

# Marine Litter – where are we?

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(Joint Group of Experts on Scientific Aspects of Marine Protection  
an Inter-Agency body of the United Nations)

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# Marine litter – a definition

*'any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment'*

UNEP 2010

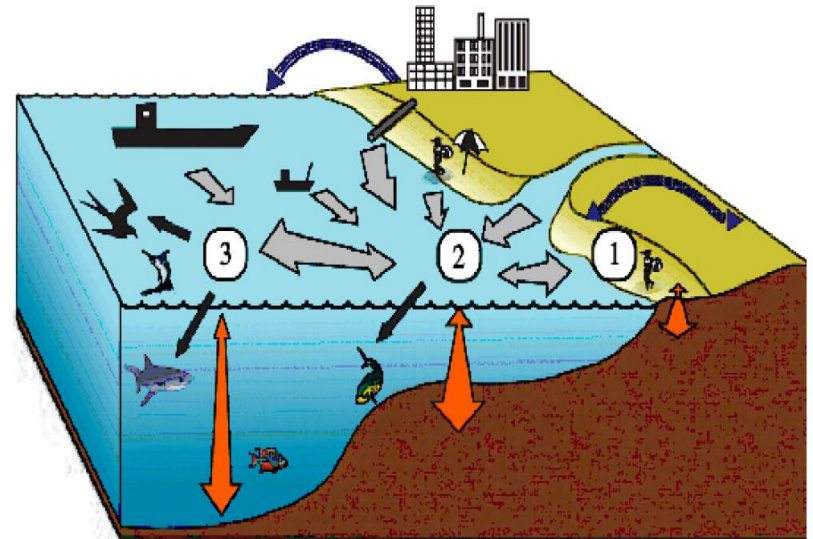
Metal, glass, fabric, plastic, ceramic/brick, ropes .....

## Land-based

- Coastal tourism/recreation
- Population centres
- Poorly controlled/illegal waste sites
- Industrial sites
- Agriculture

## Sea-based

- Merchant shipping
- Cruise ships
- Fisheries/aquaculture
- Recreational boating
- Offshore oil & gas platforms



(Peter Ryan)

# Why is marine litter a priority issue?

- Sources of marine litter poorly controlled – currently lack of effective mechanisms for effective waste management
- Plastic-based litter predominates & most plastics do not completely degrade in the marine environment; i.e. total inventory increasing
- Sufficient evidence to suggest significant social, economic and ecological harm, but needs to be better quantified
- Increasing coastal population, increasing per capita consumption, increasing global trade, increasing coastal tourism; i.e. Pressures increasing
- Global, cross-sector & trans-boundary issue, requiring new approaches & mechanisms
- Litter is one of many pressures on marine environment – potential for cumulative effects

# What is known about marine litter – sources and types

- It comes in many shapes and sizes (tens of metres to nanometres)
- It is not a new phenomenon
- It is a trans-boundary/global issue
- Some comes from land-based activities
- Some comes from sea-based activities
- There are large regional differences in the relative importance of different sources, and the quantities released
- Most litter, other than from natural disasters, arises because of inadequate waste management, on land and at sea
- Some may be accidentally lost (e.g. ship's cargo) or deliberately dumped (e.g. unwanted fishing gear)

A long history – accidental loss 2000 years ago



Amphorae on the seabed of the Mediterranean  
Used for transporting oil & wine

## A long history – accidental loss in 21<sup>st</sup> century



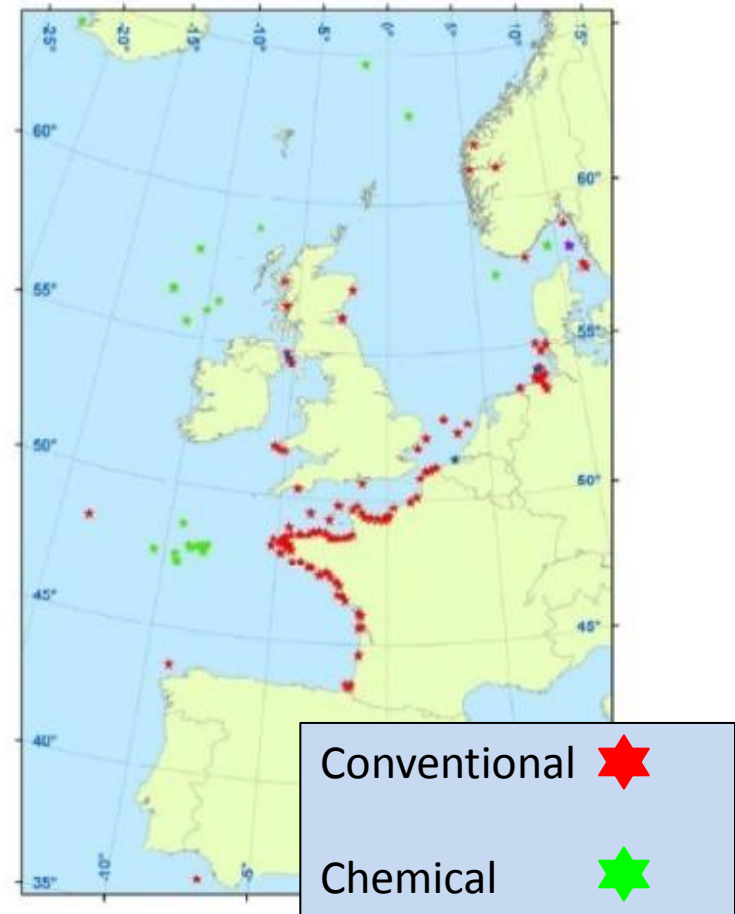
Increase in scale, and variety of materials, with population growth and globalisation of trade



# Deliberate dumping of hazardous waste – legacy issues



Discarded 20<sup>th</sup> century munitions





# Accidental loss or deliberate disposal of fishing gear



FAO/IOC, 2009

Rope & net on seabed  
off Ireland, 700 m



Recovery of derelict fishing gear, Korea (UNEP)





