International Symposium

May 27, 2012

TUAT, Tokyo, Japan

Marine Plastic Pollution : Toxic Chemicals and Biological Effects.

Background of the symposium

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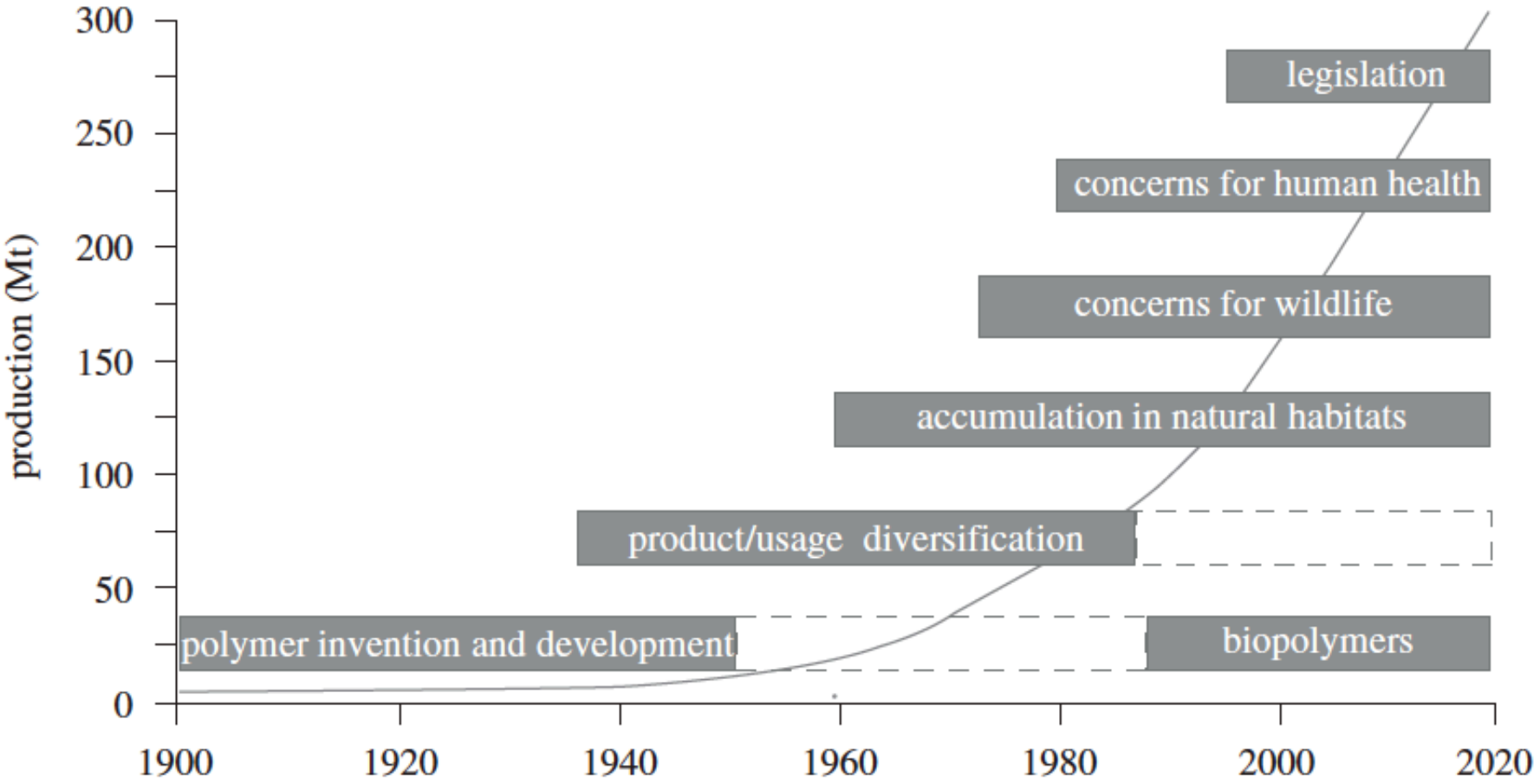
Continuous increase in plastic production



1933:Polyethylene discovered.

