 12 items per sample. Smaller mesoplastic items between 1 and 2 mm were mostly found at the beach of Bastia on Corsica (12 items), whereas items > 2 mm were dominant at Fos-sur-Mer located at the French coastline (12 items). This study presents an easy and cost-effective way for the extraction of mesoplastics from beach sediments and reveals the occurrence of mesoplastics at the selected NW Mediterranean beaches for the first time, which forms a potential hazard for the marine environment.

Keywords: Mesoplastics, Mediterranean Sea, Beach

*Speaker
†Corresponding author: francois.galgani@ifremer.fr
‡Corresponding author: e.fries@brgm.fr

Rope degradation and microfibre formation – A benthic exposure trial

Natalie Welden *† [1,2], Phillip Cowie [1]

[1] University Marine Biological Station Millport (UMBSM) – Marine Parade, Isle of Cumbrae, KA28 0EF, United Kingdom
[2] University of Glasgow (Glasgow Univ.) – Glasgow G12 8QQ Scotland, United Kingdom

Sediments and animals sampled from the Clyde Sea Area (CSA), on the west coast of Scotland, have been observed to accumulate large quantities of microplastic. Secondary microplastics, the result of degradation of macroplastic debris, made up the majority of recovered samples. The CSA receives large levels of macroplastic from urban areas, and industrial, and maritime activities; however, little is known about the rate of microplastic formation benthic environments. In this study we examine microplastic releases from ropes exposed in benthic conditions over 12 months.

Sixty centimetre lengths of polypropylene (PP), polyester (PE), nylon (N), and sisal ropes were attached to frames placed at 10 meters depth; light and temperature were sampled hourly using pendant loggers. Samples of each rope type were taken bimonthly and tested for changes in tensile strength and buoyancy. The degree of fragmentation was calculated as a reduction in dry weight. Biofouling was calculated using changes in chlorophyll a levels and weight of attached macroalgae, as well as the number and diversity of colonizers.

All rope types demonstrated a reduction in both mechanical properties and sample weight during the 12 month testing period, however this was not found to be significant. PP showed the highest reduction in dry weight, 0.92 g, followed by PE, 0.204 g, and N, 0.177 g. There was also a notable surface roughening of both PP and PE, particularly in areas of bryozoan attachment. The level of chlorophyll a on each rope varied over the course of the year; however, there was a steady increase in the weight of macro-algae recorded on all polymer ropes, as well the number and diversity of attached fauna. Sisal had the fewest fouling species, followed by N, PP, and PE.

The factors responsible for microplastic formation were examined using a GLM. The results indicate that fragmentation is the result of a combination of abrasion by substrate and action of fouling and grazing organisms. The low degradation rate of ropes may be the result of a low surface area to volume ratio, reducing the proportion of the polymer exposed to degradation factors. When rope samples were examined, inner filaments appeared un-degraded, with no visible roughening or discolouration. While the weight of plastic lost from each sample appears small, this may correspond to a large number of microplastics. Therefore, degradation caused by substrate abrasion and action of colonisers may produce large amounts of microplastic.

*Speaker
†Corresponding author: n.welden.1@research.gla.ac.uk

Keywords: Degradation, Rope, Microfibres

The ubiquitous nature of microplastics in the North Atlantic

Amy Lusher * [1], Ian O'connor [1], Rick Officer [1]

[1] Galway-Mayo Institute of Technology (GMIT) – Ireland

Levels of marine plastic pollution, including microplastics, are largely undocumented in the Atlantic Ocean. A standardised, replicable method is required to understand the distribution and abundance of microplastic pollution. A novel flow-through system of filtering has been developed for simple, cost-effective replicable sampling on research vessels to collect synthetic particles from offshore seawater. Sampling was conducted in the Northeast Atlantic during research cruises aboard Ireland's research vessel, the R.V. Celtic Explorer. More than 400 water samples were collected on the continental shelf and slope, from the Bay of Biscay to the Faroes. Non-biological synthetic particles were found in the North Atlantic across a large spatial scale. Particles were assigned to four product type categories: fibres, fragments, industrial pellets and bead scrubbers, and five length categories: $<$ 1mm, 1-2.5mm, 2.5-5mm, 5-10 mm, and $>$ 10mm. The results from this study indicate that plastic particles are widespread in the surface layer of the Northeast Atlantic Ocean, trends in abundance and distribution will be discussed. This is the first report of the ubiquitous nature of microplastic pollution in the Northeast Atlantic Ocean and highlights the potential for a method to be used as a standardised monitoring protocol.

Keywords: neuston, marine pollution, plastic, seawater

*Speaker

Transport of plastic litter via the Meuse and Scheldt Rivers to the North Sea

Maarten Van Der Wal [1], Myra Van Der Meulen * [1], Gijsbert Tweehuysen [2], Heather Leslie [3], Erwin Roex [1], Yvon Wolthuis [4], Dick Vethaak [1]

[1] Deltares – Netherlands
[2] Waste Free Waters (WFW) – Netherlands
[3] Institute for Environmental Studies (IVM) – Netherlands
[4] Investments in Sustainable Innovations (ISI) – Netherlands

The worldwide mass production, use and improper disposal of plastic materials results in the accumulation of both macro and micro plastic litter in aquatic ecosystems. Rivers are thought to be transport routes of plastic litter from river catchments to the marine environment. We present a preliminary outline of the sources, behaviour and transport pathways of plastic litter in the Meuse River and the Scheldt River, and their discharges into the North Sea.

The first step in this study wasa literature survey on the presence of litter and floating debris in these river ecosystems. However, relevant river litter data were limited. The second step was to sample plastic litter from the surface and in the water column in the Meuse River using a custom made vessel. The transport and deposition of litter seems to be concentrated during the rising limb of a flood wave inundating and polluting flood plains. Until now litter has only been sampled during a few minor flood waves and the results show some preliminary trends. In addition, we estimated the amount of micro plastics emitted by a number of sewage treatment plants. Using the available data on the presence of litter a first conceptual outline of the transport pathways of macro plastic particles in the Meuse and Scheldt Rivers has been developed.

The analysis showed that the main sources for macro plastic litter in alluvial river ecosystems are urbanised areas and polluted floodplains in a river basin and inland navigation. The data suggest that during the transport in both alluvial river basins a majority of macro plastics break down into smaller micro particles before they reach the North Sea. Furthermore, evidence for macro plastic litter accumulation hot spots along a river was found. In contrast to coastal beaches where the litter found on a short stretch of a long beach can be a representative sample of the total litter on the beach, river banks are often more heterogeneous. This implicates that special monitoring programs need to be designed for rivers.Based on this research it can be stated that the presence of (plastic) litter in the studied catchment areas is of high environmental and societal concern and is perceived as such by the general public. We will provide recommendations for establishing an international database of the quantity and the composition of plastic litter in river ecosystems. We will also provide recommendations for monitoring the amount of plastic foils suspended in a water column to assess the amount of plastic litter in a river ecosystem.

*Speaker

Keywords: rivers, litter, microplastics, north sea, monitoring, quantities

Microplastics, as vectors of biological and chemical contaminants

Are baleen whales exposed to microplastics toxicological threat? The case study of the Mediterranean fin whale (Balaenoptera physalus)

Maria Cristina Fossi * [1], Cristina Panti† [1], Daniele Coppola [1], Matteo Baini [1], Matteo Giannetti [1], Letizia Marsili [1], Ilaria Caliani [1], Cristiana Guerranti [1], Simone Panigada [2], Jorge Urban R [3]

[1] University of Siena (UniSi) – Via P.A. Mattioli, 4, Italy
[2] Tethys Research Institute – Italy
[3] Universidad Autónoma de Baja California Sur – Mexico

The emerging issue of microplastics in marine environment is recently raising increasing attention. The impacts of microplastics on baleen whales, which potentially undergo to the ingestion of micro-litter by filtrating feeding activity, are largely unknown. This case study examines the Mediterranean fin whale (Balaenoptera physalus), one of the largest filter feeders in the world. They could therefore face risks caused by the ingestion and degradation of microplastics. Micro-debris can be a significant source of lipophilic chemicals (primarily persistent organic pollutants), and plastic additives. These chemical pollutants can potentially affect marine organisms, are potential endocrine disruptors and can affect population viability. We explore the toxicological effects of microplastics on fin whale comparing two populations living in areas characterized by different human pressure: the Pelagos Sanctuary (IT-FR) and the Sea of Cortez (MX). The work is implemented through four steps: 1) collection/count of microplastics in Pelagos Sanctuary (Mediterranean Sea); 2) detection of phthalates in superficial neustonic/planktonic samples; 3) the detection of phthalates in Mediterranean stranded fin whales; 4) the detection of phthalates and biomarkers responses (CYP1A1, CYP2B, lipid peroxidation) in skin biopsies of fin whales collected in the Pelagos Sanctuary and Sea of Cortez. High presence of plastic particles have been detected in superficial neustonic/planktonic samples collected in the Pelagos Sanctuary areas investigated (mean value 0.62 items/m3) with high concentration of phthalates (DEHP and MEHP), used as tracers of plastic derivates. MEHP concentrations were detected (57.9 ng/g), in blubber samples of five stranded fin whales collected along the Italian coasts. Finally, relevant concentrations of MEHP and higher biomarker responses (CYP1A1, CYP2B, lipid peroxidation) were detected in fin whale skin biopsies collected in the Mediterranean areas in comparison to the specimens of Sea of Cortez. These results is the first evidence of the potential toxicological impact of microplastics in a baleen whale and suggests the use of phthalates as a tracer of the intake of microplastics through the ingestion of micro-debris and plankton.These preliminary investigation underscore the importance of future research on the detection of the toxicological impact of micro-plastics in filter-feeding species such as mysticete cetaceans, basking shark and devil ray. The results also underscore the poten-

*Speaker
†Corresponding author: panti4@unisi.it

tial use of these species in the implementation of Descriptor 10 (marine litter) in the EU MSFD.

Keywords: microplastic, baleen whale, phthalates

Dangerous hitchhikers: Evidence for potentially pathogenic Vibrio spp. on microplastic particles

Gunnar Gerdts * [1]

[1] Alfred Wegener Institute for Polar and Marine Research - AWI (GERMANY) (AWI) – Germany

The qualitative and quantitative composition of biofilms on microplastic surfaces is widely unknown. A previous study (Zettler et al., 2013; EST) reports the presence of potentially pathogenic bacteria (Vibrio spp.) on floating microplastic particles. Hence microplastics could function as vectors for the dispersal of microorganisms to new habitats. Several Vibrio species are serious human pathogens. Contact with contaminated water and consumption of raw seafood are the main infection factors for Vibrio associated diseases. On a research cruise to the North- and Baltic Sea, microplastic particles were collected and subjected to APW (alkaline peptone water) enrichment. Growth on selective CHROMagarTM Vibrio and further identification of isolates by MALDI-TOF (matrix assisted laser desorption/ionization time-of-flight) clearly indicate the presence of potentially pathogenic Vibrio spp. on microplastics. Our results highlight the urgent need for detailed microbiological analyses of floating microplastic particles in the future.

Keywords: Vibrio spp, biofilm, vector

*Speaker

Interactive effects of microplastics and fluoranthene on mussels Mytilus sp.

Carmen González-Fernández *† [1,2], Ika Paul-Pont [1], Camille Lacroix [1], Christophe Lambert [1], Nelly Le Goic [1], Arnaud Huvet [1], Rossana Sussarellu [1], Johan Robbens [3], Caroline Fabioux [1], Philippe Soudant [1], Hélène Hégaret [1]

[1] Laboratoire des Sciences de l'Environnement Marin (LEMAR) – CNRS : UMR6539, Université de Bretagne Occidentale (UBO), Institut Universitaire Européen de la Mer (IUEM), Institut de Recherche pour le Développement, Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – Technopôle Brest-Iroise, Place Nicolas Copernic, 29280 Plouzané, France

[2] Spanish Institute of Oceanography - Centre of Murcia – Spain

[3] Institute for Agricultural and Fisheries Research (ILVO) – Burgemeester Van Gansberghelaan 96, box 1, 9820 Merelbeke, Belgium, Belgium

Pollution of the marine environment by plastic debris constitutes an increasing issue worldwide. Particularly, microplastics (MP) can be ingested and caused adverse effects to a large range of organisms from plankton to invertebrates and vertebrates due to their small size and wide distribution in the marine environments. In addition, the potential adsorption of chemicals on MP may enhance the bioavailability and bioaccumulation of environmental contaminants in marine organisms. The aim of this study is to assess the effects of MP on the bioaccumulation and toxic effects of fluoranthene (FLU) in mussels Mytilus sp. FLU was selected among other pollutants as it belongs to the lists of priority substances in the field of water policy of the European Commission (EC) and constitutes one of the most concentrated polycyclic aromatic hydrocarbon (PAH) detected in the aquatic environment. To carry out the study, mussels were exposed to FLU and MP singularly or in combination for a period of 7 days before being depurated in clean water for a week. Bioaccumulation of FLU and detection of MP were measured in mussel tissues after exposure and depuration. Biometry, cellular immune responses and expression of genes involved in detoxification mechanisms were also investigated.