# Riverine inputs



Algalita

# Aftermath of catastrophic natural disasters

- Storms – Katrina, super storm Sandy
- Earthquakes
- Tsunamis – Indian Ocean 2003, Japan 2011
- River flooding/inundation –Thailand 2011



Japanese tsunami debris on US west coast



NOAA Marine Debris Program

# What is known about marine litter - effects

- Some types of litter can have significant direct impacts on individual biota (e.g. entanglement/ingestion by cetaceans, turtles & birds )
- Some types of litter can cause a navigation hazard and social & economic harm
- Litter can become colonised and act as a vector for non-indigenous species
- Some plastics contain additives (e.g. flame retardants) that have the potential to adversely effect biota
- Plastics will tend to absorb organic contaminants (e.g. PCBs, DDT) from seawater
- The distribution of litter is influenced by ocean currents, so concentrations are not uniform in space or time



# Entanglement & ingestion

Turtle in Caribbean (UNEP-CAR/RCU)

Seal in NE Atlantic(de Wolff, ECOMARE NL)

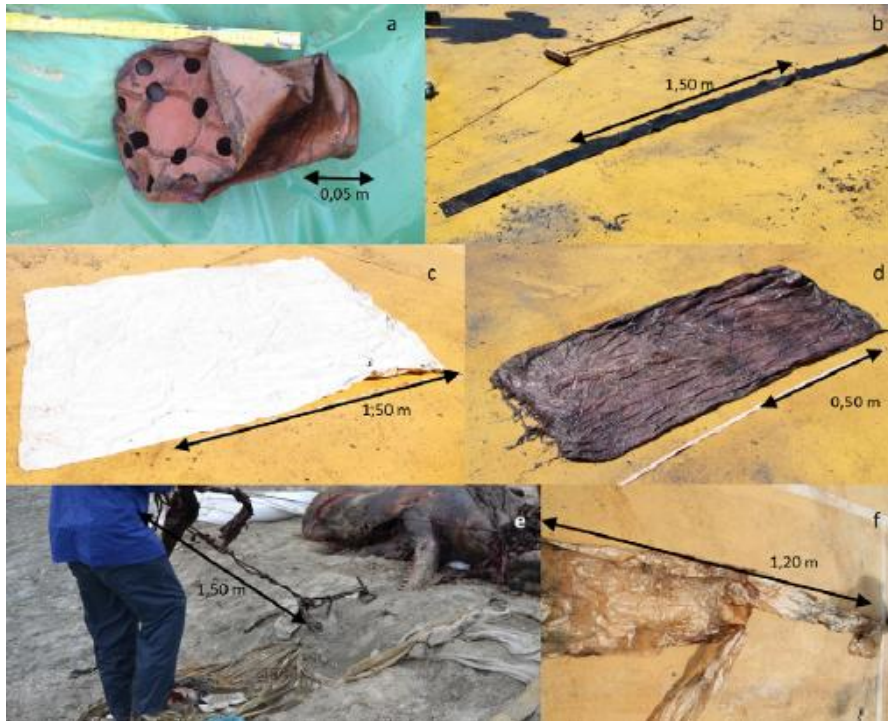


Laysan albatross, Kure Atoll, Pacific  
(Vanderlip & Algalita)

Minke whale, Mediterranean  
(Mauger & Kerleau, GECCF F)

# Ingestion by cetaceans

Ingestion of plastics from large-scale horticulture and general household waste, by Sperm whale in Mediterranean



De Stephanis et al., 2013



# Marine litter as a vector for non-indigenous species





# What is unknown about marine litter

- The quantities entering from land-based and from sea-based activities – by country or in total
- The comprehensive and quantitative distribution of litter on shorelines, the sea surface, the water column, the seafloor and in biota
- The long-term fate of litter, including times for ‘degradation’, especially for plastics
- The degree of ecological harm due to physical impacts – at a population level
- The extent of ecological harm due to ecotoxicological/chemical impacts – at a population level
- The extent of economic impact to different sectors (e.g. shipping, fisheries, coastal tourism)
- The extent of social harm (e.g. injury or loss of life, loss of enjoyment)

# Marine litter on beaches/shoreline



South Soko, Korea

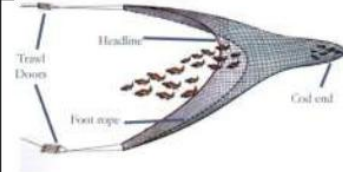
# Marine litter on the seabed

Opportunistic sampling – using existing fish stock assessment cruises for seabed litter monitoring

Beam trawl:



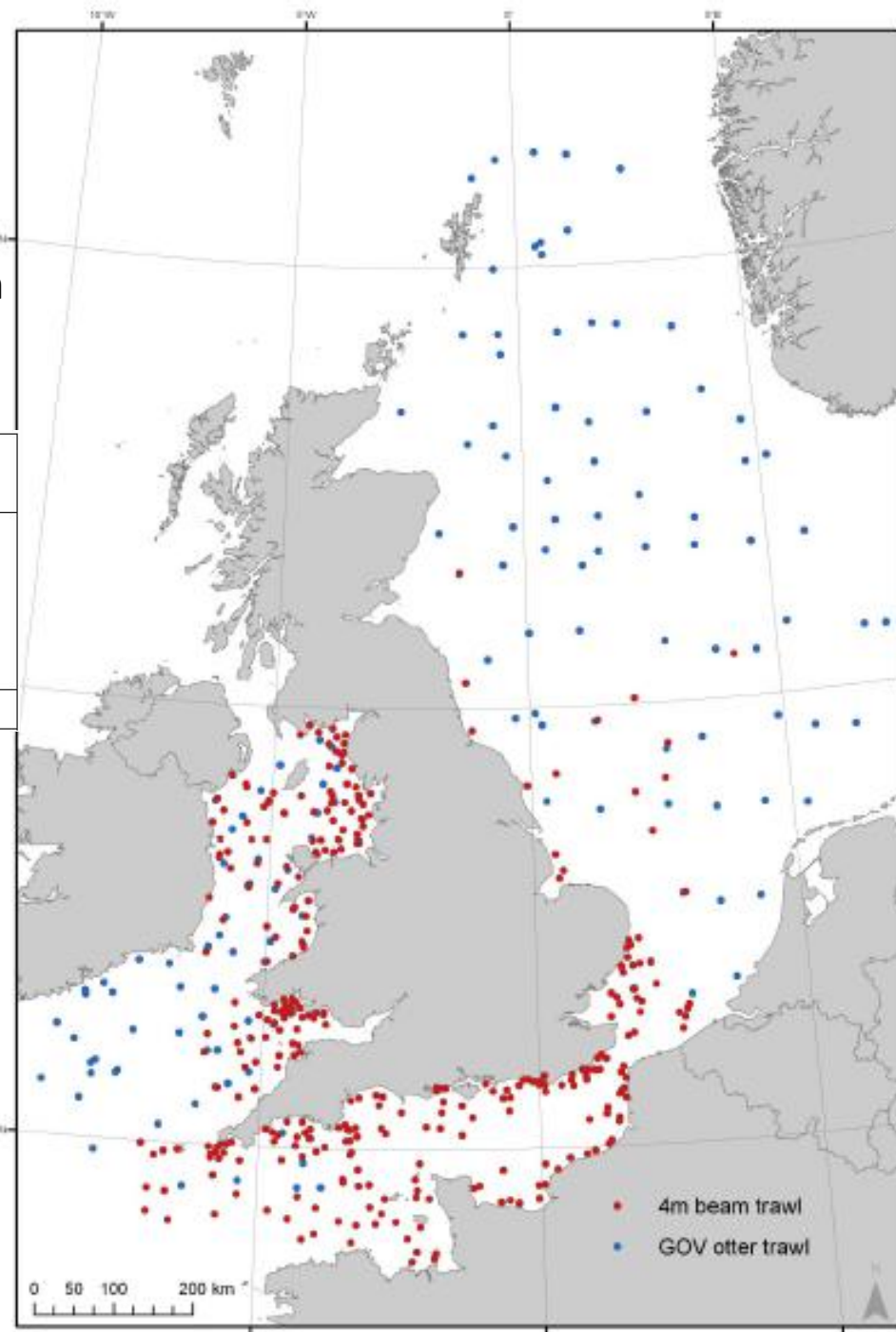
Otter Trawl:



The beam trawl “scrapes” the seabed, while the Otter trawl “floats” over the seafloor



‘sediment’ sample from the deep Mediterranean





# Marine litter recorded during fish stock assessment surveys



# Floating litter offshore



Straits of Malacca, Ryan 2013

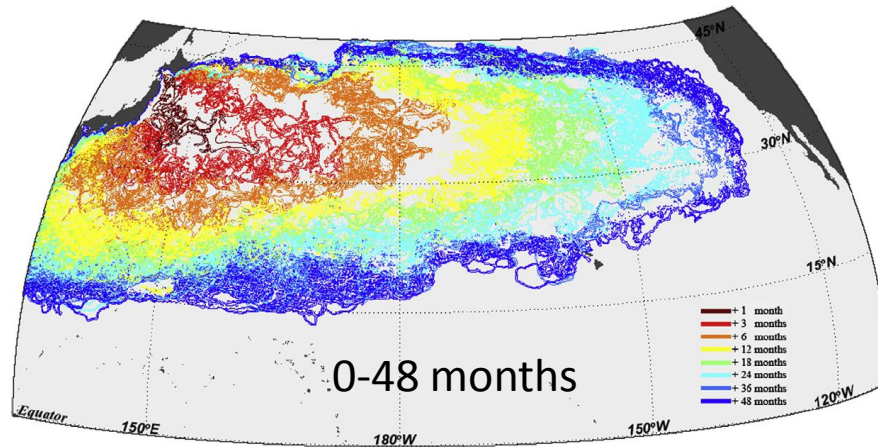
16km offshore



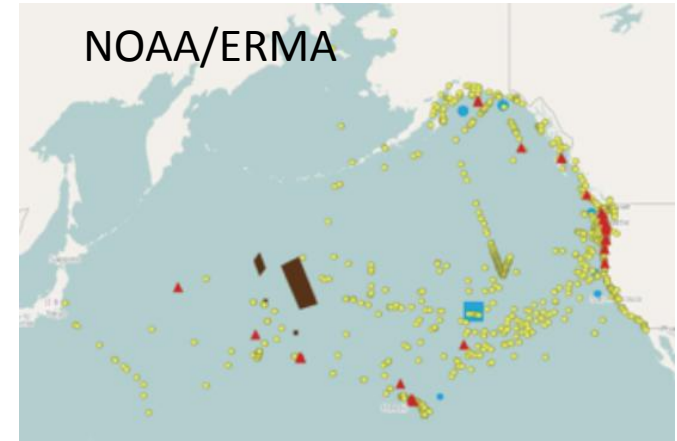
48km offshore

GEF Transboundary Waters Assessment – indicators of floating plastic  
in the ocean. Conducted by GESAMP on behalf of IOC  
Reporting December 2014