After Thompson et al., 2009

First Alert of marine plastic pollution in 1972

Plastics on the Sargasso Sea Surface

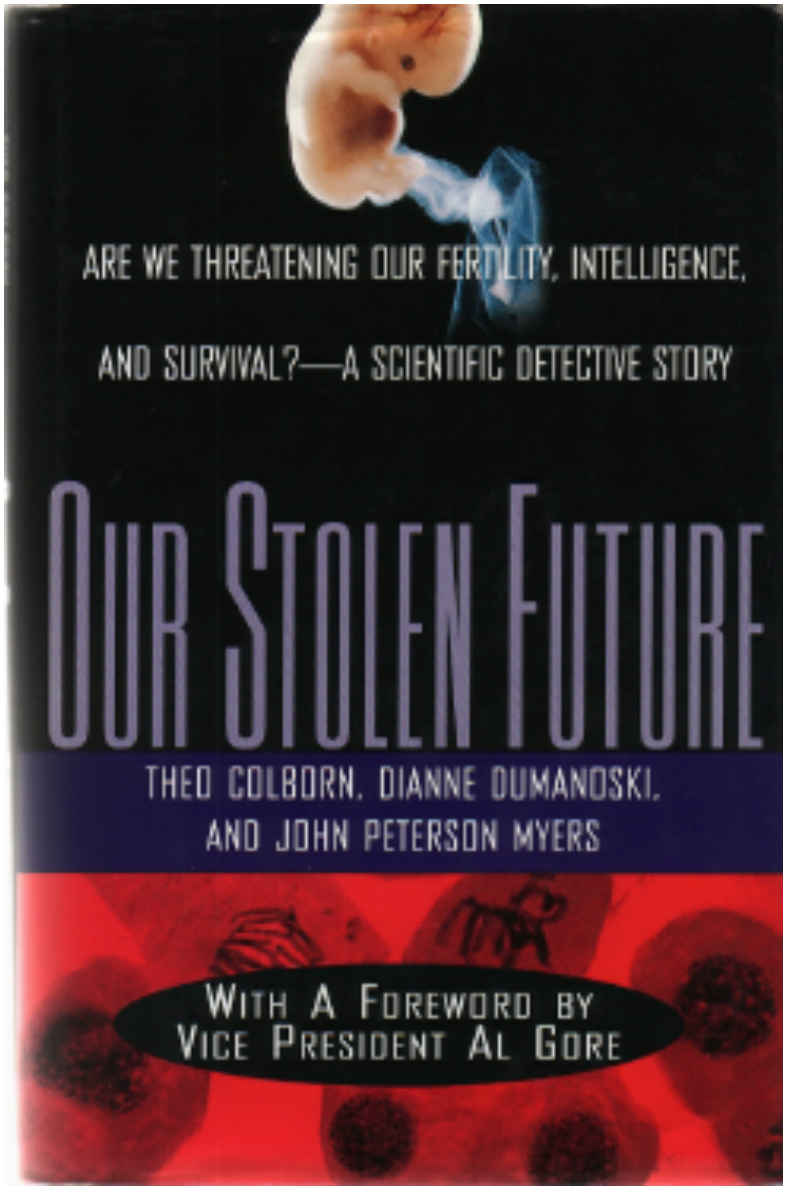
Carpenter and Smith (1972) ***Science***, March 17 p.1240-1241.

Plastic particle pollution of the surface of the Atlantic Ocean :
Evidence from a seabird