Keywords: microplastics, polycyclic aromatic hydrocarbons, bivalves, immune responses

*Speaker

†Corresponding author: carmen.gonzalez@mu.ieo.es

Microplastics and trophic transfer of polycyclic aromatic hydrocarbons (PAHs) to marine organisms

Carlo Giacomo Avio * [1], Stefania Gorbi [1], Daniele Fattorini [1], Marta Di Carlo [1], Maria Elisa Giuliani [1], Marica Mezzelani [1], Alessandro Nardi [1], Ilaria Lanzoni [1], Lucia Pittura [1], Maura Benedetti [1], Francesco Regoli [1]

[1] Department of Life and Environment Sciences, University Polytechnic of Marche, Ancona, Italy (Di.S.V.A.) – Italy

Microplastics represent an important environmental concern due to their great abundance in the oceans, the entanglement of large vertebrates and physical damages caused once ingested. Their capability to adsorb different classes of pollutants has been recently suggested, but the possibility that microplastics represent a biologically relevant source of chemical exposure for aquatic organisms is still relatively unexplored. In this study, the efficiency of adsorbing pyrene was assessed under laboratory conditions for two different polymers, polyethylene (PE) and polystyrene (PS); obtained results were compared with chemical characterization of microplastics collected from some local beaches. The trophic transfer of pyrene from microplastics was evaluated in experiments with a classical bioindicator, the mussel Mytilus galloprovincialis. Results on chemical levels of pyrene were integrated with histological analyses to detect the presence and tissue localization of microplastics, and with a battery of biomarkers, including immunological parameters, peroxisomal proliferation, oxidative stress, lipid peroxidation, lysosomal stability, and DNA integrity. This study provided the first evidence that microplastics can adsorb PAHs, emphasizing an elevated bioavailability of these chemicals after the ingestion, and the sensitivity of several cellular responses to the presence of either contaminated or virgin plastics.

Keywords: microplastics, biavailability, mussels, biomarker

*Speaker

Microplastics as vectors of chemical contaminants

Albert Koelmans * [1], Ellen Besseling [1], Edwin Foekema [2]

[1] Wageningen University (WU) – Netherlands
[2] IMARES – Netherlands

It is often assumed that ingestion of microplastics by aquatic species leads to increased exposure to plastic additives. However, experimental data or model based evidence is lacking. Here we evaluate the likeliness of leaching of nonylphenol (NP) and bisphenol A (BPA) in the intestinal tracts of two species, A. marina (lugworm) and Gadus morhua (North Sea cod) using literature data and a prognostic model analysis. We provide a plastic-inclusive bioaccumulation model that allows calculations of the relative contribution of plastic ingestion to total exposure of aquatic species to chemicals residing in the ingested plastic. The model is parameterised using literature data and uncertainty in the most crucial parameters was accounted for by Monte Carlo probabilistic modelling. Modeled NP and BPA concentrations due to plastic ingestion are compared to present global environmental concentration data. For the lugworm, plastic ingestion may yield NP and BPA concentrations that overlap the lower ends of global NP and BPA concentration ranges, and thus may constitute a relevant exposure pathway. For cod, plastic ingestion yields concentrations that are a factor 1000 (BPA) or 10E6 (NP) lower than the lower ends of global NP and BPA concentration ranges. We conclude that plastic ingestion is irrelevant for direct exposure to species like cod, although exposure of benthivorous fish through consumption of benthic worms may be relevant. The bioaccumulation model is general and can be implemented for a wide variety of chemicals and species. As such, it is a powerful tool for the risk assessment of plastic-facilitated transfer of chemicals to organisms

Keywords: microplastic, leaching, POPs, bisphenol A, nonylphenol, bioaccumulation model

*Speaker

Plastic debris as a vector in transporting toxic additive chemicals in the marine environment: hexabromocyclododecanes in expanded polystyrene fragments

Sang Hee Hong * [1,2], Manviri Rani [1], Mi Jang [1,2], Gi Myung Han [1], Young Kyung Song [1,2], Won Joon Shim† [1,2]

[1] Korea Institute of Ocean Science and Technology – South Korea
[2] University of Science and Technology – South Korea

Expanded polystyrene (EPS) is commonly known as Styrofoam. There has been enormous growth in EPS market in the last decades by virtue of many useful properties such as insulation,lightweight, durability and low cost. Annual production of EPS in Korea is 200,000 tons, among witch 1.25% areused for aquaculture buoy.In South Korea, oyster farms employ the suspended culture technique, in which longlines supported by numerous floating EPS buoys are used. And the buoys are also widely used along the southern coast by fishermen as markers, floats, fishing fly holders and underwater net-trap lifters. As a result, EPS buoy and its fragments become the most dominant macro ($>$ 2.5cm) and micro (1mm $<$ size $<$ 5mm) debris on the beaches of South Korea, accounting for 12% and 99% to total number of debris, respectively.

At our previous study, we found the enrichment of hexabromocyclododecane (HBCD),a brominated flame retardants, in sediment near oyster farms where are not located near known sources of HBCD, such as industrial factories and sewage treatment plants. We suspected that the EPS buoys used for oyster farm could contain HBCD. HBCD is most commonly used in polystyrene foams. Since HBCDs are additive type of flame retardants and are not covalently bonded to the material, they easily leach from the product during its use or disposal and are released into the environment.On 10 May 2013,HBCD put its name to a list of 22 other substances targeted for global elimination under the Stockholm Convention.

In order to answer our qestion, we purchased new EPS buoys in market and collected stranded EPS buoys along the coasts, and conducted chemical analysis. HBCD concentration showed wide variation among buoys produced by the same manufacturer and even in one buoy.The overall concentration of HBCDs deteced in EPS buoys were in the range of 0.02-422 mg/g with a median concentration of 40 mg/g. The inner fresh layer of stranded EPS buoy showed relatively higher level of HBCDs than the outside weathered layer, which confirms the leaching of HBCDs from the buoys surface throughout their lifetime. The stranded EPS spherules on beaches also showed a similar level of HBCDs (range: 34-53 μg/g, median value: 41 μg/g).

Because of their exposure to salt and hard-fouling organisms and their high water content, EPS buoys that are not disposed of appropriately can end up in the marine environment as a

*Speaker
†Corresponding author: wjshim@kiost.ac

debris. EPS buoy can gradually fragment into millions of spherules with a diameter 1-5 mm that float on the water's surface or become stranded on the shoreline. The fragmentation of EPS buoys increases the surface-to-volume ratio and thus enhances the leaching rate of HBCDs into the surrounding environment. In a lab experiment, 15-20% of HBCDs were rapidely leached out from EPS fragments within 96h and 80% of HBCDs were remined inside the fragments for a long time. This result implies that EPS debris can be a moving source of transporting HBCDs to the marine environment.

Keywords: expanded polystyrene, additives, hexabromocyclododecane, marien debris

Relative importance of microplastics as a pathway for the transfer of persistent organic pollutants to marine life

Adil Bakir *† [1], Steve Rowland [1], Tamara Galloway [2], Richard Thompson [1], Stephanie Wright [2]

[1] Plymouth University – University of Plymouth, Drake Circus, Plymouth, Devon PL4 8AA, United Kingdom

[2] University of Exeter – School of Biosciences, University of Exeter, Streatham Campus, Northcote House, Exeter EX4 4QJ, United Kingdom

Microplastics are small fragments of marine debris which now appear to be widespread in the marine environment and have been reported at the sea surface, on shorelines and on the sea bed. Microplastics have the potential to uptake and release persistent organic pollutants (POPs); however, subsequent transfer to marine organisms is poorly understood. Some models estimating transfer of sorbed contaminants to organisms neglect the role of gut surfactants under differing physiological conditions in the gut (varying pH and temperature). We investigated the potential for polyvinylchloride (PVC) and polyethylene (PE) microparticles (200-250 um) to sorb and desorb DDT, phenanthrene (Phe), perfluorooctanoic acid (PFOA) and di-2-ethylhexyl phthalate (DEHP). Sorption equilibrium times were determined over 15 days and most contaminants reached equilibrium onto plastic in 24 hours. Equilibrium distribution coefficients (Kd) were used to represent sorption capacity of plastic for the pollutants under investigation. Desorption rates of POPs were quantified in seawater and under simulated gut conditions. Influence of pH and temperature was examined in order to represent cold and warm blooded organisms. Desorption rates were faster with gut surfactant, with a further substantial increase under conditions simulating warm blooded organisms. Desorption under gut conditions could be up to 30 times greater than in seawater alone. Of the POP/plastic combinations examined Phe with PE gave the highest potential for transport to organisms. Subsequent transfer of surface sorbed POPs to a lugworm, a fish and a seabird was examined using a model approach. Single-compartment models were applied to estimate the internal concentration of POPs of each organism. The relative importance of different pathways of exposure (respiratory vs. dietary) was investigated at low and worst case environmentally relevant concentrations. This study aims to provide some information on the potential environmental consequences of microplastics in the marine environment and their potential "harm" to marine organisms.

Keywords: Microplastics, POPs, Transfer, Bioaccumulation model, Marine Strategy Framework Directive

*Speaker

†Corresponding author: adil.bakir@plymouth.ac.uk

The plastic-associated microorganisms of the North Pacific Gyre

Magnus Svendsen Nerheim * [1,2], Henri Carson [2], Katherine Carrol [2], Marcus Eriksen [3]

[1] University of Bergen (UIB) – Postboks 7800, NO-5020 BERGEN Phone: +47 55 58 00 00, Norway
[2] University of Hawaii at Hilo (UHH) – 200 West Kwili St., Hilo, HI 96720, United States
[3] 5 Gyres Institute – 2122 S. Spaulding Ave. Los Angeles, CA 90016, United States

Microorganisms likely mediate processes affecting the fate and impacts of marine plastic pollution, including degradation, chemical adsorption, and colonization or ingestion by macroorganisms. We investigated the relationship between plastic-associated microorganism communities and factors such as location, temperature, salinity, plankton abundance, plastic concentration, item size, surface roughness, and polymer type. Small plastic items from the surface of the North Pacific Gyre in 2011 were examined using scanning electron microscopy. Bacillus bacteria (mean 1664 ± 247 individuals mm2) and pennate diatoms (1097 ± 154 mm2) were most abundant, with coccoid bacteria, centric diatoms, dinoflagellates, coccolithophores, and radiolarians present. Bacterial abundance was patchy, but increased on foamed polystyrene. Diatom abundance increased on items with rough surfaces and at sites with high plastic concentrations. Morphotype richness increased slightly on larger fragments, and a biogeographic transition occurred between pennate diatom groups. Identifying the dominant organisms of this community, their distribution in the ocean, and their effects on the debris they inhabit, will be a crucial step in understanding the future of plastic pollution in the ocean.

Keywords: Marine debris, Plastic pollution, Microorganisms, Bacteria, Diatoms, North Pacific Gyre

*Speaker

The role of microplastics as a vector for PCBs through the marine trophic levels

Lisa Devriese * [1], Bavo De Witte [1], Sabrine Derveaux [1], Hannelore Theetaert [1], Mattias Bossaer [1], Kevin Vanhalst [1], Johan Robbens [1]

[1] Institute for Agricultural and Fisheries Research, Ostend, Belgium (ILVO) – Belgium

Recently, the occurrence of microplastic litter is recognized as an area of global concern. Depending on the presence, size, density, shape, colour and biofouling, microplastics could be introduced to marine organisms and ingested when mistaken as food. It is known that plastic litter tends to accumulate hydrophobic organic compounds such as PCBs from the marine environment due to the higher partition coefficients of organic pollutants for plastics than for seawater or sediments. The ingestion of microplastics may therefore provide an additional biomagnifications route for plastic-adsorbed contaminants in the marine ecosystem. Otherwise, ingested synthetic polymers may possibly counteract biomagnifications by adsorbing contaminants from the tissues of the marine organisms.