# Simulating the transport of the Japanese tsunami debris

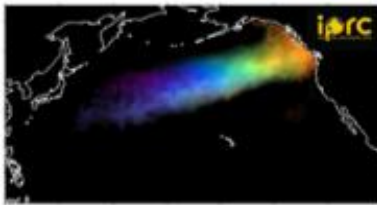


Lebreton & Hafner, 2013

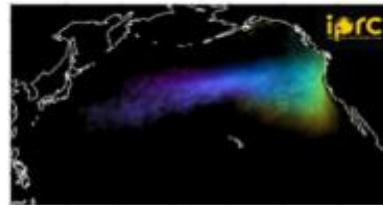


Observations – confirmed ▲, potential ▲

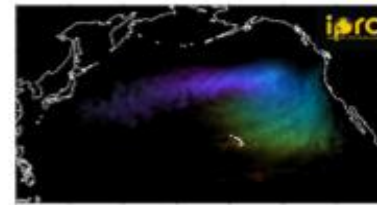
March 11 2012



June 11 2012

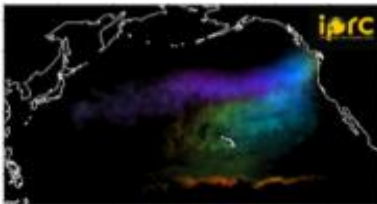


September 11 2012

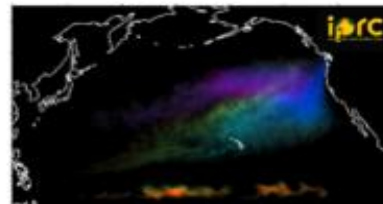


- Alert shipping
- Interpret observations
- Direct sampling/recovery

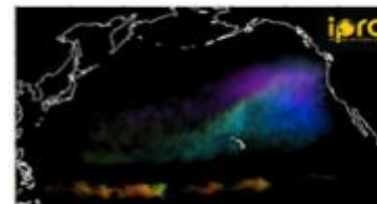
December 11 2012



March 11 2013



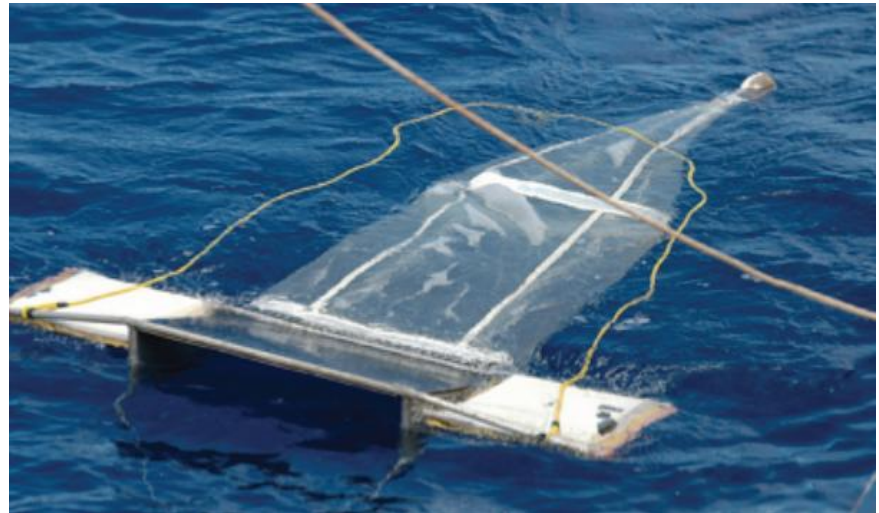
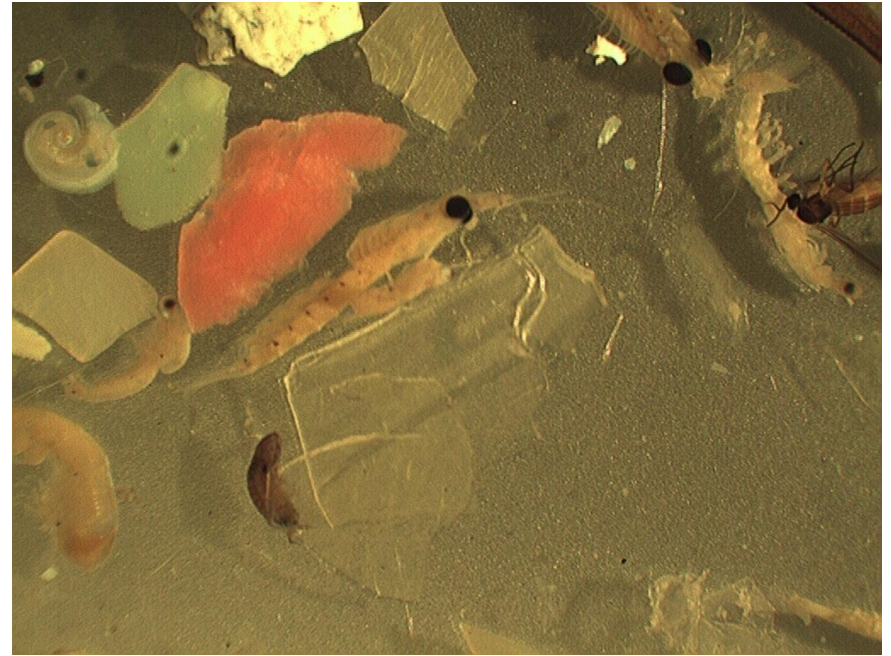
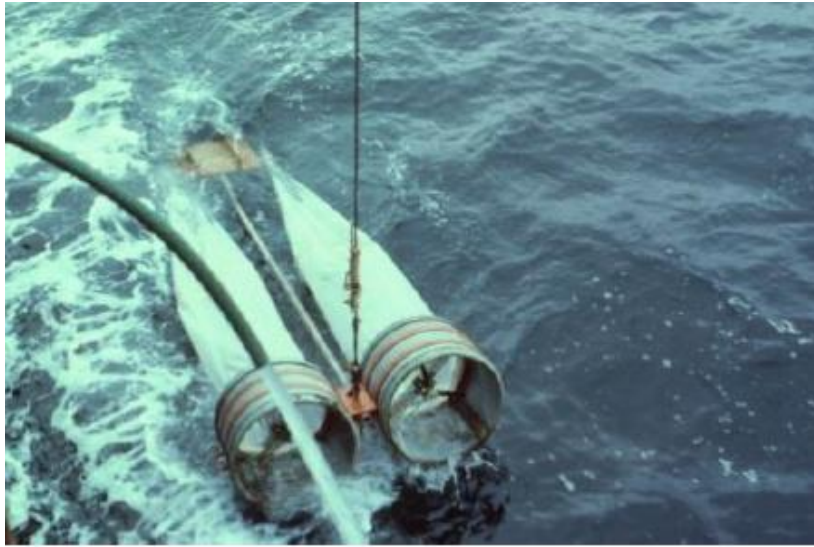
June 11 2013