Rothstein (1973), ***The Condor***, vol.75, p.344-345

Captain Charles Moore discovered garbage patch in central pacific gyre in 1997

Increase in public concern on Endocrine disrupting chemicals in late 1990s



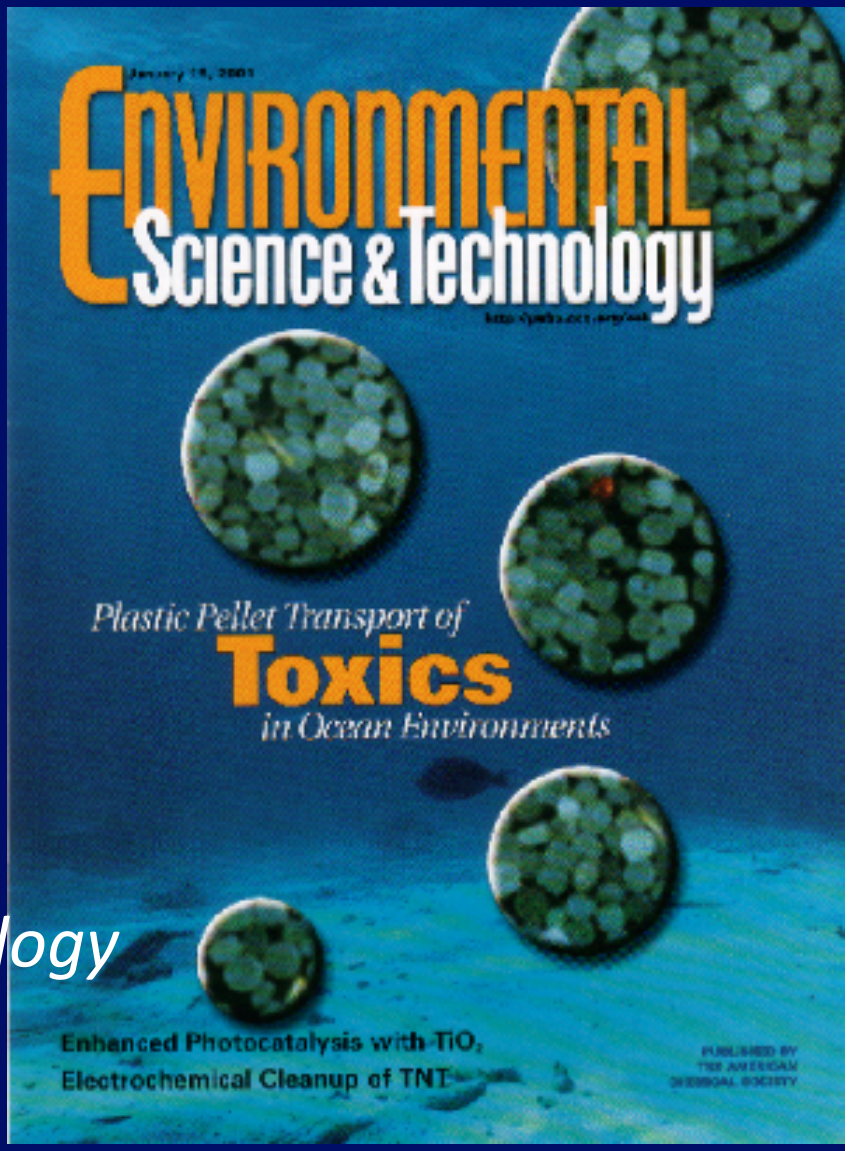
1996

Here, there, and everywhere

Soto et al., 1991

Dr. Ana Soto demonstrated that plastic additive nonylphenols rampant proliferation in breast cancer cells.

Plastic Resin Pellets as a Transport Medium for Toxic Chemicals in the Marine Environment



Environmental Science & Technology
2001, vol.35, 318-324

Discovery of microscopic plastic in 2000s

7 MAY 2004 VOL 304 SCIENCE www.sciencemag.org

Lost at Sea: Where Is All the Plastic?

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Anthony Davis,[1] Steven J. Rowland,[1] Anthony W. G. John,[2]
Daniel McGonigle,[3] Andrea E. Russell[3]

International symposium on Marine plastic debris in 2005 at Long beach

International Pellet Watch

Global Monitoring of Persistent Organic Pollutants (POPs) Using Beached Plastic Resin Pellets

ELSEVIER

Available online at www.sciencedirect.com
ScienceDirect

Marine Pollution Bulletin 52 (2006) 1547–1548

MARINE POLLUTION BULLETIN

www.elsevier.com/locate/marpolbul

Since 2005

Editorial

Call for pellets! International Pellet Watch Global Monitoring of POPs using beached plastic resin pellets

On our beaches, we see various quantities of many materials (e.g., seaweed, driftwood, trash, plastic fragments, cigarette ends) along the high-tide line. Among them, we can commonly find plastic resin pellets. Recently we have started a global monitoring programme of persistent organic pollutants (POPs) using these stranded plastic resin pellets (International Pellet Watch: http://www.tuat.ac.jp/~gaia/ipw/index.html).

Plastic resin pellets are small granules, generally with shape of a cylinder or a disk with a diameter of a few mm (Fig. 1). These plastic particles are the industrial raw material of plastics which are transported to manufacturing sites where "user plastics" are made by re-melting the pellets and molding them into the final products. Resin pellets can be unintentionally released to the environment, both during manufacturing and transport. The released resin pellets are carried by surface run-off, streams and river waters, eventually leading to the ocean. Because of their environmental persistence, they are distributed widely in the ocean and are now found on beaches all over the world. In 2001, we revealed the existence of various organic micro-pollutants (i.e., polychlorinated biphenyls: PCBs, DDE, and nonylphenol) in these stranded plastic resin pellets collected on beaches (Mato et al., 2001).

Fig. 1. Plastic resin pellets.