Given the little data available on the role of microplastics as a vector for PCBs through the marine trophic levels, an impact study is required via controlled conditions. Benthic marine organisms such as the common shore crab and Norway lobster were exposed to PCB loaded microplastics under controlled laboratory conditions. In these experiments, 500-600 μm diameter polyethylene or polystyrene spheres were loaded with the 7 ICES PCBs. It is expected that spheres of 500-600 μm will pass the digestive tract without accumulation in the organisms. Within this research, it is investigated whether this short period in the digestive system is sufficient for the plastic spheres to release or adsorb PCBs? After 3 weeks of exposure, the PCB levels in the tissues of the tested organisms were quantified using a Bligh and Dyer extraction followed by GC-ECD analysis. The results will be presented and discussed during the conference.

Keywords: PCBs, bioaccumulation, microplastics, Carcinus maenas, Nephrops norvegicus

*Speaker

Impacts of microplastics on the marine life

Biological effects of exposure to plastic particles in the 3-spined Stickleback (Gasterosteus aculeatus)

Tim Katzenberger * [1], Christopher Payne [1], Karen Thorpe† [1]

[1] University of Portsmouth (UoP) – University House, Winston Churchill Ave, Portsmouth PO1 2UP, UK, United Kingdom

Plastic wastes are rapidly accumulating in landfill and in natural habitats, especially the marine environment, where they create a potential hazard for wildlife. The full environmental impacts of plastic waste are not understood, but UNEP estimates that marine plastic wastes cause the deaths of hundreds of thousands of aquatic vertebrates each year. These deaths result partly from entanglement but there are also concerns that ingestion of plastic fragments may be blocking the digestive system and causing starvation. To address this, two laboratory exposures were conducted to assess the biological effects of ingested plastic particles. In the first, larval 3-spined stickleback (Gasterosteus aculeatus) were exposed for 7-days to suspended 1.0 μm fluorescent polystyrene spheres at a density of 10, 100 and 1000 mg/L. Fluorescent imaging confirmed that the larvae ingested the plastics and that the quantity of fluorescence within the digestive tract was proportional to the density of plastics added to the water. There was no evidence that ingestion of the plastics impacted larval survival, however, a negative relationship between quantity of plastic added to the beaker and condition factor was observed ($r = -0.380$; $p < 0.001$, $n=144$); condition factors in the low, medium and high exposures were 14.6% ($p < 0.05$), 18.9% ($p < 0.01$) and 31.6% lower ($p < 0.01$), respectively, when compared to the controls. In a second experiment, adult 3-spined stickleback, were exposed for 7-days to 72 dph Artemia that had been exposed for 24 hours to 1.0 or 10 μm fluorescent plastic spheres. High and low dose groups were generated by feeding with either 100% or 10% contaminated Artemia, respectively. The low dose groups and a control group were fed 90% and 100% non-contaminated Artemia, respectively. Following the 7-day exposure a sub-group of fish were fed non-contaminated Artemia for a further 14-days, to monitor excretion of the plastics. Estimates of particle density (based on fluorescent intensity) in daily faecal samples indicated that uptake and excretion of the plastics was rapid; plastics were found in the faeces within one day of initiating exposure, but within 2-days of ceasing exposure a 71% decrease in fluorescence was observed, implying that the plastics are not retained within the digestive tract for prolonged periods. There was no evidence that ingestion of the microplastics, via their diet, impacted on adult fish survival, body size or condition. Collectively, these experiments demonstrate that fish will actively take up microplastics from the water column, as well as ingesting them via their diet. Although ingestion of the micron sized plastics does not appear to be deleterious to the health of adults, at least in the short-term, there is clear evidence that the plastics can accumulate to harmful levels in larval fish with negative impacts on body condition. These results highlight the urgent need for longer-term studies that can more fully evaluate the environmental

*Speaker

†Corresponding author: karen.thorpe@port.ac.uk

impacts of plastic ingestion for aquatic organisms.

Keywords: plastic pollution, three spined Stickleback, ingestion, biological effects, trophic transfer

Ecotoxic effects of nano plastic on freshwater plankton (Scenedesmus obliquus and Daphnia magna)

Ellen Besseling * [1,2], B. Wang [1], Albert Koelmans [1,2]

[1] Aquatic Ecology and Water Quality Management Group, Department of Environmental Sciences, – Wageningen University, P.O. Box 47, 6700 AA Wageningen, The Netherlands, Netherlands
[2] Institute for Marine Resources Ecosystem Studies (IMARES) – Wageningen UR, P.O. Box 68, 1970 AB IJmuiden, The Netherlands, Netherlands

The amount of nano- and microparticles in the aquatic environment rises due to the industrial production of nanoplastic and the degradation of macroplastic into small particles. Little is known about the fate and effects of nanoplastic, while there are lots of speculations about possible effects. In this study, the effects of nano polystyrene on performance of green algae Scenedesmus obliquus and zooplankton Daphnia magna were assessed. At high doses inhibiting effects on the growth of S. obliquus were shown. During chronic tests the suspensions of nano polystyrene were not lethal to D. magna but reproduction effects were observed. Interestingly, aqueous vs. dietary exposure to nano polystyrene played an important role in the occurrence of effects on D. magna. Thereby this study provides a novel indication about the importance of uptake routes in nano plastic exposure.

Keywords: Nano plastic, plankton, toxicity, reproduction

*Speaker

Impact of microplastics on feeding, function and fecundity in the copepod Calanus helgolandicus

Matthew Cole * [1,2], Pennie Lindeque [1], Elaine Fileman [1], Claudia Halsband [3], Tamara Galloway [2]

[1] Plymouth Marine Laboratory – Prospect Place, The Hoe, Plymouth PL1 3DH, UK, United Kingdom
[2] University of Exeter – College of Life and Environmental Sciences: Biosciences, Geoffrey Pope Building, University of Exeter, Stocker Road, Exeter EX4 4QD, UK, United Kingdom
[3] Akvaplan-niva – High North Research Centre for Climate and the Environment, N-9296 Tromsø, Norway, Norway

Copepods are an abundant and ecologically important class of zooplankton, common to marine ecosystems across the globe and representing an essential source of prey for a range of marine life. Our recent work has demonstrated that microplastics (7 - 30 μm) can be ingested by a range of zooplankton common to the northeast Atlantic, and $<$ 5 μm microplastics can become entrapped by and accumulate around functionally important appendages of copepods. Further studies have indicated that microplastics can interfere with copepod feeding and egestion, with polystyrene spheres significantly reducing the ingestion rates of algal preybyCentropages typicus, and altering the properties of faecal pellets produced by Calanus helgolandicus. In this study we demonstrate that 20 μm polystyrene microplastics can significantly impact upon algal prey ingestion rates in the copepod C. helgolandicus. We explore the ramifications of this reduced feeding on metabolism, egestion and reproductive outputs (including egg production, egg size and hatching success) ofthis species. This study highlights both the potential risks that microplastics pose to organisms at the base of the marine food web and the need for further research on marine microplastic debris $<$ 333 μm in size.

Keywords: zooplankton, copepod, microplastics, ingestion, reproduction, metabolism, carbon budget

*Speaker

Microplastics are love-killers for Pacific oysters!

Marc Suquet *† [1], Eve-Julie Arsenault-Pernet [1], Nelly Le Goic [2], Philippe Soudant [2], Christian Mingant [1], Rossana Sussarellu [2], Myrina Boulais [1], Yanouk Epelboin [1], Johan Robbens [3], Arnaud Huvet [2]

[1] Laboratoire de Physiologie des Invertébrés (LPI) – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – 11, presqu'île du vivier, 29840 Argenton, France
[2] Laboratoire des Sciences de l'Environnement Marin (LEMAR) – CNRS : UMR6539, Université de Bretagne Occidentale (UBO), Institut Universitaire Européen de la Mer (IUEM), Institut de Recherche pour le Développement, Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – Technopôle Brest-Iroise, Place Nicolas Copernic, 29280 Plouzané, France
[3] Institute for Agricultural and Fisheries Research (ILVO) – Burgemeester Van Gansberghelaan 96, box 1, 9820 Merelbeke, Belgium, Belgium

The effects of long-term exposure to microplastics on the reproductive characteristics of the Pacific oyster (Crassostrea gigas) were studied. During their gametogenesis, oysters were exposed or not (control), for two month, to polystyrene beads (diameter 2 and 6 μm, concentration: 1800 and 200 ml-1 respectively). During the reproductive period, gamete characteristics were assessed by studying oocyte quantity and quality (flow cytometry, D-larval yield) and sperm biological features (image analysis and flow cytometry).

A significantly lower number of oocytes (38%) was collected after gonad stripping in microplastic exposed oysters as compared to control ones. Oocyte relative size of oysters exposed to microplastics was significantly lower (8%) than values observed for control. On the other hand, no significant differences were recorded between the two oyster groups for oocyte ROS production and viability. For sperm, no significant differences were observed between the two oyster groups for the following parameters: sperm viability and morphology, mitochondrial membrane potential, ROS production and the percentage of motile spermatozoa. However, sperm movement speed from oysters exposed to microplastics was 23% lower than that from control oysters. Furthermore, the D-larval yield estimated 48h post fertilization, decreased by 41% for larvae produced from female oysters exposed to microplastics as compared to control ones.

In the present study, we demonstrated that the exposure of ripening oysters to microplastic particles reduced their fecundity, gamete quality and fertilization success.

Keywords: Microplatics, Pacific oyster, Reproduction, Gamete, Oocyte, Sperm

*Speaker
†Corresponding author: msuquet@ifremer.fr

Microplastics are taken up by marine invertebrates living in natural habitats

Lisbeth Van Cauwenberghe *† [1], Michiel Claessens [1,2], Michiel Vandegehuchte [1], Colin Janssen [1]

[1] Laboratory of Environmental Toxicology and Aquatic Ecology - Ghent University (UGent) – Jozef Plateaustraat 22 9000 Ghent, Belgium
[2] DuPont Coordination Center – Antoon Spinoystraat 6 2800 Mechelen, Belgium

Microplastics are present throughout the marine environment, and ingestion of these small (< 1 mm) plastic particles has been demonstrated repeatedly in laboratory settings for a wide array of marine (invertebrate) organisms. These ingestion experiments, however, are performed using unrealistically high particle concentrations (thousand times higher than current environmental concentrations), making it difficult to asses the environmental relevance of these observations. Here, we demonstrate, for the first time ever, the uptake and translocation of microplastics under field conditions in three marine invertebrate species: Mytilus edulis, Arenicola marina and Crassostrea gigas.

At first, two species of marine invertebrates representing different feeding strategies were collected in the field: the blue mussel M. edulis (filter feeder) and the lugworm A. marina (deposit feeder). These organisms were subjected to a gut depuration in order to remove all material, including microplastics, present in the intestinal tract. Chemical digestion of the soft tissues indicated that microplastics are present in every sampled organism collected in the field. Tissue of M. edulis contained on average 0.2 ± 0.3 microplastics/g tissue (ww), while A. marina contained slightly higher concentrations of microplastics, i.e. 1.2 ± 2.8 particles/g (ww). These tissue concentrations are low compared to the concentrations present in the environment (water: 10.1 ± 4.6 particles/L; sediment: 33.5 ± 17.9 particles/kg dry sediment).
Additionally, the presence of microplastics in seafood destined for human consumption was investigated. Since shellfish are cultured in natural conditions, and in this way exposed in the same way as their wild counterparts to pollutants present in the seawater (including microplastics), we hypothesised that these organisms would contain microplastics as well. In order to address this, microplastic load was determined for two species of commercially grown and globally consumed bivalves: M. edulis and C. gigas. At time of consumption, M. edulis (North Sea) contains on average 0.4 ± 0.1 particles/g tissue, while a plastic load of 0.5 ± 0.2 particles/g was detected in C. gigas (Atlantic Ocean). On an annual basis, consumption of these bivalves would entail a dietary exposure of approximately 1000 microplastics.

The presence of marine microplastics in marine wildlife and consequently seafood could hence pose a threat not only to marine food webs but also to food safety and human health. However, due to the complexity of estimating microplastic toxicity, calculating the potential risks for human health posed by microplastics in food stuffs is not (yet) possible.