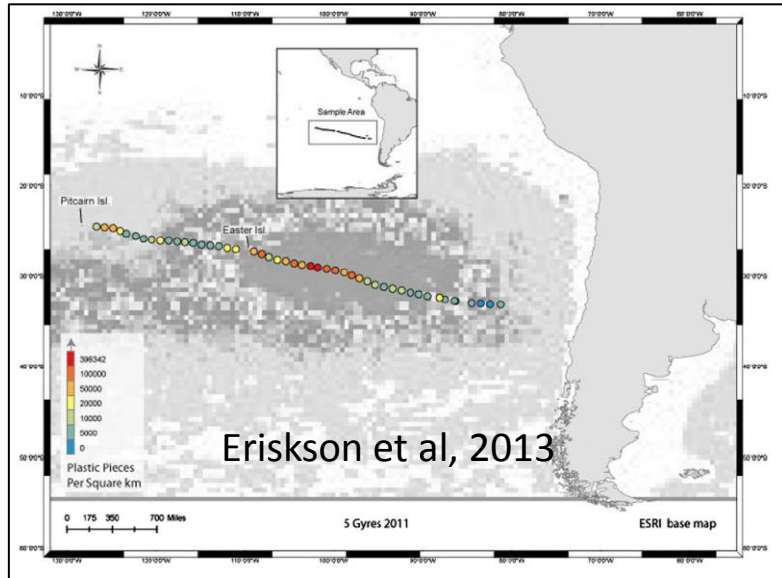
Maximenko & Hafner, IPRC Hawaii



# Sampling for microplastics using a plankton net (300 micron)

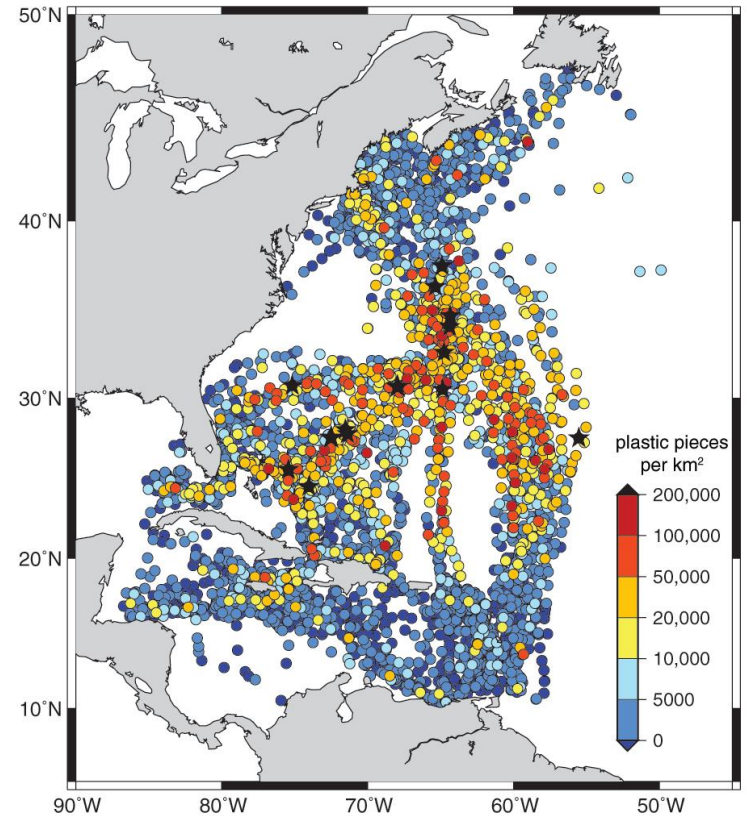
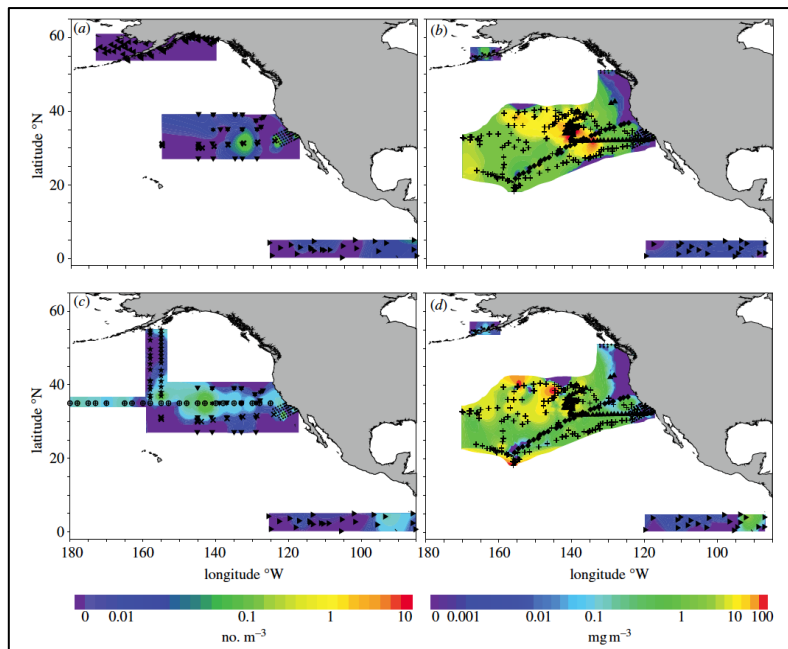