Because of the hydrophobic nature of the plastic surfaces, hydrophobic pollutants such as PCBs and DDTs are adsorbed to the pellets from the surrounding seawater with concentration factors of up to 10^6. We observed a weak correlation between PCBs concentrations in plastic resin pellets collected on beaches with levels in traditional monitoring media (i.e., mussels), although large piece-to-piece variability of PCB concentrations was also observed (Endo et al., 2005). Because the resin pellets are distributed on beaches the world over, and because collection and shipping of the pellets are easy, we propose global monitoring of persistent organic pollutants (POPs) using these beached plastic resin pellets.

In the International Pellet Watch project, we ask people from all countries to collect plastic resin pellets on their nearby beaches and send them to our laboratory via airmail. No cooling nor freezing is necessary during shipment. People just need to put the pellets into a paper envelope and post it to us. To get representative data, we need 100–200 pieces of pellets (preferably yellowed pellets) from each location. Organic micro-pollutants in the pellets will be analyzed in our laboratory. Based on the analytical results, global distributions of these organic micro-pollutants will be mapped. Results will be sent to the participants through e-mail and will be released on the web as well.

The purpose of International Pellet Watch is to understand the current status of global POPs pollution, and the advantage of Pellet Watch is its extremely low cost of sampling and shipping as compared with conventional monitoring using water, sediment and biological samples. Further, we can draw global POPs pollution maps for a very low cost. Already several NGOs who conduct beach clean-up projects are helping with sample collection.

So far, our spatial coverage is very limited and of course the strength of the programme will be related to the coverage

0025-326X/$ - see front matter
doi:10.1016/j.marpolbul.2006.10.010

New Directions in Plastic Debris in 2005, ***Science***

New Directions in Plastic Debris

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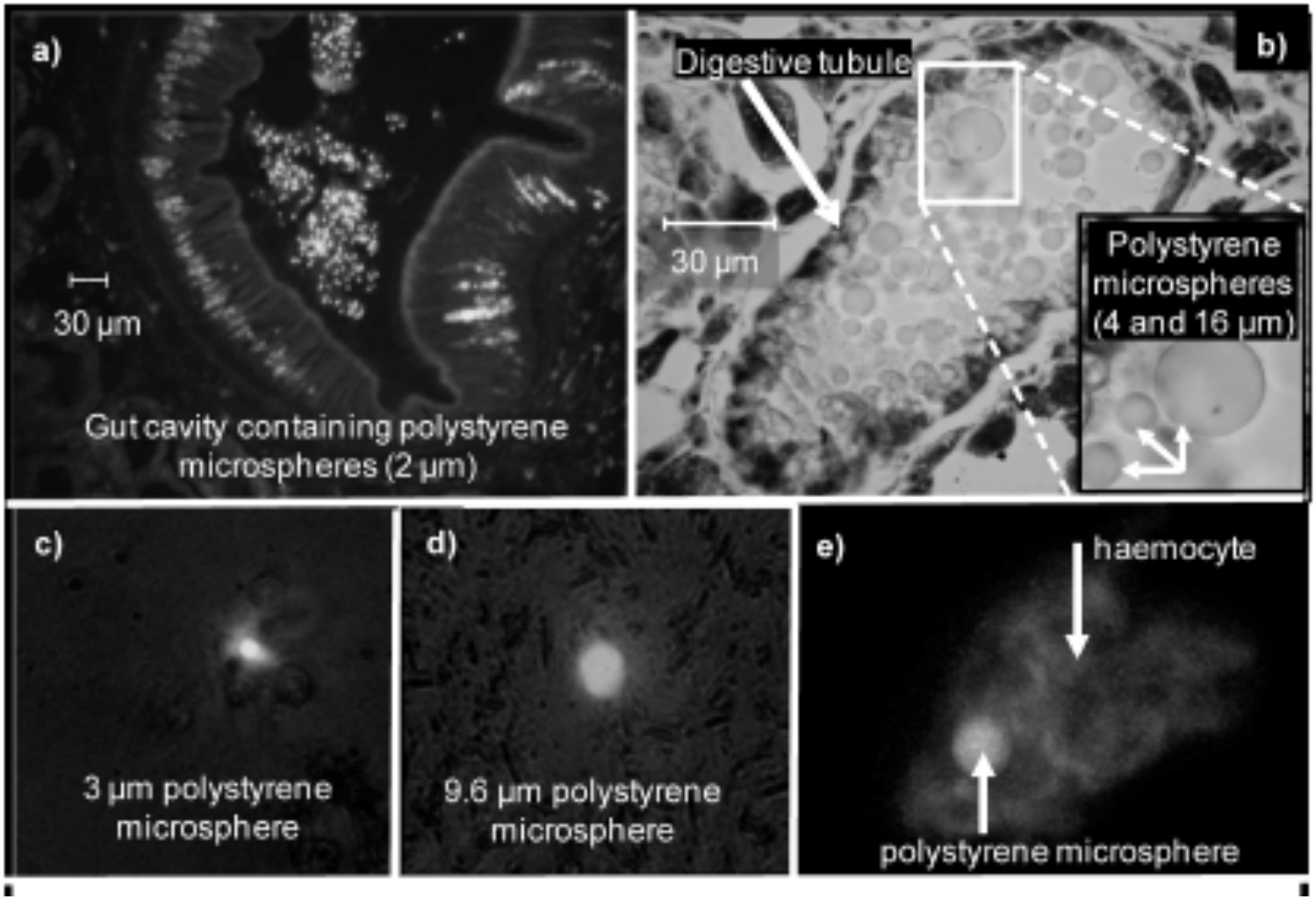
ANTHONY ANDRADY,[3] MURRAY GREGORY,[4]
HIDESHIGE TAKADA,[5] STEPHEN WEISBERG[6]