*Speaker
†Corresponding author: lisbeth.vancauwenberghe@ugent.be

Keywords: Microplastics, Tissue concentration, Field conditions, Mytilus edulis, Crassostrea gigas, Arenicola marina

Microplastics in our food: ingestion by commercially important fish species

Amy Lusher * [1], Ian O'connor [1], Rick Officer [1]

[1] Galway-Mayo Institute of Technology (GMIT) – Ireland

Ireland's 7,500km coastline has a remarkable biodiversity and is rich in aquatic life: it provides a wide variety of fish and shellfish of commercial importance. Whilst most seafood from Irish waters is produced remote from heavy industry there is an increasing level of concern regarding contamination of seafood by marine litter. Of particular concern are microplastics which have been identified in marine habitats worldwide. Laboratory studies have shown that microplastics can be ingested by a variety of organisms but data on the abundance of microplastics in natural populations are limited. Wild caught species and marine farmed animals that feed naturally on plankton have the highest risk of ingesting microplastics. This is because organisms are unable to discriminate synthetic items from natural prey and actively or accidently ingest them. Once ingested, microplastics may have biological and chemical effects on the organisms, which could have trophic level effects if transferred to the food chain, resulting in threats to food safety and security. This baseline study documents the incidence of microplastics found in commercially important fish caught in Irish waters. The amount of plastic ingested is expected to depend on the method of feeding. Effort is therefore directed towards species that feed directly on plankton. The greatest risks to food security are anticipated when such species are subsequently consumed whole (e.g. small pelagic fish). The quantity of microplastics identified is compared to studies in other regions providing the first comparative report on plastic ingestion by organisms from Irish waters.

Keywords: microplastics, marine debris, ingestion, fish

*Speaker

Microplastics: effects on oyster physiology and reproduction

Rossana Sussarellu * [1], Philippe Soudant [1], Christophe Lambert [1], Caroline Fabioux [1], Charlotte Corporeau [1], Charlotte Laot [1], Nelly Le Goic [1], Virgile Quillien [1], Pierre Boudry [1], Marc Long [1], Christian Mingant [2], Bruno Petton [1], Thomas Maes [3], Dick Vethaak [4], Johan Robbens [5], Arnaud Huvet [1]

[1] Laboratoire des Sciences de l'Environnement Marin (LEMAR) – CNRS : UMR6539, Institut Universitaire Européen de la Mer (IUEM), Institut de Recherche pour le Développement, Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), Université de Bretagne Occidentale (UBO) – Technopôle Brest-Iroise, Place Nicolas Copernic, 29280 Plouzané, France

[2] Laboratoire de Physiologie des Invertébrés (LPI) – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – 11, presqu'île du vivier, 29840 Argenton, France

[3] Center for Environment, Fisheries Aquaculture Science (CEFAS) – CEFAS, Lowestoft Laboratory, Lowestoft, Suffolk, UK, United Kingdom

[4] Deltares (Deltares) – Rotterdamseweg 185, 2629 HD Delft, Pays-Bas, Netherlands

[5] Institute for Agricultural and Fisheries Research (ILVO) – Burgemeester Van Gansberghelaan 96, box 1, 9820 Merelbeke, Belgium, Belgium

Plastics are persistent synthetic materials, which can accumulate in the marine environment. Although the consequences of macroplastic debris for wildlife are well documented, the impacts of microplastics on marine life are still largely unknown. Microplastics are defined as plastic particles smaller than 1 mm and may derive from many different sources. Filter feeders organisms are likely to be impacted by MP pollution as they filter large volumes of water and can ingest little particles while feeding. Occurrence and effects of MP filtration evidenced reduction of the feeding activity, inflammatory response and translocation of MP in the circulatory system. Longer term effects on growth, survival or reproduction are still unknown. As part of the MICRO EUInterreg project (MicroPlastics – Is it a threat for the 2 seas Area?), biological effects of MP were assessed through an integrative approach on the Pacific oyster Crassostrea gigas during a gametogenesis period.

A chronic exposure of adult oysters to MP, during two months, was performed under controlled conditions using a mix of yellow-green fluorescent polystyrene MPs (2 and 6 μm). Appropriate experimental conditions were designed to induce gametogenesis. Physiological perturbations were assessed by measuring ecophysiological behaviour (ingestion rate, assimilation efficiency), condition index and reproductive effort. A preferential uptake of 6 μm particles was observed compared to 2 μm. Ingestion rate in MP exposed animals was significant higher, supposedly to compensate the lower energy intake. Reproductive effort tended to be reduced together with a significant decrease in the total number of produced oocytes (-40%). This could be caused by a disruption of the energetic metabolism and should be explored further. These measurements would help defining toxic endpoints and to guide future studies on the effects of MP on Pacific

*Speaker

oyster physiology.

Keywords: microplastic, oyster, growth, reproduction, ingestion

The physical impacts of microplastics on marine worms

Stephanie Wright * [1], Darren Rowe [1], Richard Thompson [2], Tamara Galloway† [1]

[1] University of Exeter – Biosciences College of Life and Environmental Sciences Geoffrey Pope University of Exeter Stocker Road Exeter EX4 4QD, United Kingdom
[2] Plymouth University – University of Plymouth, Drake Circus, Plymouth, Devon PL4 8AA, United Kingdom

Plastic debris at the micro-scale (microplastic) is a widespread element of marine litter. Microplastics have accumulated in sediments worldwide from low densities to localized 'hotspots'. Ingestion by indiscriminate deposit feeders has been reported, yet physical impacts remain understudied. The current work aims to determine the extent to which microplastics affect the health of an OSPAR-approved marine polychaete. We are using an integrated approach combining sublethal toxicological measurements at the cellular and physiological level alongside behavioural responses to assess the short- and long-term implications of virgin microplastics in vivo. Here we show that deposit-feeding marine worms maintained in sediments spiked with microscopic unplasticised polyvinylchloride (UPVC) at concentrations overlapping those reported in the environment had significantly depleted energy reserves - by up to 50% - compared to controls; an effect that was not attributed to reduced organic content. Our results suggest that depleted energy reserves arise from a combination of reduced feeding activity, longer gut residence times of ingested material and inflammation. This illustrates how the influx of this anthropogenic substrate into the marine environment may impact deposit feeders with crucial roles in marine ecosystems.

Keywords: Microplastics, polyvinylchloride, polychaete, sediment

*Speaker
†Corresponding author: t.s.galloway@exeter.ac.uk

Translocation of microplastic in the circulatory system of the oyster Crassostrea gigas : Evidences and uncertainties : investigation to load.

Christophe Lambert *† [1], Rossana Sussarellu [1], Caroline Fabioux [1], Nelly Le Goic [1], Christian Mingant [2], Arnaud Huvet [1], Thomas Maes [3], Dick Vethaak [4], Johan Robbens [5], Philippe Soudant [1]

[1] Laboratoire des Sciences de l'Environnement Marin (LEMAR) – CNRS : UMR6539, Institut Universitaire Européen de la Mer (IUEM), Institut de Recherche pour le Développement, Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), Université de Bretagne Occidentale (UBO) – Technopôle Brest-Iroise, Place Nicolas Copernic, 29280 Plouzané, France
[2] Laboratoire de Physiologie des Invertébrés (LPI) – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – 11, presqu'île du vivier, 29840 Argenton, France
[3] Center for Environment, Fisheries Aquaculture Science (CEFAS) – CEFAS, Lowestoft Laboratory, Lowestoft, Suffolk, UK, United Kingdom
[4] Deltares (Deltares) – Rotterdamseweg 185, 2629 HD Delft, Pays-Bas, Netherlands
[5] Institute for Agricultural and Fisheries Research (ILVO) – Burgemeester Van Gansberghelaan 96, box 1, 9820 Merelbeke, Belgium, Belgium

The oyster Crassostrea gigas, is likely to be impacted by microplastic (MP) pollution since, as a filter feeder organism, it filters large volumes of water and by the way, it can ingest little particles while feeding. Previous works evidenced the absorption of MP in various tissues of the mouse (Ebel, 1990) using similar techniques as the ones described in the present work. Translocation in the circulatory system (hemolymph) of mussels has also been proposed more recently (Browne et al, 2008).

During an experiment where adult oysters Crassostrea gigas were exposed to microplastics (fluorescent beads of 2 and 6 microns), we tested two different methods for collecting hemolymph: in the adductor muscle or directly in the pericardial cavity. We were able to find MPs in the hemolymph of bivalves throughout the experiment. But, did we observed a real translocation phenomenon or was it a simple contamination due to sampling technique? The presence of MPs in the water of the pallial cavity, three days after stopping the exposure, casts doubt on the reality of the phenomenon of translocation. The study of histological sections did not raise this doubt, since the presence of microplastic was clearly observed only in the digestive tract.

In view of these results and knowing that it is impossible to exclude completely contamination as an explanation of the observation of MP in the hemolymph in our experiment, we went back to the two papers mentioned above to redo a critical reading: some elements of the methods developed by these authors suggest that there is indeed still some uncertainties as to the reality

*Speaker
†Corresponding author: christophe.lambert@univ-brest.fr

of the phenomenon of translocation of MP in bivalves. Note that this replay has been deliberately made to load. The aim is to launch the discussion in order to improve our understanding of MP translocation, and to go further on the significance of this phenomena for the physiology of marine animals, especially filter-feeders.

Browne, M.A., Dissanayake, A., Galloway, T.S., Lowe, D.M., Thompson, R.C., 2008. Ingested Microscopic Plastic Translocates to the Circulatory System of the Mussel, Mytilus edulis (L.). Environmental Science & Technology 42, 5026-5031.

Ebel, J., 1990. A Method for Quantifying Particle Absorption from the Small Intestine of the Mouse. Pharmaceutical Research 7, 848-851.

Keywords: microplastics, bivalves, translocation, Crassostrea gigas

Two alternate mechanisms for uptake of microplastics into the Shore crab Carcinus maenas. Trophic transfer and direct exposure

Andrew Watts *† [1], Charles Tyler [1], Ceri Lewis [1]

[1] University of Exeter – College of Life and Environmental Sciences: Biosciences, Geoffrey Pope Building, University of Exeter, Stocker Road, Exeter EX4 4QD, United Kingdom

Filtering feeding marine invertebrates (such as Mytlis edulis) are generally considered amongst the most susceptible marine organisms to microplastic contamination due to the volumes of seawater processed during feeding. Furthermore, as important secondary producers in many benthic marine ecosystems, these animals might play fundamental roles for microplastic entry into marine trophic webs. However, some invertebrates, such as the common shore crab, Carcinus maenas, which feed upon M. edulis, also take up large volumes of seawater over the gills for respiratory processes. This could provide a secondary, and so far un-studied, entry point for microplastics into marine biota. The aim of this study was to investigate the uptake of microplastics into C. maenas via these two alternative routes: trophic transfer from the mussel M. edulis and through direct exposure via seawater. We investigated the uptake and internal distribution of 10μm fluorescently labelled polystyrene microspheres via ingestion through the foregut and inspiration through the gills. Our results indicate that both of these routes are involved in microplastic uptake, with significant numbers of microspheres accumulating in the foregut of C. maenas when fed with M. edulis previously exposed to these plastics, demonstrating the importance of trophic transfer. Significant numbers of microspheres on the gills of C. maenas were also observed when crabs were exposed directly to microplastics through the water. Translocation occurs between these two organs as well as the midgut gland within the first 30 minutes of consumption of M. edulis. Plastic microspheres were excreted over the first 14 days however were still found on the gills 22 days post exposure.

Keywords: Carcinus maenas, Mytlis edulis, Microplastics, pollution, trophic transfer, direct exposure, CLEANSEA

*Speaker

†Corresponding author: a.j.r.watts@exeter.ac.uk

Outreach and mitigation regarding "microplastics"

Actions de terrain et sensibilisation du grand public comme outils de lobbying contre les microplastiques

Marie-Amélie Néollier *† [1]

[1] Surfrider Foundation Europe – - – France

L'association Surfrider Foundation Europe a la capacité de monter des actions scientifiques de terrain couplées à des campagnes d'information en multipiant ses rapports avec de nombreux acteurs du littoral (organismes scientifiques, grand public, médias, ...). Cela permet de transmettre de manière adaptée des données scientifiques parfois peu accessibles au grand public et aux médias et ainsi valoriser ce travail de terrain. sa représentativité lui permet ensuite de faire valoir ce travail auprès des instituions européennes et de faire du lobbying, soutenu par le grand public et s'appuyant sur des projets sérieux.

