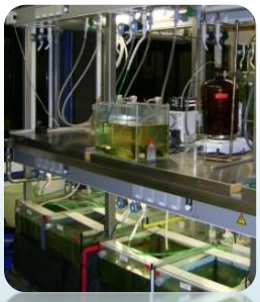
EPHEMARE

ECOTOXICICOLOGICAL EFFECTS OF MICROPLASTICS IN MARINE ECOSYSTEMS

JPI OCEANS



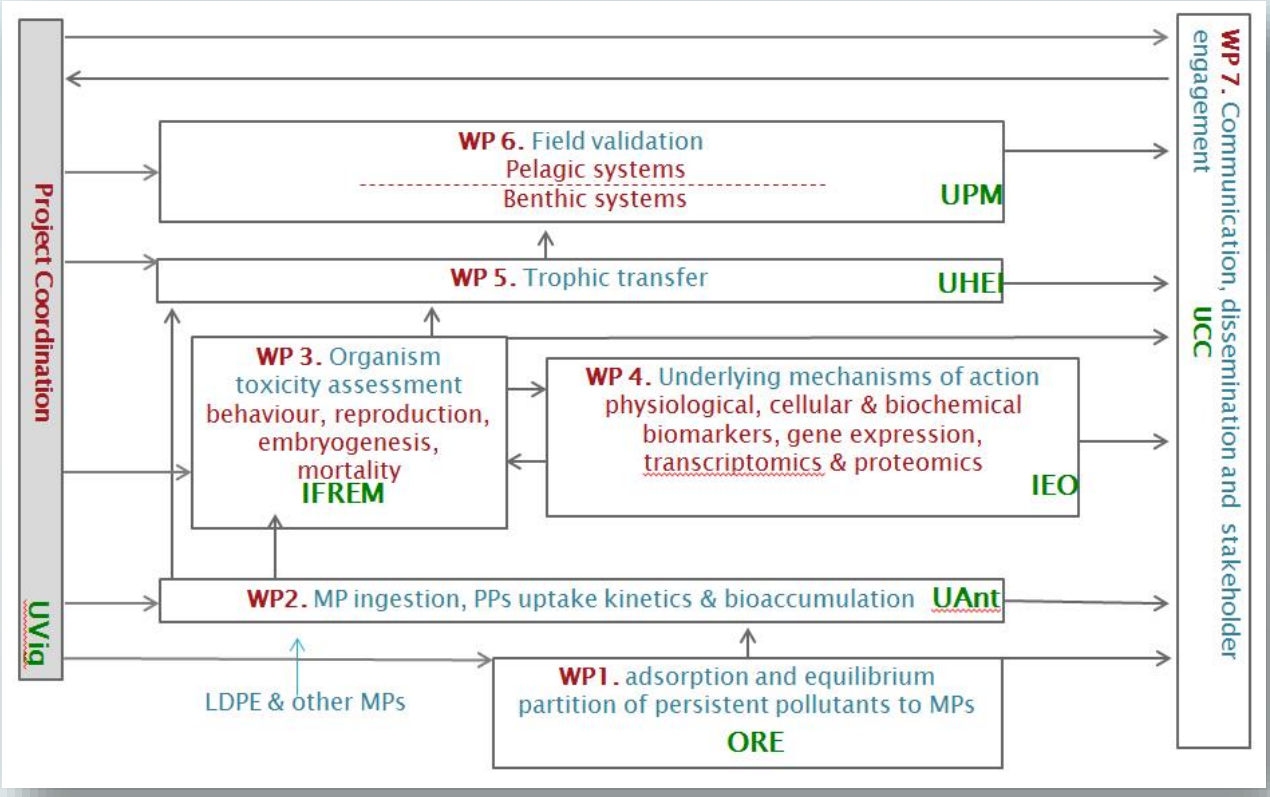


Project Duration:	36 Months	Lead Partner:	University of Vigo, Spain
Start Date:	January 2016	End Date:	December 2018
Total Partners:	16	Total Project Cost:	€ 3,154,000

Microplastics show the potential to play a remarkable role in the incorporation and trophic transfer of pollutants into marine food webs. The toxic effects of microplastics on marine organisms are unclear and need further investigation, which **EPHEMARE aims to address through the following objectives:**

- ✓ **To investigate the uptake, tissue distribution and final fate of microplastics in organisms representative of pelagic and benthic ecosystems.**
- ✓ **To investigate the potential role of microplastics as vectors of marine pollutants and their trophic transfer in marine food webs.**
- ✓ **To assess by means of internationally accepted standards and methods (ISO, OECD, ICES, ASTM) whether microplastic accumulation leads to detrimental effects at molecular, cellular, physiological and organism levels.**
- ✓ **To test the suitability of exposure and effect biochemical, cellular and physiological biomarkers and cutting-edge omics methods to trace MP exposure.**
- ✓ **To assist public and private stakeholders with the scientific basis for the development and compliance with general environmental regulations concerning chemicals used in plastic production (WFD, MSFD, environmental quality standards, REACH, Directive 2002/72/ECEU and subsequent amendments, Regulation No 10/2011).**
- ✓ **To raise public awareness on the risks that the less visible plastics pose to marine ecosystems and, eventually, human health.**

EPHEMARE deals with the ecotoxicological effects of microplastics (MPs) in marine ecosystems and is structured in 7 tightly interconnected WPs: aimed to investigate adsorption of chemicals on microplastics (WP1), their ingestion, trophic transfer and chemical release (WP2 and WP5), and a wide array of ecotoxicological effects (from transcriptomic to cell damage and organism responses), using several invertebrate and vertebrate models.