Science, 2005

NOAA Tacoma workshop on microplastics in 2007

2007, Tacoma, WA

Dr. Mark Browne demonstrated translocation of microscopic plastics to circulatory system of bivalves in 2008



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.). Environ. Sci. Technol. 42, 5026–5031.

Garbage patch in central gyres

Frequent observation of injections of plastics by marine organisms

Plastic acts as transport medium of toxic chemicals in the marine environments

Endocrine disrupting chemicals

Microscopic plastic

Increase in Academic and public attention on marine plastics in USA and Europe

2010 Feb. American Geological Union (AGU) meeting

2010 May Society of Ecotoxicology and Chemistry (SETAC) Europe

2010 June GESAMP Workshop, Paris

2010 Sep. International Symposium in Matsuyama

2010 Nov. SETAC North America

2010 Nov. NOAA Tacoma workshop

2011 Mar. International Marine Debris Conference, Hawaii

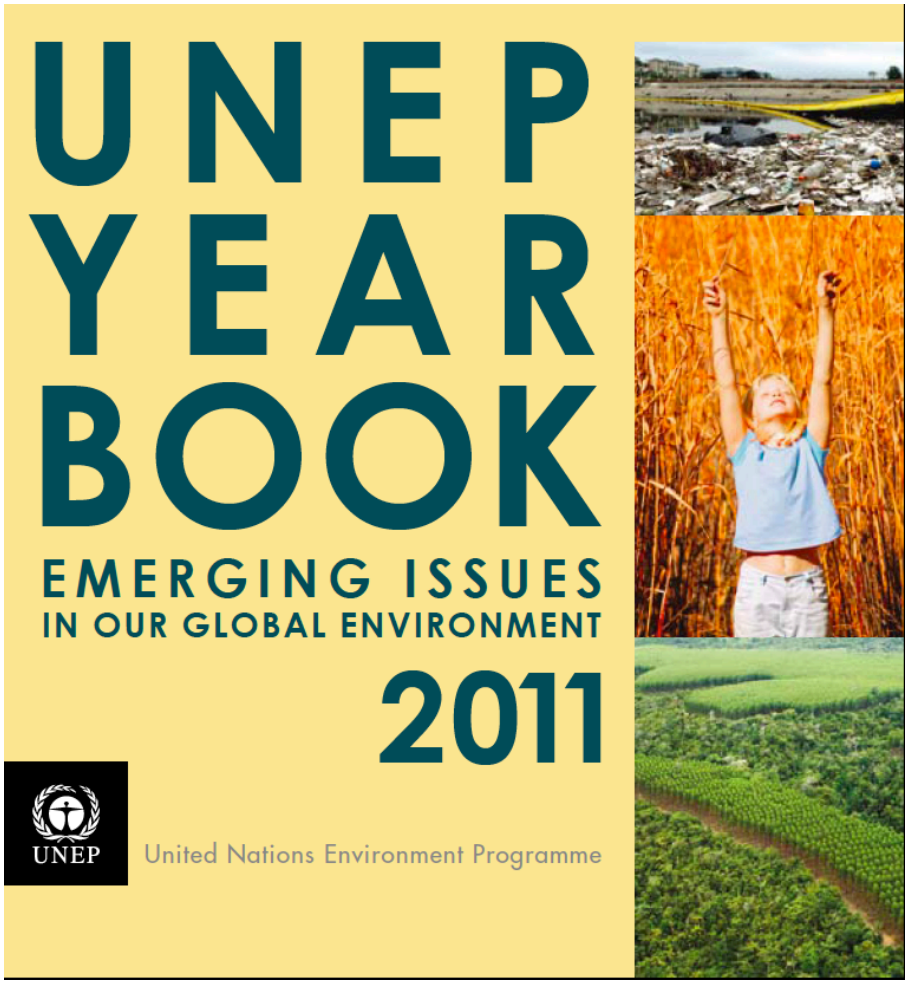
2011 May SETAC Europe

2012 May SETAC Europe

GESAMP

Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection

Proceedings of the GESAMP International Workshop on Microplastic particles as a vector in transporting persistent, bio-accumulating and toxic sub-stances in the ocean



Plastic Debris in the Ocean

Every year large amounts of plastic debris enter the ocean, where it slowly fragments and accumulates in convergence zones. Scientists are concerned about the possible impacts of small plastic fragments—microplastics—in the environment. The role of plastics as a vector for transporting chemicals and species in the ocean is as yet poorly understood, but it is a potential threat to ecosystems and human health. Improved waste management is the key to preventing plastic and other types of litter from entering the ocean.

The ocean has become a global repository for much of the waste we generate. Marine debris includes timber, glass, metal and plastic from many different sources. Recently, the accumulation and possible impacts of microplastic particles in the ocean have been recognized as an emerging environmental issue. Some scientists are increasingly concerned about the potential impact of releases of persistent bio-accumulating and toxic compounds (PBTs) from plastic debris. At the same time, the fishing and tourism industries in many parts of the world are affected economically by plastic entering nets, fouling propellers and other equipment, and washing up on beaches. Despite international efforts to stem the flow of plastic debris, it continues to accumulate and impact the marine environment. To reduce the quantity of plastic entering the ocean, existing management instruments need to be made more effective and all aspects of waste treatment and disposal need to be improved.