# Distribution of floating microplastics



1972-87

1999-2010



Law et al., NEA

Goldstein et al., 2012



# What are microplastics?

Operational definition – particles < 5mm

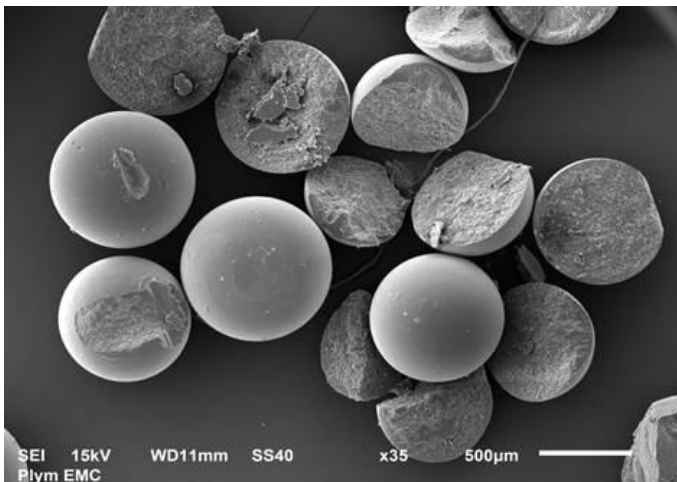
‘primary’ & ‘secondary’ i.e fragmented



Plastic resin beads, used in plastics manufacture (Ogata)



Beach sample of microplastics, Hawaii (NOAA Marine Debris Program)



Polyethylene microplastics extracted from shower gel (A. Bakir and RC Thompson)

## Microplastics as an emerging issue?

- Increasing in abundance
- Ingested by large variety of organisms
- Intrinsic additives *may* have an ecotoxicological effect
- Microplastics absorb organic contaminants which *may* have an ecotoxicological effect
- Some evidence of transfer of chemicals from plastic particles to tissue
- **Cannot** remove them from the environment in significant quantities

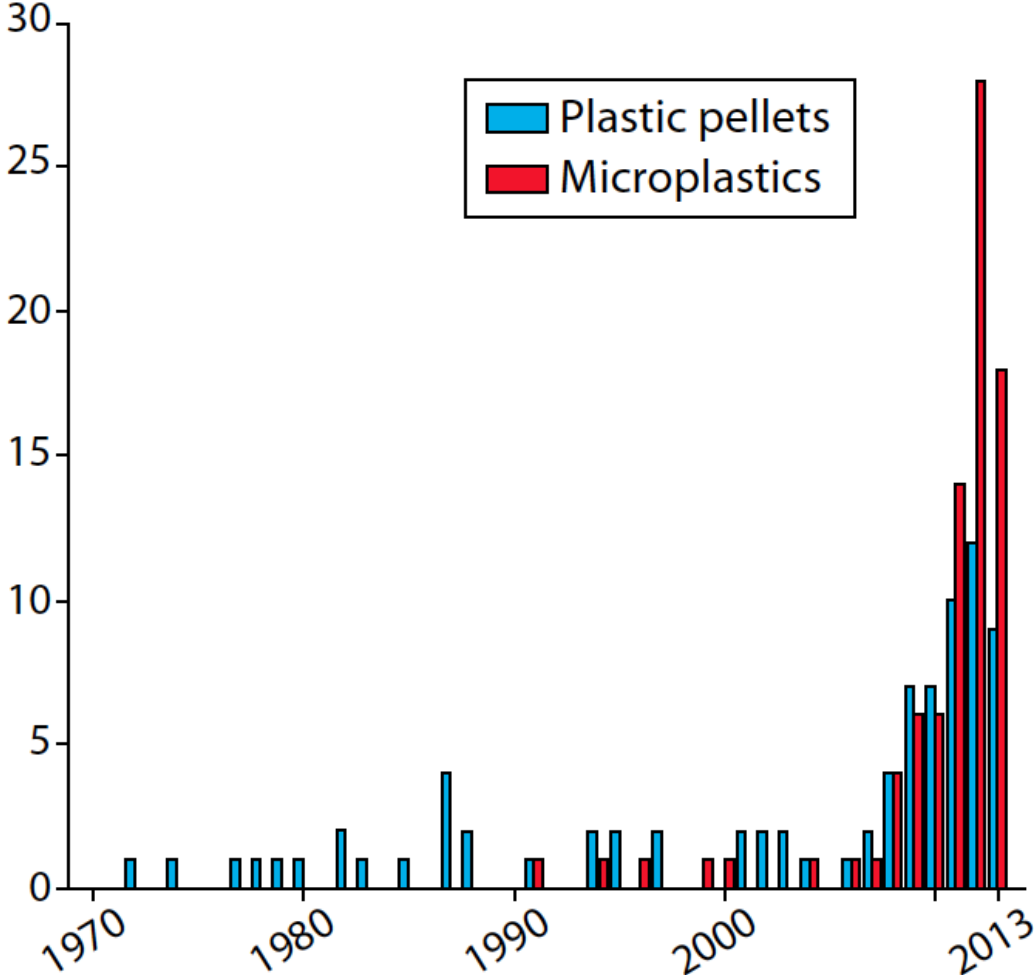
GESAMP Working Group 40 – ‘Sources, fate & effects of microplastics in the marine environment – a global assessment’