C'est ainsi par exemple que nous appliquons le protocole OSPAR en Bretagne depuis 2010 et que nous utilisons ses données pour le PAMM de la DCSMM ou encore que nous collaborons avec le CEDRE à l'élaboration d'un protocole de tri et de quantification simplifié. Surfrider est une "passerelle" active entre les divers acteurs du littoral, contribuant à une meilleure gestion intégrée du littoral. Toutes ses actions de terrain sont également déclinées sous forme de campagnes d'information ou d'outils pédagogiques afin que le message soit le plus adapté et utile pour l'amélioration de la qualité du milieu marin.

Par son action de lobbying, Surfrider a largement contribué à la reconnaissance des déchets aquatiques comme pollution réelle (cf descripteur DCSMM). Son travail auprès des institutions européennes et nationales est constant depuis plus de 20 ans.

Keywords: Campagnes d'information, lobbying, gestion intégrée

*Speaker

†Corresponding author: mneollier@surfrider.eu

Posters - Occurence of microplastics in the marine environment

Assessing the microplastics in urban effluents and in the Seine River (Paris)

Rachid Dris *† [1], Johnny Gasperi [1], Bruno Tassin [1]

[1] laboratoire Eau, Environnement et Systèmes Urbains (LEESU) – AgroParisTech, École des Ponts ParisTech (ENPC), Université Paris-Est Marne-la-Vallée (UPEMLV), Université Paris-Est Créteil Val-de-Marne (UPEC) – Université Paris Est - AgroParisTech, UMR MA-102, 6-8 avenue Blaise Pascal, 77455 Champs sur Marne cedex 2, France

Most studies are dealing with the issues of microplastics in the marine environment. On the contrary, their behaviour in freshwater is largely unknown. However, the issue of the abundance of the microplastics in the continental environment is very important as they constitute a potentially major source of marine ones. For instance, studies suggest that a large proportion of microplastic fibres found in the marine environment could originate from sewage as a consequence of washing machine effluents [1].

In this context, this study aims at providing a first assessment of the abundance of microplastics in the continental environment. It was conducted at the scale of the Seine River catchment, and more especially on the Paris urban area. Surface water, sediments as well as waste water treatment plant effluents were collected and microplastics evaluated. The natural samples were collected in the Seine River bank , upstream of Paris. The wastewater effluents were collected from the Seine-Aval wastewater plant, downstream Paris.

For liquid matrices, samples were filtered. For sediments, the samples were treated with H2O2 to remove natural organic debris. A sequential density separation was then employed, with NaCl followed with ZnCl2. The supernatant was filtered. Microplastics were accounted on the filters with a stereomicroscope.

Whatever the matrix considered, microplastics encountered in all types of samples are almost fibres. For surface water, between 62 and 101 fibres/l were found. This results are very high compared to other studies in the marine environment [2]. The sediments also presented very high concentrations varying between 405 and 750 fibres/kg of dry weight.This is in, our knowledge, the highest concentration ever found in a study [3].

Wastewater exhibits very high concentrations (469 fibres/l) of microplastics while treated water presents much lower concentrations (31 fibres/l). Based on these first results, this could suggest that microplastics are removed with a great efficiency during the treatment.

Further investigations are required in order to investigate for all microplastics sources, to confirm these first results and to gain a better understanding of the distribution and sources of the microplastics in the terrestrial habitats.

*Speaker
†Corresponding author: drisr@leesu.enpc.fr

Browne, M. A., P. Crump, S. J. Niven, E. Teuten, A. Tonkin, T. Galloway et R. Thompson (2011). "Accumulation of Microplastic on Shorelines Woldwide: Sources and Sinks." Environmental Science & Technology 45(21): 9175-9179.

Norén, F. (2007). Small plastic particles in Coastal Swedish waters: 11.

Liebezeit, G. et F. Dubaish (2012). "Microplastics in Beaches of the East Frisian Islands Spiekeroog and Kachelotplate." Bulletin of Environmental Contamination and Toxicology 89(1): 213-217.

Keywords: La Seine, microplastiques, milieu continental, sources, milieu urbain, fibres, station d'épuration, sédiments, eaux douces

Development of a Nile Red staining method for microplastic identification and quantification

Young Kyoung Song * [1]

[1] Korea Institute of Ocean Science and Technology (KIOST) – 1Oil and POPs Research Group, Korea Institute of Ocean Science and Technology, 41 Jangmok-1gil, Jangmok-myon , Geoje 656-834, South Korea, South Korea

It is essential to identify microplastics from other inorganic and organic natural particles. Microplastics are classically visually identified with a microscope. Microscopic identification has low reliability especially in small (e.g. < 200 m) transparent or white particles. FT-IR equipped with a microscope has been frequently applied to spectroscopic identification of microscale polymers including qualitative confirmation of polymer types. It is a little hard to detect microplastics less than 50 m in size. Raman spectroscopy may apply to smaller particles than a FT-IR. However, both FT-IR and Raman spectroscopic methods are still quite time-consuming process to identify a number of microplastic particles on a filter paper. We aim to develop a subsidiary method to facilitate identification of synthetic polymers using a fluorescent dye.

Nile Red (NR), a fluorescent dye, which was well known to dye neutral lipid in cell and tissue sample. It is strongly fluorescent only in the presence of a hydrophobic environment. Applicability of NR for identification and quantification of microplastics was tested and staining condition was optimized in this study. Micro-sized polyethylene (PE), polypropylene (PP) and expanded polystyrene (EPS) were used as model plastics. A number of carrying solvents were tested. NR demonstrated good staining capability in n-hexane without damage on both white and black polycarbonate (PC) filter papers. But, because low solubility of NR in n-hexane, stock solution was made in acetone and then diluted with n-hexane in working solution (5 and 50 mg/L). Stained polymer particles were recognized better in green fluorescence (Ex.; 534-558 and Em.; 515-565) than red (Ex.; 534-558 and Em.; > 590) without background (PC filter paper) staining under a fluorescent microscope. Both the NR concentrations were enough to dye three polymer particles, but 50 mg/L solution showed higher fluorescence than 5 mg/L solution. Fluorescence intensity was in the order of EPS > PP > PE. The developed NR staining method was successfully applied to identify and quantify the fragmented polymer particles in a laboratory accelerated mechanical abrasion study. Staining polymer particles with NR is easy and fast to identify and quantify polymer particles. Other polymer types are being tested with the NR staining method. The further application of NR staining to field samples accompanying with removal of biogenic materials are currently undergone.

Keywords: microplastic, Nile Red, identification

*Speaker

Freshwater fish are also contaminated by microplastics – need of an integrated continental/marine water strategy

Wilfried Sanchez * [1], Coline Bender [1], Jean-Marc Porcher [1]

[1] Institut National de l'Environnement Industriel et des Risques (INERIS) – INERIS – Parc Technologique Alata 60550 Verneuil-en-Halatte, France

Several studies describe the contamination of marine water bodies by plastic debris including particles smaller than 5mm named microplastics. However, only any recent works report the contamination of freshwater ecosystems by this new class of environmental pollutants. Indeed, microplastics were detected in surface water samples from American Great Lakes, Lake Geneva in Switzerland and Jade System in Southern North Sea. to our knowledge, no data is available on the contamination of freshwater wildlife such as fish by microplastics. To bridge this gap, the present study was designed to address occurrence of microplastics in wild fish from French rivers. For this purpose, 186 adult wild gudgeons (Gobio gobio) were electrofished in 11 French streams characterized by various environmental pressures. Digestive tract of all fish was dissected and its content was subjected to a direct visual inspection under a dissecting microscope. Among 11 investigated sites, microplastics were clearly observed in digestive tracts of gudgeons from 7 sites with an occurrence of contaminated gudgeons between 11 and 26 % particularly in urban rivers. This result is in accordance with the sources of microplactics in continental water bodies such as urban waste water effluents. To conclude, this study provides the first evidence of freshwater fish contamination by microplastics. Also, the problem of aquatic environment pollution by this novel contaminant must be investigated in a continental/marine continuum approach.

Keywords: fish, freshwater, microplastics

*Speaker

Identification of sink areas for plastic pellets at coastal zones

Danilo Balthazar-Silva * [1], Fabiana Tavares Moreira [1], Alexander Turra [1]

[1] Laboratório de Manejo, Ecologia e Conservação Marinha, Instituto Oceanográfico USP (IOUSP) – Instituto Oceanográfico da USP Praça do Oceanográfico, 191 Cidade Universitária, São Paulo, SP, Brasil 05508-120, Brazil

Recent reviews on microplastics pollution in the marine environment suggest that the elucidation of the sink areas of this contaminant at coastal zones is an urgent issue for standardizing of monitoring strategies. The present work had two objectives: 1. To identify sink areas for plastic pellets at local and regional scales; 2. To describe trend differences in the spatial distribution of plastic pellets between two compartments of sandy beaches, the backshore zone and the coastal plan. Two hypotheses were tested: a) at coastal zones, the coastal plain acts as a sink area for plastic pellets. b) The spatial distribution of the plastic granules at the across shore direction and in depth is opposite between the two compartments. Sampling strategy was done at 13 different sandy beaches. On each beach, an area of 50m at both compartments was selected. To insure independence of samples, one meter buffer line was established between the compartments. Five transects were randomly chosen at the across shore direction at the both compartments. The number of sampling points by transect was established by dividing the across shore extension by 12, when it was 12 meters or more, or separated by one meter when the across shore extension was less than 12 meters. The sediment was taken with the aid of an auger from zero to one-meter depth with 0.20 meters stratification. Sediment samples were also collected from the surface of the sediment at the zero, 25 and 50m limits of the inferior, intermediary and superior portions of the backshore zone. The abundance data was transformed in to density by linear meter. Then, 3d graphs showing the distribution of the pellets were plotted. The Kriging method was used to create a trend surface. Analysis of variance was used to estimate differences between the sink areas. The correlation between the density of plastic pellets and the size of the sediment granules was tested by the Spearman correlation coefficient. The 3d graphs indicate that there is a tendency for aggregation at the inferior portions of the compartments and that the deposition occurs mainly at the first strata of the sediment (e.g. 0.20 cm depth). There was a significant variation between the coastal plain and the backshore zone at the regional scale ($F = 3.333$, $p = 0.00041$) and at the local scale ($F = 15.988$, $p = 0.00012$). There was no correlation between the mean density of pellets and the mean size of sediment granules ($r = 0.289$, $p = 0.338$). The results suggest that the coastal dunes act as sink areas for plastic resin pellets.

Keywords: Plastic pellets, Sandy beaches, Sink Areas Coastal plan, Backshore zone

*Speaker

Improving microplastic detection in plankton-rich samples

Matthew Cole * [1,2], Hannah Webb *

[3], Pennie Lindeque [1], Elaine Fileman [1], Tamara Galloway [2]

[1] Plymouth Marine Laboratory – Prospect Place, The Hoe, Plymouth, PL1 3DH, United Kingdom
[2] University of Exeter – College of Life and Environmental Sciences: Biosciences, Geoffrey Pope Building, University of Exeter, Stocker Road, Exeter EX4 4QD, United Kingdom
[3] Plymouth University – Plymouth, PL4 8AA, United Kingdom

Prevalent in marine ecosystems across the globe, microplastics are now widely classified as a marine pollutant. It is therefore increasingly important to implement standardized protocols to efficiently and accurately enumerate and identify microplastics in a variety of marine habitats. Neuston nets and on-board pumps are most commonly used to sample for microplastics within the water column, however, in areas of high biological productivity (e.g. sites of upwelling, coastal sites), it is inevitable that organic material – primarily plankton – will dominate the samples. Large quantities of organic material can mask the presence of anthropogenic litter, particularly microscopic debris, making quantification of microplastics difficult to determine. Traditional acid digestion techniques can remove this organic material but will also destroy or alter polymers with low pH intolerance (e.g. nylon, a polymer commonly used in fishing gear and noted in numerous marine samples). In this study, we address these limitations and trial the use of chemical and biological media to digest the organic material present in water-column samples, without destroying microplastics. Our optimised protocol has a $> 95\%$ digestion efficiency, with low risk of external contamination and showing no damage to a range of polymers. The nature of the protocol will further consider tiny microplastics that may have been internalised by zooplankton present within the sample. As such, this standardized protocol should be considered a useful additional step in quantifying microplastics in biota-rich samples, irrespective of the sampling method utilised.

Keywords: Microplastics, digestion, marine, water column, sampling, method development

*Speaker

Initial assessment of microplastic on the French coasts : the special case of industrial granules

Laurent Colasse * [1]

[1] Association SOS Mal de Seine – Aucune – Association SOS Mal de Seine AJ1 ernemont 117 rue Vincent Auriol 76300 Sotteville-lès-rouen, France

Global demand for plastic increases and with it the presence of industrial pellets in aquatic environments. The presence of this synthetic material is scientifically observed since the 70s on all the beaches of the world. (Carpenter and al - 1972, Gregory and al – 1977, Shiber and al - 1979). But, as these granules are so small (about 5 mm), their presence on our river (Seine) was not discovered before 2009.

