**ICES CM 2013/A:04**

# Continuous monitoring of microplastic abundance in the North Atlantic

*Amy Lusher (1), Ian O'Connor (1) and Rick Officer (1)*
*(1) Marine and Freshwater Research Centre, Galway-Mayo Institute of Technology, Ireland*. Presenter contact details: amy_lusher@yahoo.co.uk, Phone + 353 (0) 91 74 2501

**Summary**
Pollution levels of marine debris, including microplastics, are largely undocumented in the Atlantic Ocean. A standardised monitoring method is required to understand the distribution and abundance of microplastic pollution. Sampling of the Northeast Atlantic was conducted during research cruises aboard Ireland's research vessel, the *R.V. Celtic Explorer*. Transects covering a total of 14,200 km were sampled through continuous monitoring of open ocean surface water resulting in 482 samples. Items classified as potential plastic were identified in 99% of samples. A total of 6,608 particles were identified, 92.5% were less than 5 mm in length therefore classifying them as microplastic. This is the first report of ubiquitous nature of microplastic pollution in the Northeast Atlantic Ocean and highlights the potential for the method to be used as a standardised monitoring protocol.

**Introduction**
Pollution of the marine environment is a global phenomenon, and plastic debris presents a threat to ecosystems and marine organisms because of its durability and persistence. Studies from the past four decades have identified microplastics in almost every habitat around the globe and there have been some attempts at monitoring the spatial and temporal trends of microplastics (Shaw & Day 1994). With the exception of Continuous Plankton Recorder data from the Northeast Atlantic (Edwards et al. 2011), there are no reported cases of microplastics in the Irish marine environment. A standardised method has yet to be established for monitoring the distribution and abundance of microplastics over large spatial scales. A study of microplastics on this scale will provide data to policy makers and government organisations on the fate of microplastics in the marine environment, including the Marine Strategy Framework Directive. As plastic pollution is increasing it is important to establish its origins, trajectory, and its fate in the environment if we hope to mitigate future effects. A new sampling method was trialled with the aim of developing a sampling protocol suitable for use at sea for continuous underway sampling of the marine environment. Once microplastics have been identified in the Irish marine and coastal environment and standardised field methods developed the results can be fed into international monitoring strategies to map the distribution of microplastics worldwide.

**Material and Methods**
A method of continuous sampling was developed to be conducted alongside the R.V. *Celtic Explorer* vessel operations without impinging on the survey's primary research aims. The vessel has a continuous intake of seawater and samples were collected using a hose connected directly to the nontoxic system. A stainless steel 250µm sieve in simple frame was used to collect suspended particulate matter from a known volume of water. After a given time the material in the sieve was suspended and subsequently filtered under vacuum onto glass filter paper. The papers were visually examined under a dissecting microscope and potential microplastics were accepted using previously described criteria (Norén 2007). Particles were assigned to five product type categories: fibres, fragments, industrial pellets, beads and foam, and five length categories: < 1mm, 1 – 2.5mm, 2.5 – 5mm, 5 – 10mm and > 10mm. Cotton clothing and gloves were worn when working on the boat to reduce contamination. The sieve was covered to prevent airborne fibres affecting the sample. After filtration, the collected sample was immediately folded and wrapped in tinfoil. Prior to analysis at the

laboratory work surfaces were cleaned with alcohol, and hands and forearms were scrubbed to prevent contamination. All manipulation instruments and equipment were checked under a microscope before use and airflow kept to a minimum

**Results and Discussion**

Samples were collected over a transect length which covered 14,200 km of the Northeast Atlantic Ocean including the shelf margins of the Atlantic continental shelf, Rockall Trough, Porcupine Bank, Celtic shelf, Celtic Sea and the Hebridean shelf and Slope. A total number of 482 samples were collected during preliminary sample collection on six different research cruises. Due to varying weather conditions and boat speeds, the average transect length was 29.45 ± 0.9km. Analysis of the samples found 99% to contain potential plastics, ranging between zero and 121 particles. A total of 6,608 potential plastic particles were identified, and when standardised for volume, there was an average of 13.72 ± 0.51 particles per $m^3$. The five different types of particles were encountered with the majority (count) being fibres (98%). The most common size class was 1 – 2.5mm ranging from 0.15mm to 46.54 mm. There were 92.5% of the particles are less than 5mm in length and therefore identified as microplastics. The average size was 2.55 ± 0.03mm. A range of colours were identified in this study, with black the most prominent colour identified (47%). The values of plastic particle abundance varied across all sampling stations, between 0 and 60.5 per $m^3$.

The results from this study indicate that plastic particles are widespread in the surface layer of the Northeast Atlantic Ocean. The predominance of fibres is in accordance with previous studies (Browne et al. 2011; Claessens et al. 2011; Thompson et al. 2004). The difference in number of particles could be a result of polymers being less dense than seawater floating on ocean currents. Plastics in the surface waters could have impacts on filter feeding organisms or other planktivorous animals feeding in the photic zone, the presence of microplastics in the surface waters could compete and threaten the plankton (Collignon et al. 2012). This study is the first to document the ubiquitous nature of microplastics in the Northeast Atlantic and further work is required to understand the trends in abundance. Modelling to standardise the method will take place to allow for further investigation on the occurrence, distribution, and the fate of microplastics in relation to oceanographic features in the Northeast Atlantic.

**References**


Browne, M.A. et al., 2011. Accumulation of microplastic on shorelines woldwide: sources and sinks. *Environmental Science & Technology*, 45(21): 9175–9.

Claessens, M. et al., 2011. Occurrence and distribution of microplastics in marine sediments along the Belgian coast. *Marine Pollution Bulletin*, 62(10): 2199–204.

Collignon, A. et al., 2012. Neustonic microplastic and zooplankton in the North Western Mediterranean Sea. *Marine Pollution Bulletin*, 64(4): 861–4.

Edwards, M. et al., 2011. *Ecological Status Report: results from the CPR survey 2009/2010. SAHFOS Technical Report, 8*, Plymouth, UK.

Norén, F., 2007. Small plastic particles in coastal Swedish waters. *KIMO Sweden*: 11 pp.

Shaw, D.G. & Day, R.H., 1994. Colour- and form-dependent loss of plastic micro-debris from the North Pacific Ocean. *Marine Pollution Bulletin*, 28(1): 39–43.

Thompson, R.C. et al., 2004. Lost at sea: where is all the plastic? *Science*, 304(5672): 838.