Several common types of plastic are buoyant and have been transported by ocean currents to the remotest regions of the planet, including the Arctic and Antarctic (Barnes et al. 2010). Media attention has focused on reports of the relatively high incidence of plastic debris in areas of the ocean referred to as 'convergence zones' or 'ocean gyres'. This has given rise to the widespread use of terms like 'plastic soup', 'garbage patch' and 'ocean landfill'. Such terms are rather misleading in that much of the plastic debris in the ocean consists of fragments that are very small in size while the areas where they are floating are not, for example, distinguishable on satellite images. Nevertheless, publicity resulting from media reports and from the activities of several NGOs has helped to raise public and political awareness of the global scale of the plastic debris problem, together with the larger issue of marine litter.

Microplastics are generally considered to be plastic particles smaller than 5 millimetres in diameter (Arthur et al. 2009).

Persistent, bio-accumulating and toxic substances (PBTs) have a range of chronic health effects, including endocrine disruption, mutagenicity and carcinogenicity. A subset is regulated under the Stockholm Convention on Persistent Organic Pollutants (POPs).

Assessing the extent of the problem

It is difficult to quantify the amounts and sources of plastic and other types of debris entering the ocean. Land-based sources include poorly managed landfills, riverine transport, untreated sewage and storm water discharges, industrial and manufacturing facilities with inadequate controls, wind-blown debris, recreational use of coastal areas, and tourist activities (Barnes et al. 2009). These sources are thought to dominate the overall supply of marine debris, but there are important regional variations. For example, shipping and fisheries are significant contributors in the East Asian Seas region and the southern North Sea (UNEP/COBSEA 2009, Galgani et al. 2010). In general, more litter is found closer to population centres, including a greater proportion of consumer plastic items such as bottles, shopping bags and personal hygiene products (Ocean Conservancy 2010).

The greatest technological development of modern plastics occurred during the first half of the 20th century. Their production and use have continued to expand rapidly up to the present day (**Figure 1**). In many sectors, they have become a popular material for packaging (**Box 1**). A major benefit of their use in the food industry is that it can extend shelf life, thus decreasing the risk of infection and reducing food waste.

Ship- and platform-based sources of plastic litter in the ocean include fishing and recreational vessels, cruise liners, merchant shipping, oil and gas platforms, and aquaculture facilities (**Figure 2**).

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Science writer: John Smith