Little is known about the fate of industrial plastic pellets once they have been lost during production, sea and terrestrial transportation, transformation, waste treatment or various bad usages (Peening, moving heavy objects, insecticide granules, horse tracks...).

The initial objective of the present study was to detect their presence in the Seine river, harbors, marinas, and all along the coast. A visual method was setup to characterize pellet pollutions in various environments.

Scarce presence - more than 5 pellets through a whole beach ;

quiet presence - less than 50 per square meter ;

low density - more than 50 per square meter;

moderate density - more than 1000 per square meter ;

high density - soil or sediment are no longer visible ;

very high density – continue presence over a significant depth.

Combined to these density observations, it is considered the extension and shape of the pollution.

small spot from few centimeters to few square meters ;

low linear pollution on few meters ;

moderately linear on few tens of meters ;

*Speaker

very linear over hundred meters.

These criteria have allowed to make an initial evaluation of the coastlines of the the North Sea, English Channel, Celtic Sea, Bay of Biscay and the Mediterranean Sea (For Ifremer / MSFD and GES).

The method of Costa et al (2010) was adapted by using a 100mL sampling pot (fast sampling) or a light stainless steel frame to collect from 1.2 to 2 liters of sediments to be sieved. Significant accumulations of industrial pellets are generally found on coastline and could be very concentrated. Up to 100 g of pellets per liter of sediment can be found on the polluted beaches. Also, up to 215 g of pellets per liter of sediment in a very polluted harbor. (Le Havre)

Careful sorting of yellowed granules allowed to discover pellets heavily contaminated with persistent organic pollutants (results published on the web by Dr. Hideshige Takada - Tokyo University of Agriculture and Technology - Japan). The most polluted pellets were found in the harbour cited above as it contains 2746 ng of PCBs per g of pellets. (http://www.pelletwatch.org/maps/map-1.html#France).

Recently, high concentration of black industrial plastic pellets, thought to be " recycled" pellets, (75 grams per liter of sand) was detected in the English channel (Hardelot, between the Somme Bay and Boulogne-sur-mer). The same pellets were also found from eastern channel (FR) up to Texel island (NL). (Pictures on the web by IMARES Netherland, J.A. Van Franeker and Jasmien Claeys - school study 2011) These pellets are probably one of the largest observable maritime losses in the English Channel and the North Sea.

The characteristics of granules (shapes and colors) allowed identifying some specificity in polluted areas along French coastlines. Beyond these first observations, further studies are needed to better characterize their fate in marine environment and thus target their industrial and transportation origins.

Keywords: industrial plastic pellets, MSFD, GES

Introducing FP7 CLEANSEA: towards a clean, litter-free european marine environment through scientific evidence, innovative tools and good governance

Dick Vethaak * , Heather Leslie , Myra Van Der Meulen [1], Frank Kleissen , Ghada El Serafy

[1] Deltares – Netherlands

Marine litter is widely recognized as a threat to Europe's marine ecosystems. It is a major societal challenge because it impacts the vast natural marine capital that supports economies, societies and individual well being. Marine litter, of which plastic is a main component, is explicitly identified as a descriptor for determining Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD). Europe aims to achieve GES by 2020 and CLEANSEA – the first European framework program research project dedicated to the marine litter issue – is providing key scientific knowledge and tools for marine litter monitoring and action plans. The CLEANSEA project will i) provide comprehensive characterization and analysis of the marine litter problem (biological, chemical, social, economic, legislative and policy-oriented) in the EU's four main marine regions, ii) propose innovative monitoring tools and standard protocols to facilitate monitoring marine litter in a harmonized way, and iii) present cost-effective management measures and policy options to meet MSFD and other international objectives regarding marine litter. CLEANSEA aims to break down interdisciplinary barriers by synthesizing data and knowledge generated across its 5 RTD work packages, and uses an integrated framework to construct a Road Map for European marine litter reduction. Advanced techniques in the fields of (eco)toxicology, analytical chemistry, satellite imaging, oceanographic modeling and materials biodegradation testing will be used to assess the distribution, fate and impacts of marine litter. Economic, institutional and policy analysis research methods, tools and participatory approaches will be applied to inform trade-offs in policy and decision-making, identify economic, social and governance barriers to GES, and recommend effective policy options and management measures to remove these barriers and incentivize sustainable use of marine resources. CLEANSEA contributes to an adaptive ecosystem approach to the management of human activities in EU marine regions. Project outcomes will benefit not only the MSFD but also various EU directives and strategies including the Europe 2020 Strategy. Measures, strategies and policies that promote upstream sustainable production and use of plastics or recycling of waste that will be highlighted in the CLEANSEA Road Map can also contribute to the EU's policies and initiatives for a Resource Efficient Europe.

*Speaker

Investigation of the first stage of polymer degradation by combined Raman and AFM study

Fabienne Lagarde * [1], Nicolas Delorme [1], Pamela Pasetto [1], Philippe Daniel [1], Alain Bulou [1]

[1] Institut des molécules et des matériaux du Mans (IMMM) – CNRS : UMR6283, Université du Maine – UFR Sciences et Techniques Université du Maine - Avenue Olivier Messiaen - 72085 LE MANS Cedex 9, France

In the environment, biotic and/or abiotic factors act synergistically to degrade plastic materials. The primary process is generally a (i) surface-erosion process occurring at the upper layer of the material (a few nm at the beginning) coupled with chemical modifications.

Changes in chemical struture can be easily characterized by Raman spectroscopy. Raman spectroscopy is a non-destructive and non-invasive technique that can be used in-situ if required without any sample preparation. When coupled with microscopy, a micrometric scale spatial localization can be obtained and slight changes in the chemical composition of a sample can be detected by using chemometric tools (as principal component analysis).

Atomic Force Microscopy (AFM) is a powerful technique to investigate surface morphology or mechanical properties of polymer material at the nanometer scale. It also offers the advantage of being able to work in liquid and controlled media.

These two complementary tools were used to follow the early stages of biodegradation of partially biodegradable polymers. The first results showed that only after a small percentage of biodegradation (less than 5% of the total C was degraded), changes in the samples could be observed with both Raman and AFM.

This methodology has the potential to be applied for the study of thin films (< 100nm). We will show that Raman and AFM are very promising tools in the perspective of characterizing micro and nanoplastics.

Keywords: Raman, AFM, nanofilms, biodegradable polymers

*Speaker

Micro-plastics: a threat to the Bay of Brest?

Laura Frère * [1], Christophe Lambert [1], Arnaud Huvet [1]

[1] Laboratoire des Sciences de l'Environnement Marin (LEMAR) – CNRS : UMR6539, Institut Universitaire Européen de la Mer (IUEM), Institut de Recherche pour le Développement, Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), Université de Bretagne Occidentale (UBO) – Technopôle Brest-Iroise, Place Nicolas Copernic, 29280 Plouzané, France

Micro-plastics (MPs) are synthetic organics polymers with diameters < 1mm. MPs are persistent materials, which accumulate in marine habitats. It can have several origins: primary MPs, that are manufactured to be of a microscopic size, are used in industrial abrasives, exfoliates, cosmetics, synthetic fibers (from washing clothes) and plastics production pellets; Secondary MPs are fragments derived from the breakdown of larger plastics debris. MPs can contain additives and have the ability to act as a transportation vehicle for persistent organic contaminants and shellfish/human pathogens. Because of their size, MPs can be ingested by a large array of marine biota and can be transferred to the food chain.

This work is a continuation of the European project MICRO (Interreg IVa: MicroPlastics – Is it a threat for the 2 seas Area?) dedicated to the bay of Brest. It is why it is also supported by the "Université de Bretagne Occidentale" and "Brest Métropole Océane". Our aim is to establish an initial inventory of microplastic contamination in this bay (western Britanny, France). It will be conducted with the following objectives:

- (1) sampling of MPs depending on uses and habitats in the Bay of Brest where varied activities as fishing, aquaculture and tourism coexist. Four distinct environments (estuaries, beach, inshore and offshore) have been selected to understand the behaviour of MP in different biological and physical settings;

- (2) characterisation of the physical, biological and chemical properties of sampled MPs

  - (2a) physical properties (FT-IR and/or Raman);
  - (2b) inherent and adsorbed contaminants (GC-MS, CEDRE);
  - (2c) attached microbial communities;

- (3) establishment of models simulating transport and accumulation zones of MPs (collaboration with ZABrI: "Zone Atelier Brest Iroise");

- (4) determination of organisms contamination in hotspots;

*Speaker

- (5) regarding the level of contamination, socio-economic impacts of MPs in this maritime area will be studied and mitigating action to reduce the MPs problem will be discussed.

Keywords: microplastics, marine ecosystems, organic contaminants, Bay of Brest

Microplastic pollution in deep-sea sediments

Lisbeth Van Cauwenberghe *† [1], Ann Vanreusel [2], Jan Mees [2,3], Colin Janssen [1]

[1] Laboratory of Environmental Toxicology and Aquatic Ecology - Ghent University (UGent) – Jozef Plateaustraat 22 9000 Ghent, Belgium
[2] Marine biology research group - Ghent University (UGent) – Krijgslaan 281/S8 9000 Ghent, Belgium
[3] Flanders Marine Institute (VLIZ) – Wandelaarkaai 7 8400 Ostend, Belgium

Microplastics are small plastic particles (< 1 mm) originating from the degradation of larger plastic debris. These microplastics have been accumulating in the marine environment for decades and have been detected throughout the water column and in sublittoral and beach sediments worldwide. However, up to now, it has never been established whether microplastic presence in sediments is limited to accumulation hot spots such as the continental shelf, or whether they are also present in deep-sea sediments. Here we show, for the first time ever, that microplastics have indeed reached the most remote of marine environments: the deep sea.

Sediment originating from several locations in the Atlantic Ocean and Mediterranean Sea were investigated for the presence of microplastics. The sampling stations were located in the Atlantic sector of the Southern Sea, on the Porcupine Abyssal Plain (Northern Atlantic Ocean), in the distal lobe of the Congo Canyon (Gulf of Guinea, South Atlantic Ocean) and in the Nile Deep Sea Fan in the Eastern Mediterranean. These locations range in depth from 1100 to 5000 metres.
Microplastics sized in the micrometer range (75 – 161 μm) were detected in the top centimetre of the sediment at three of the four locations. Based on the (limited) surface sampled it can be tentatively concluded that in/on the seafloor of the deep sea, microplastics can reach an average abundance of 0.5 microplastics per 25 cm.

Our results demonstrate that microplastic pollution is present in the top sediment layer of the deep-sea floor. However, no conclusive statements can be made on how these microscopic particles were transported to the seafloor. Yet, their presence indicates that microplastics have spread throughout the world's seas and oceans, and into the remote and largely unknown deep sea.