Reporting: November 2014

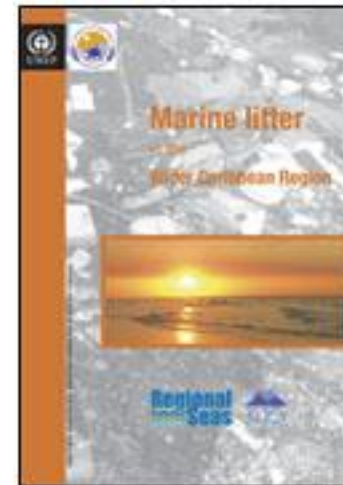
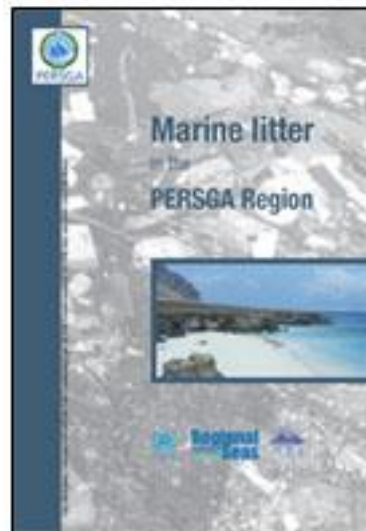
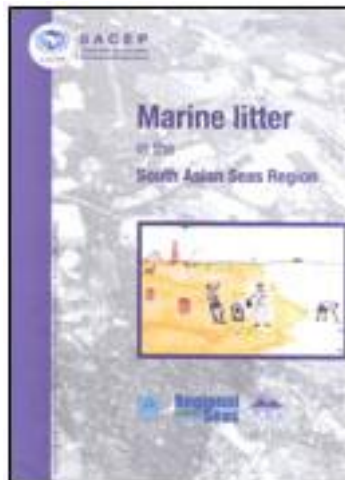
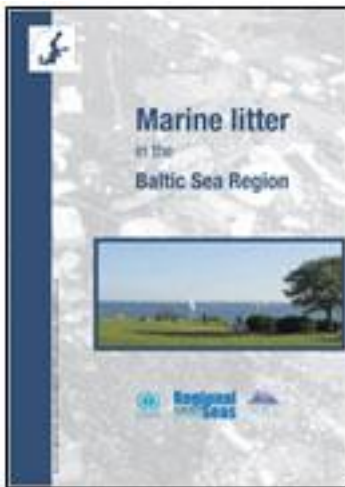
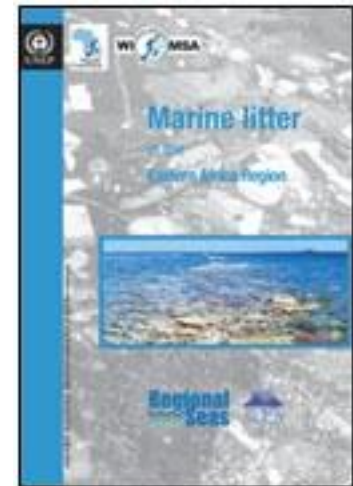
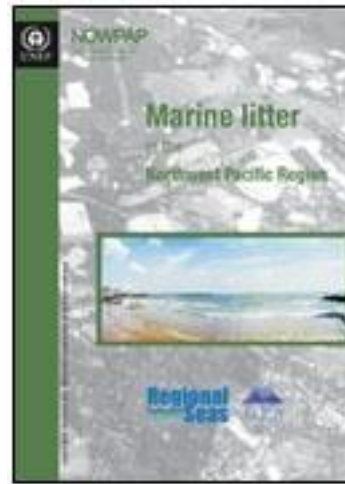
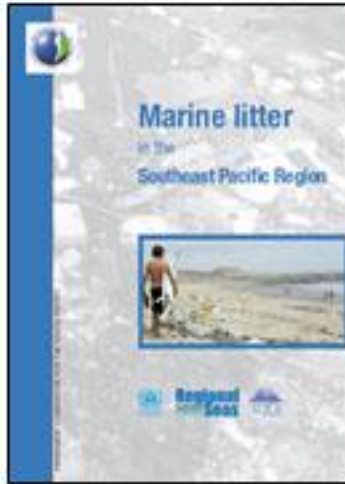
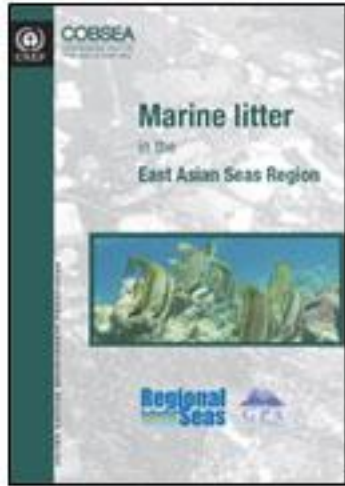
Supported by: UNESCO-IOC, UNEP, IMO, UNIDO, UNDP, NOAA, ACC, Plastics Europe

# Charting the growing interest in microplastics

Number of scientific publications and reports describing studies of 'micro-sized' plastics



# Getting the message across – the ‘normal’ route





# Getting the message across – more focused approach

The cover of the report features a header with the text "Science for Environment Policy" and "DG Environment News Alert Service". Below this is an orange banner with "IN-DEPTH REPORT" and the title "Plastic Waste: Ecological and Human Health Impacts" dated "November 2011". The main image shows a beach littered with plastic bottles and debris. At the bottom, there are logos for the European Commission and the Environment Directorate.

Science for Environment Policy  
DG Environment News Alert Service

IN-DEPTH REPORT

**Plastic Waste:**  
Ecological and Human Health Impacts

November 2011

EUROPEAN COMMISSION  
environment

The infographic shows a close-up of various microplastic particles. The title "microplastics" is written in a large, blue, sans-serif font. Below the title, there are three paragraphs of text explaining the definition, concerns, and current research. The UNEP logo is visible on the left, and a small inset image shows a collection of colorful microplastics. At the bottom right, the text "EMERGING ISSUES" is displayed in a blue box.