Keywords: Microplastics, Deep Sea, Sediment, Pollution

*Speaker
†Corresponding author: lisbeth.vancauwenberghe@ugent.be

Morphological changes in polyethylene abrasives of brazilian cosmetics caused by mechanical stress

Liv Ascer * [1], Márcio Custódio [1], Alexander Turra [1]

[1] Universidade de São Paulo (USP) – Cidade Universitaria - 05508-090 São Paulo, Brazil

Plastic materials are known as dominant components of marine pollution. Final destination of residues, the ocean has become a dump yard where debris can concentrate around gyres and other areas. Even if macroplastics are still the major source of pollution, in the last few years the concern about the fate and impacts of smaller particles has increased. Microplastics can originate from the degradation of larger materials, but also can reach the environment as a fine powder. One of the origins of such pollution is the material present in some cosmetics such as facial and body cleansers and toothpastes. First recognized as a minor problem in the early 90's, the pollution potential of abrasive microplastics increased when it replaced natural exfoliating elements such as oatmeal or walnuts. Most of these products, in Brazil, contain microplastics in their composition. To this end the most common used is polyethylene. To date there is no knowledge of harmful effects to human health, however, once used, these components can travel through the wastewater systems and are not retained in the preliminary sewage treatments, eventually ending up in the oceans. Besides containing industrial additives, these microplastics can adsorb and act as a vector to other pollutants that would be later released in the environment or inside the digestive system of detritivores or filter feeding animals. The potential for such impact depends not only of the compounds carried, but also on the shape of the particles. In order to understand the morphological alterations that these components can undergo through wastewater systems up to the oceans, we disposed 2.5 grams of polyethylene powder (industrial grade) in beakers containing 1 liter of seawater. The system was maintained under constant agitation for 10, 20 and 30 days and after this period, the plastic was collected, dried and placed in glass slides. Using stereomicroscopes, 100 particles were measured and classified according to the length of strips they presented. We observed that the polyethylene undergo marked morphological changes in comparison with the original material, from round and compact particles to irregular with shred strips expansions and this process increased significantly over time. These observations should be taken into account when designing future experiments on microplastics exposure in aquatic organisms. Alterations in the shapes and surface area can alter not only the way the microplastics are retained and ingested but also the adsorption and release of chemicals compounds

Keywords: microplastic, polyethylene, cosmetics, morphology, marine pollution, impacts

*Speaker

Plastic ingestion by short-tailed shearwaters (Puffinus tenuirostris) in Northern Australia

Heidi Acampora * [1,2,3,4], Britta Hardesty [4], Kathy Townsend [5], Karim Erzini [6]

[1] Galway-Mayo Institute of Technology (GMIT) – Ireland
[2] University of Queensland (UQ) – Brisbane QLD 4072 Australia, Australia
[3] Ghent University (UGent) – Belgium
[4] CSIRO Marine and Atmospheric Research (CSIRO-MAR) – Private bag n5 Wembley WA 6913, Australia
[5] University of Queensland – Brisbane QLD 4072 Australia, Australia
[6] Faculdade de Ciências e Tecnologia (FCT) – Faculdade de Ciências e Tecnologia, Campus de Gambelas, 8005-139 Faro Portugal, Portugal

Marine debris is a present and growing threat to wildlife species around the globe. Debris can impact marine wildlife in two main ways: entanglement and ingestion. This study has investigated the ingestion of marine debris by Short-tailed shearwaters (Puffinus tenuirostris), popularly known as muttonbirds, a common and abundant species of seabird in Australia. We obtained our samples through two stranding events that took place on North Stradbroke Island, Queensland, Australia, in 2010 (n=102) and 2012 (n=27). In total, 129 birds were necropsied and all solid contents found in the guts were analyzed. At least 67% (n=87) birds had ingested debris and 399 pieces of debris were collected. Fragments consisted of plastic particles, strings, soft plastic and rubber fragments, including balloons. Among the non-anthropogenic debris, we noted squid beaks, small rocks and gastropods. We found no significant relationship between the body condition of the birds which had ingested debris versus the ones that had not ingested anthropogenic debris. No preference for debris color or size could be detected between sex or life stage. We compared what was found in the bird guts to what was found at sea to determine if muttonbirds are randomly ingesting marine debris or if they are actively selecting for certain types of debris. To do this we conducted boat based tows for marine debris in northern Queensland during the period from November 2011 to May 2012 to obtain an estimate of the types of debris the birds would be exposed in their foraging environment at sea. We found significant differences between debris which occurs in the marine environment to that which the birds had ingested, suggesting that the birds appear to have a preference for certain categories of debris such as hard plastic, rubber and balloons.

Keywords: Ingestion – Marine debris – Puffinus tenuirostris – North Stradbroke Island, Australia – Plastic – Trawls

*Speaker

Science under sail: On the hunt for < 333 μm microplastic debris in the Gulf of Maine

Matthew Cole * [1,2], Stephanie Wright [1], Andrew Watts [1], Ceri Lewis [1], Tamara Galloway [1]

[1] University of Exeter – College of Life and Environmental Sciences: Biosciences, Geoffrey Pope Building, University of Exeter, Stocker Road, Exeter EX4 4QD, United Kingdom
[2] Plymouth Marine Laboratory – Prospect Place, The Hoe, Plymouth, PL1 3DH, United Kingdom

Microplastics are considered a pervasive and widespread pollutant of marine ecosystems across the globe. Over recent years numerous studies have looked to enumerate microplastics within a range of marine habitats, however, the complexities of sampling very small microplastics at dilute concentrations has resulted in the majority of these studies only focussing on microplastics > 333 μm in diameter. As our lab-based research has identified that microplastics within the size range $2 - 230$ μm can be ingested by and cause harm to an array of marine life, including zooplankton, mussels, polychaetes and crabs, it becomes increasingly important to identify and quantify microplastics of this size range within the marine environment itself. In this study, we consider the use of novel and adapted methods specifically designed to sample microplastics both greater and smaller than 333 μm in size. Sampling techniques were trialled in conjunction with the Rozalia Project, a US-based NGO, during July 2013 in productive, coastal regions of the Gulf of Maine (US). Replicated pelagic and benthic samples were collected from targeted study sites (e.g. river outlets, sites of upwelling, convergence zones), from which we aim to extract, quantify and identify all microplastics present; further, we look to investigate biological uptake of microplastics in benthic specimens collected during sediment sampling. Our goal is to provide much needed comparative data between microplastics of different sizes and draw attention to smaller size fractions of microplastic debris present within coastal marine ecosystems.

Keywords: Microplastics, ingestion, occurence, sampling, neuston, water column, sediment

*Speaker

Season variation and types of plastic resin pellets at campeche beach, Santa Catarina Island- Brazil

Patrícia Louro *† , Walter Widmer [1]

[1] Instituto Federal de Educação, Ciência e Tecnologia de Santa Catarina (IFSC) – Brazil

In parallel with the growing pattern of plastic items consumption, we witness huge amounts of plastic continuously being discarded into the environment. Marine contamination by microplastics motivated this study, pioneer in Santa Catarina Island, South Brazil, where spatial and temporal distribution of plastic resin pellets, collected at Campeche beach, were analysed, and their polymer composition was identified, from July 2011 to August 2012. Plastic pellets were found in every sampling day, with a mean average of 1.16 pellets/ m2. Although an increase of pellets was registered in autumn, there was a variable abundance along the monitoring period. The quantities were affect by two factors: Place of sampling and Sampling day nested in each season. We found a significantly higher amount of pellets at Joaquina sampling place, compared to Novo Campeche, and a heterogeneous pellet composition, with a prevalence of low density polyethylene polymers (LDPE). This study points out the needs of improving regulamentation and procedures on stocking and transportation of plastic pellets and on plastic litter destination, as well as actions towards conscientious plastic consumption.

Keywords: Coastal management, Florianópolis, Marine Pollution, Microplastics, Monitoring, Pellets, Plastic litter, Seasonality.

*Speaker

†Corresponding author: patricia.louro@sapo.pt

Spectrocopic and thermal analysis of Ligurian Sea surface floating plastic fragments collected in the framework of participative science.

Bruno Dumontet * [1,2,3], Stéphane Bruzaud [1], Yves Grohens [1], Pierre Voisin [3], Amanda Elineau [2], Gaby Gorsky [2]

[1] Université de Bretagne-Sud, Laboratoire d'Ingénierie des Matériaux de Bretagne – Aucune – 56321 Lorient, France

[2] Observatoire océanologique de Villefranche-sur-mer (OOVM) – CNRS : UMS829, INSU, Université Pierre et Marie Curie (UPMC) - Paris VI – Observatoire Océanologique BP 28 06234 VILLEFRANCHE SUR MER CEDEX, France

[3] Expédition MED – Aucune – 29, rue de Lattre de Tassigny, 56230 Molac, France

Surface floating microplastic was collected during the Expédition MED citizen science association exploration of the Ligurian Sea using a Manta trawl. 52 samples were collected between Toulon and Genova and transferred to the collaborating scientific institutes. Microplastic was enumerated and measured by imaging techniques and sorted out. It was further characterized using spectroscopic techniques and thermal analysis in order to classify it into different families of plastics such as polyolefins, polystyrenics, polyesters, polyamides and others.

Non-destructive Fourier transform infrared spectroscopy (FTIR) was used to specify absorption bands for each microplastic and to compare them with spectra found in literature. On the base of these results, a data bank containing the spectra of main marine microplastic could be established.

Thermogravimetric analysis (TGA) was carried out on each microplastic sample. The results were compared to the values of commercial polymers.

The thermal characteristics of microplastics, i.e. glass transition temperatures (Tg) and melting temperatures (Tm), were collected using differential scanning calorimetry (DSC). The Tg and Tm values measured for each sample allowed us to clarify the morphological behavior of microplastic samples.

The results obtained using the combination of the different characterization techniques permitted us to initiate and to develop a methodology for classifying microplastic samples into the main families of plastics previously cited.

Keywords: Microplastics, infrared spectroscopy, thermogravimetric analysis, differential scanning calorimetry, imaging

*Speaker

Posters - Microplastics, as vectors of biological and chemical contaminants

Ecological and ecotoxicological effects of microplastics and associated contaminants on aquatic biota

Martin Ogonowski * [1], Annika Jahnke [2], Elena Gorokhova [2], Matthew Macleod [2], Marghareta Adolfson-Erici [2]

[1] AquaBiota Water Research/Department of Applied Environmental Science, Stockholm University – Sweden

[2] Department of Applied Environmental Science, Stockholm University (ITM) – Sweden

Plastics are a large and increasing component of marine litter, harming marine life. The degradation of plastics leads to minute plastic particles (microplastics - MPs) being accumulated in the sea, which can be ingested or passively adsorbed by heterotrophs leading to blockage of the gastrointestinal tract and inflammatory responses. In autotrophs, exposure to MPs may hamper photosynthesis and change nutritional quality for grazers. Moreover, the chemical composition and small size make MPs effective sorbents of persistent organic pollutants (POPs) which may be transferred to biota and alter bioaccumulation. Despite these concerns, the impact of MPs and their role in mediating POP transport and bioaccumulation in aquatic food webs is largely unknown. In particular, the net effects of MPs in food webs have not been addressed in a coherent manner to examine relative contributions of ecological (i.e. particles exerting mostly mechanical disturbance for photosynthesis, food uptake and trophic interactions) vs. ecotoxicological (i.e. particles acting as vectors of POPs, increasing exposure) factors. Our aim is to develop and apply an integrated approach for delineating direct effects of MPs on basic physiological functions in model aquatic organisms, and the effects of MP-associated transfer of POPs. These effects will be examined across trophic levels spanning from primary producers to top consumers and integrated in a modeling framework; which can be applied in risk assessment.

Keywords: microplastics, trophic transfer, persistent organic pollutants, behavior, fish, pelagic:food, web, zooplankton, phytoplankton, ecosystem approach

*Speaker

Microscopic PVC as a vector for PAHs: bioaccumulation and toxicity in a sediment-dwelling marine polychaete

Stephanie Wright *† [1], Adil Bakir [2], Steve Rowland [2], Richard Thompson [2], Tamara Galloway [1]

[1] University of Exeter – School of Biosciences, University of Exeter, Streatham Campus, Northcote House, Exeter EX4 4QJ, United Kingdom
[2] Plymouth University – University of Plymouth, Drake Circus, Plymouth, Devon PL4 8AA, United Kingdom

Microscopic plastic debris (microplastics, < 5mm) litters the marine environment worldwide. Microplastics attract and concentrate a range of hydrophobic organic contaminants (HOCs). Since many marine organisms are capable of ingesting microplastics, they present a potential route for the introduction and bioaccumulation of HOCs in marine food webs. Here we determine whether microplastics facilitate the transfer of the polycyclic aromatic hydrocarbon phenanthrene to the sediment-dwelling polychaete Hediste diversicolor (ragworm).

Using sedimentary mesocosms, we are exposing ragworms to both microscopic polyvinylchloride (unplasticised, mean size 130μm) and phenanthrene, at concentrations ranging from 0-10 ug g-1. We will present our latest results including phenotypic endpoints such as antioxidant activity and oxidative damage to macromolecules. Additionally, we are quantifying the expression of antioxidant and detoxifying genes. We shall link these endpoints to levels of bioaccumulation across treatments. This study will offer insight into the potential role microplastic debris plays in transferring contaminants to marine food webs. We aim to further our understanding of how marine litter can impact fundamental biochemical and molecular processes in these important components of the benthos, indicating the level of risk microplastic debris poses to the environment.

Keywords: Microplastics, hydrophobic organic contaminants, polyvinylchloride, phenanthrene, polychaete, sediment

*Speaker
†Corresponding author: sw393@exeter.ac.uk

Posters - Impacts of microplastics on the marine life

Effects of microplastics on the tropical mangrove crab Uca rapax

Dennis Brennecke * [1], Erica C. Ferreira [2], Bernardo A.p. Da Gama [2], Mark Lenz [1], Martin Wahl [1]

[1] Helmholtz Centre for Ocean Research Kiel, Marine Ecology (GEOMAR) – Düsternbrooker Weg 20, Kiel 24105, Germany, Germany
[2] Department of Marine Biology, Institute of Biology, Universidade Federal Fluminense – C.P. 100.644, CEP 24001-970, Niterói, Rio de Janeiro, Brazil, Brazil

Microplastics, which are accumulating in marine sediments, pose an increasing challenge to deposit feeding invertebrates. We investigated whether the fiddler crab, Uca rapax, ingests microplastics (polystyrene) in the size range of 180 – 250 μm and whether the ingestion of these particles with and without absorbed pollutants alters their tolerance to hypoxia. In a 2 months laboratory experiment, individuals of U. rapax from Itaipu Lagoon (Niterói, Rio de Janeiro, 22 55' S, 43 03' W) were exposed to an environmentally realistic concentration of microplastic particles (100 mg microplastic / kg dry weight sediment) in the surrounding sediment. Prior to this, the virgin microplastic particles were submerged at two sites differering in seawater pollution ('low' and 'high') for two weeks in order to load them with contaminants. After two months, microplastics were found in stomach, gills and hepatopancreas of the crabs. However, neither the mere presence of microplastics nor the possible carry-over of pollutants affected the crabs' tolerance to hypoxia. Although we could not find any influence of the microplastics on the tolerance of the crabs, perhaps due to the short length of the experiments, detrimental long-term effects of microplastics on U. rapax can not be excluded. In particular, the presence of these particles in different body parts highlights the need for follow-up investigations, since U. rapax is considered a keystone species in Brazilian mangrove habitats.

*Speaker

Impact of polyethylene microbeads ingestion on seabass larvae development

David Mazurais * [1], Arnaud Huvet [2], Lauriane Madec [1], Patrick Quazuguel [1], Armelle Severe [1], Elisabeth Desbruyeres [1], Christine Huelvan [1], Thomas Maes [3], Myra Van Der Meulen [4], Dick Vethaak [4], Philippe Soudant [2], Lisa Devriese [5], Johan Robbens [5], Rossana Sussarellu [2], Jose Zambonino-Infante [1]

[1] Ifremer, PFOM/ARN, Laboratoire des Sciences de l'Environnement Marin (LEMAR) – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – Technopôle Brest-Iroise, Place Nicolas Copernic, 29280 Plouzané, France

[2] Laboratoire des Sciences de l'Environnement Marin (LEMAR) – CNRS : UMR6539, Université de Bretagne Occidentale (UBO), Institut Universitaire Européen de la Mer (IUEM), Institut de Recherche pour le Développement, Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – Technopôle Brest-Iroise, Place Nicolas Copernic, 29280 Plouzané, France

[3] Center for Environment, Fisheries Aquaculture Science (CEFAS) – CEFAS, Lowestoft Laboratory, Lowestoft, Suffolk, UK, United Kingdom

[4] Deltares (Deltares) – Rotterdamseweg 185, 2629 HD Delft, Pays-Bas, Netherlands

[5] Institute for Agricultural and Fisheries Research (ILVO) – Burgemeester Van Gansberghelaan 96, box 1, 9820 Merelbeke, Belgium, Belgium

Microplastics including polyethylene (PE) microbeads are present in marine habitats worldwide and may be ingested by fish larvae, with unknown consequences for their health and future life. Within the framework of the MICRO project (INTERREG IVA 2 Seas Programme), the purpose of the present work was to evaluate the effect of per os administration of PE microbeads on European seabass () larvae development.

Larvae were fed from day 8 post-hatching (dph) until 26 dph with an inert diet including 0, 103, 104 and 105 fluorescent microbeads (mix of 10-45 μm) per gram. From 27 to 35 dph, larvae were fed a diet devoid of microplastics. PE beads ingestion was followed in the larvae using fluorescent microscopic analysis and samplings were performed to investigate their impact on different ontogenetic processes by gene expression analysis.

Ingestion of PE had no effect on mortality but induced a significant decrease (25%) in growth rate. PE microbeads were detected using histological techniques in the gastrointestinal tracts of larvae as long as fish were fed on a diet incorporating microplastic (i.e 26 dph). Any fluorescent beads were found in the larvae 4 days after the end of exposure suggesting that PE microbeads were totally flushed through faeces. Molecular analyses reveal that expression of IGF1 and osteocalcin genes tended to be reduced in fish exposed to PE. This down-regulation of genes involved in fish growth and ossification can be related to the decrease of growth rate observed in these groups.

*Speaker

Altogether, these findings are important in understanding the environmental impact of microplastics present in marine environment on the development of marine fish larvae and, more generally, the possible consequences on the population biology of marine fish species.

Keywords: microplastic, fish, larvae, development, growth, gene expression

Ingestion of microplastics by mesopelagic fish from the North Atlantic

Amy Lusher * [1], Ian O'connor [1], Rick Officer [1]

[1] Galway-Mayo Institute of Technology (GMIT) – Ireland

A large amount of the world's ocean biomass comprises of mesopelagic fish, the majority are small filter feeders, including the family Myctophidae. Mesopelagic fish display a diurnal feeding behaviour, ascending to surface waters to feed on planktonic aggregations during night-fall. With the increasing awareness of microplastic distribution in pelagic waters, it is important to understand microplastic interactions with marine biota. Microplastics mix with the food sources of these planktivorous organisms and there is a potential for individual fish to ingest plastic particles. Once ingested, microplastics may have biological and chemical effects on the organisms, resulting in threats to food safety and security. As mesopelagic fish have recently been highlighted for their potential commercial value, it is important to understand if these fish are actively ingesting plastic. If ingestion is found to occur, this study will make a significant contribution to the growing knowledge of microplastic ingestion by marine biota. The objective of the present study was to determine whether mesopelagic fish are ingesting microplastics, and if so whether fish caught during daylight hours have more or less than those caught at night. This baseline study documents the incidence of microplastics found in the digestive tracks of mesopelagic fish from the North Atlantic. The quantity of microplastics identified is compared to studies in other regions providing the first comparative report on plastic ingestion by mesopelagic fish in the North Atlantic.

Keywords: microplastics, planktivors, fish, marine debris, neuston

*Speaker

Intake and size selection of microplastic particles (PVC) by marine invertebrates: a preliminar assessment of biological risks

Marina Santana * [1], Leonardo Yokoyama , Márcio Custódio , Alexander Turra

[1] Oceanography Institute of University of São Paulo (IOUSP) – Praça do Oceanográfico, 191 Cidade Universitária, São Paulo, SP, Brazil

The plastic have many qualities that make it widely distributed throughout current society. This abundance, however, has been generating environmental issues. Since the its size is directly linked to the risks that it might offer, microparticles may become available for a wide variety of marine animals depending on their feeding habits. The polyvinyl chloride (PVC) is an example placed in that context. In order to get basic information about the potential impacts of microplastics in the marine biota and to assist on future studies, this work aimed to study the ingestion and size selection of microplastics particles (raw PVC) by marine invertebrates, using as biological models: the mussel Perna perna (Mollusca), the sea-cucumber Holothuria grisea (Echinodermata), the ascidia Phallusia nigra (Chordata) and the sponge Hymeniacidon heliophila (Porifera). The animals were individually exposed to 0,5g/L of PVC (with a diameter varing between 50 and 250μm) for 3h and then transfered to clean sea water conditions, where they remain for 12h prior to registering the occurence and size of the ingested particles found in their feaces and gut content (choanocyte chambers and atrium, in case of sponges). All the four models ingested the PVC microplastics. For P. nigra it was also remarkable that the plastic intake happened together with a possible defense mechanism since some exemplars released a mucus by their oral siphon whose content had only PVC particles. The microplastic selection was tested by the comparison between the size of the PVC offered and ingested and showed that all biological models selected smaller grains among the available in the aquaria. That selection behavior continued (selection post-ingestion) during the digestive process of P. perna but not with a pattern. Although the measurements indicated that these mussels eliminated the largest grains eaten through their feaces and retained the smallest in their tract, the size of the microplastics defecated varied from individual to individual. Anyhow, this may indicate that as smallest the microplastics, greater are their risks of being confused with nutritive materiald during digestive process and, thus, higher are the chances of its retention in the digestive tract, which may result in its assimilation and, perhaps, bioaccumulation. The results help in the understanding of the influence of particle size on the risks of bioavailability of plastic fragments for marine organisms with suspension and deposit feeding habits. Its effects, however, remains poorly unknown and should be more investigate.

Keywords: marine debris, microplastics, marine invertebrates, selection, ingestion, assimilation, retention, impacts

*Speaker

Occurrence of synthetic fibres in brown shrimp on the Belgian part of the North Sea

Lisa Devriese * [1], Sofie Vandendriessche [2], Hannelore Theetaert [1], Griet Vandermeersch [1], Kristian Hostens [2], Johan Robbens [1]

[1] Chemical Monitoring and Product Technology; Institute for Agricultural and Fisheries Research, Ostend, Belgium (ILVO) – Belgium
[2] Biological Environmental Monitoring; Institute for Agricultural and Fisheries Research, Ostend, Belgium (ILVO) – Belgium

Marine microplastics can be described based on categories such as colour, stage of erosion, shape (fibre – film – spherule – fragment) or polymer type (polyethylene, polystyrene, nylon...). Synthetic fibres, originated by the degradation of plastic rope or packaging materials and the washing of synthetic clothing, are the most common type of microplastics in the marine environment. Depending on the occurrence, biofouling and characteristics, micro-debris could be ingested by marine benthic species when mistaken as food. Several scientific papers on laboratory trials describe the ingestion, accumulation or translocation of microscopic plastic fragments for numerous species such as plankton (zooplankton and phytoplankton), nematodes (C. elegans), deposit feeders (blue mussel, lugworm, and sea cucumbers) and crustacean (Norway lobster, amphipods, littoral crab and barnacles). Higher trophical species such as fish, sea birds and whales could also ingest microplastics indirectly by feeding on plastic-contaminated seafood or plankton.

This research presents the occurrence of synthetic fibres in brown shrimp (Crangon crangon) and plastic benthic litter (beam trawl), caught on the Belgian part of the North Sea during spring 2013. The extraction of microplastics from the shrimp tissues was performed using an acid destruction with a mixture of nitric acid and perchloric acid HNO3:HClO4 (4:1 v:v). For an optimal digestion of the tissues 500 ml acid mixture was used to digest 100 g tissue. The acid digest was filtered over a 15 μm Whatman filter and the fibres were visualized under a stereo microscope. Each plastic fragment was verified as plastic with a hot needle. Synthetic polymer types were not identified. The results will be presented and discussed during the conference.

Keywords: ingestion, synthetic fibres, microplastics, Crangon crangon

*Speaker

Trophic level transfer of microplastic: Mytilus edulis (L.) To Carcinus maenas (L.).

Paul Farrell * [1]

[1] kathryn Nelson – Institute of Marine Sciences, Ferry road, Portsmouth, United Kingdom

This study investigated the trophic transfer of microplastic from mussels to crabs. Mussels (Mytilus edulis) were exposed to 0.5 μm fluorescent polystyrene microspheres, and then fed to crabs (Carcinus maenas).Tissue samples were then taken at intervals up to 21 days. The number of microspheres in the haemolymph of the crabs was highest at 24 hours (15 033 ml-1 ± SE 3146), and were almost gone after 21 days (267 ml-1 ± SE 120). The maximum amount of microspheres in the haemolymph was 0.04% of the amount to which the mussels were exposed. Microspheres were also found in the stomach, hepatopancreas, ovary and gills of the crabs, in decreasing numbers over the trial period. This study is the first to show 'natural' trophic transfer of microplastic, and its translocation to haemolymph and tissues of a crab. This has implications for the health of marine organisms, the wider food web and humans.

Keywords: microplastic, trophic, transfer, Carcinus

*Speaker

SPONSORS & PARTNERS

cnrs

Ifremer

Deltares
Enabling Delta Life

ILVO

Cefas

labex MER
frontiers in marine research

iuem
UBO CNRS IRD
INSTITUT UNIVERSITAIRE EUROPÉEN DE LA MER

UBO
université de bretagne occidentale

Zone Atelier
LTER FRANCE BREST IROISE

CONSEIL GÉNÉRAL Finistère
Penn-ar-Bed

Brest
métropole océane
COMMUNAUTÉ URBAINE

Région BRETAGNE