**microplastics**

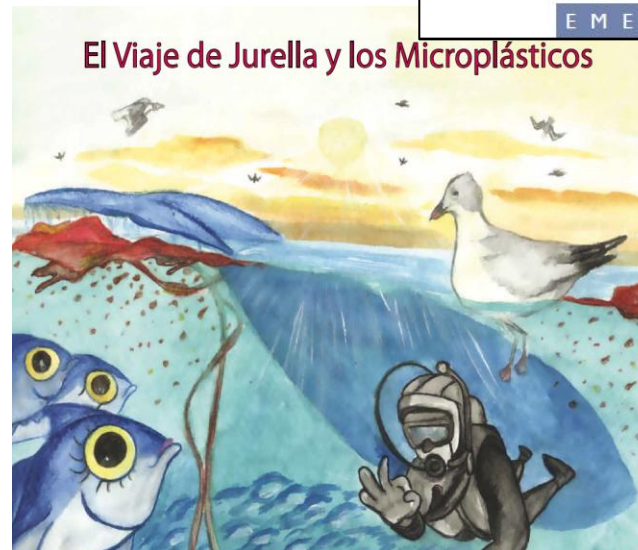
Microplastics are tiny plastic particles up to 5 mm in diameter. In the last four decades, concentrations of these particles appear to have increased significantly in the surface waters of the ocean.

Concern about the potential impact of microplastics in the marine environment has gathered momentum during the past few years. The number of scientific investigations has increased, along with public interest and pressure on decision-makers to respond.

Despite a rapidly growing knowledge base, the extent to which microplastics represent a hazard to marine life – and may provide a pathway for transport of harmful chemicals through the food web – is still being assessed. A number of international initiatives are under way to determine the physical and chemical effects of microplastics in the ocean, and to identify ways to address this emerging issue.

UNEP

EMERGING ISSUES





# Getting the message across – involving artists



# Some essential requirements for tackling marine litter

- Education – public, managers, policy-makers, financial
- Cooperation
- Collaboration
- Harmonisation
- Capacity building
- Sharing good practice
- Forming partnerships between industry/business sectors, policy makers, managers, school education, NGOs, funding agencies & academia – covering land- and sea-based activities,
- Recognising this is a shared problem required a shared response

## Final thoughts

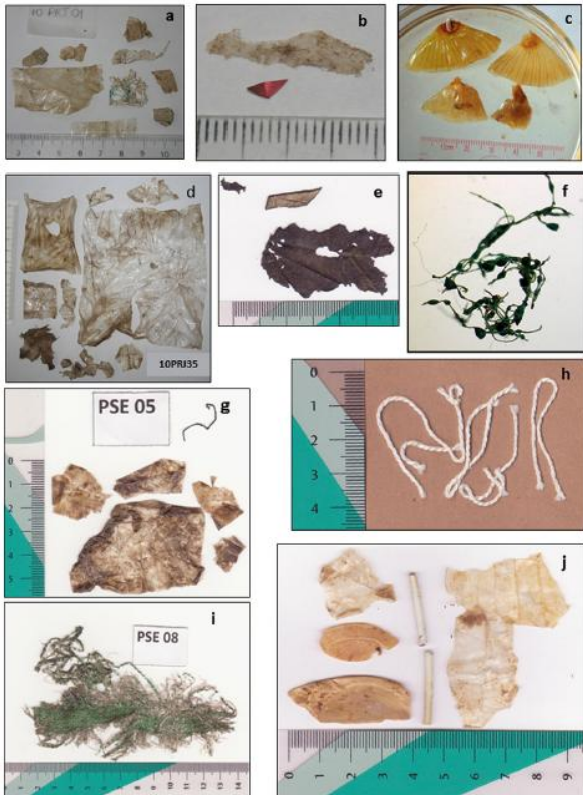
- Aim to significantly reduce generation of ML, with particular focus on reducing plastic
- We need to be realistic in what we can do – solutions have to be appropriate for different situations, specific & cost-effective
- We have to recognise pressures on budgets and conflicting priorities facing politicians and make sure advice is policy-relevant
- Sometimes it is justified to act before all information we would like is available – but needs to be proportionate and adaptive, as some proposed ‘solutions’ may make the ML situation worse
- Scientists have a moral responsibility to help inform the public, decision makers, politicians and others—that ML is important and needs to be dealt with



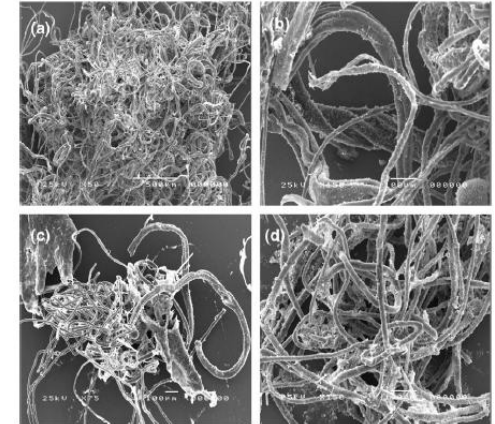
# Thank you

[peter@pjkershaw.com](mailto:peter@pjkershaw.com)

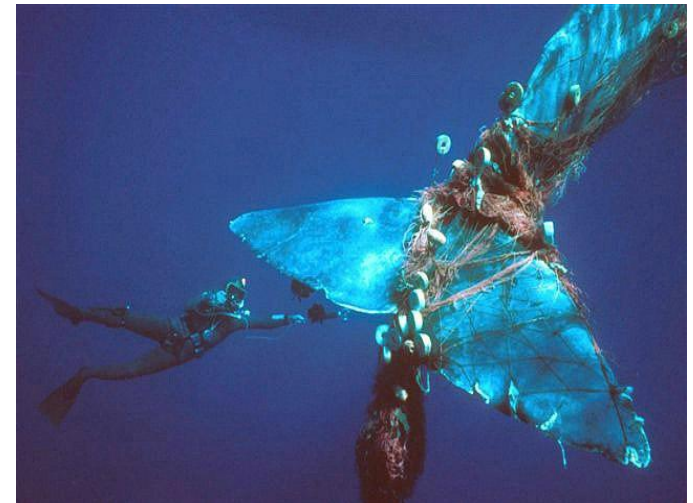
Magellanic penguin, *Spheniscus magellanicus*, Brazilian coastal waters



Brandao et al., 2011



Gut contents - *Nephrops norvegicus*



UNEP