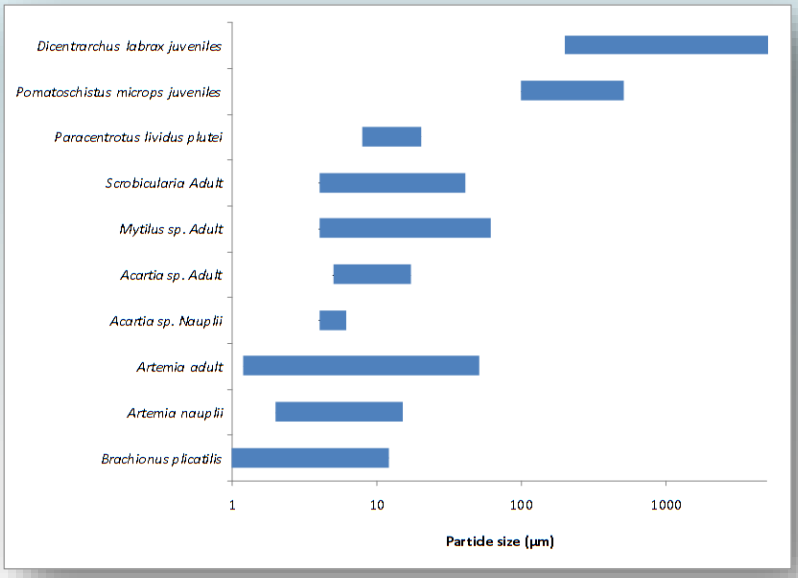


Schematic illustrating how the individual WPs are connected as well as their specific merits

Different typologies of polymers both virgin and previously contaminated and exposure conditions will be tested (WP3 and WP4) in order to highlight and validate mechanistic relationships and mode of action of microplastics and associated chemical compounds, while field validation studies (WP6) will allow to link the ecotoxicological findings from laboratory studies to the environmental scale.

The applicability of results to environmental quality standards, environmental protection regulations and advise for correct management of marine environment by national and international authorities will be verified within WP7, together with an identification of potential stakeholders for developed protocols. Disclosure activities related to results and information obtained within the project are also considered here (WP7).

Materials: Standard materials will be distributed to all partners to investigate chemical adsorption and release, uptake, accumulation and trophic transfer, and ecotoxicological effects. The main standard materials used will be Polyethelene (PE) and Polyvinyl Chloride (PVC) microparticles of different shapes and size ranges from 1 to 5,000 µm depending on what is taken up by each biological model. PE is the most abundant polymer in the marine environment and also the plastic material with the highest adsorption capacity for hydrophobic organic contaminants. The relative weight of PE is very similar to that of seawater.

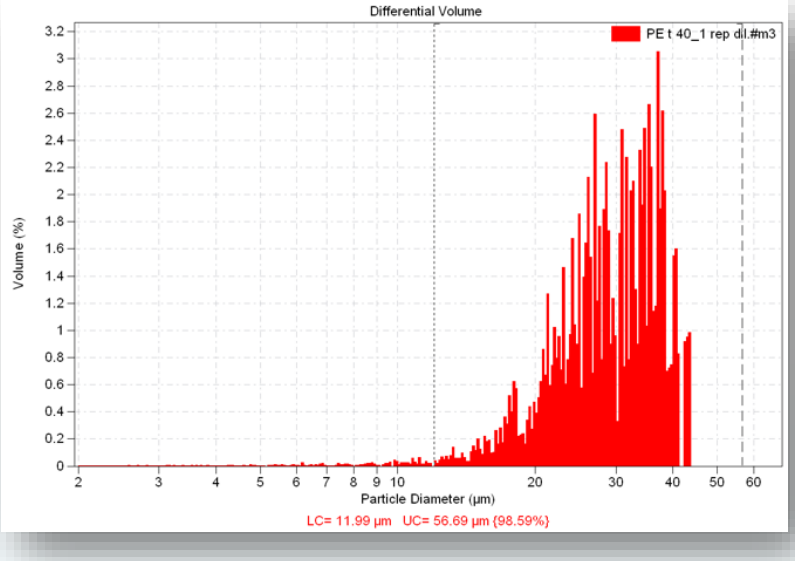


Particle size ranges ingested by some of the testing models (Source University of Vigo)

PVC due to its high density has special interest for benthic studies, since it has been reported as one of the most frequent plastics in sediment samples. Due to industrial applications, it is the polymer with the highest addition of orthophthalates.

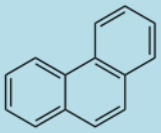
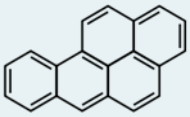
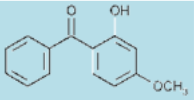
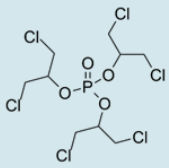
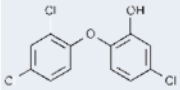
Polyethylene terephthalate (PET), Polypropylene (PP) as well as Polystyrene (PS) microparticles will also be considered for specific experimental approaches.

PET is the most common plastic polymer used as fibres in clothing. The project will also access MPs obtained from the field, including Arctic samples, Oceanic samples from the Race for Water Odyssey, and samples from four representative European coastal ecosystems.



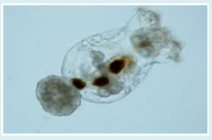
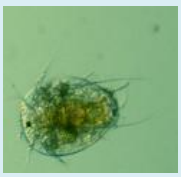
Size distribution of Class 3 PE microparticles (Source: Instituto Español de Oceanografía)

Persistent Pollutants: The project investigates the role of microplastics as vectors of persistent pollutants, either isolated or in combination. The following model contaminants are proposed: PAHs (Phe, Pyr, BaP), PFOS, Cr, Cd, phthalates, triclosan, bisphenol A, BDE-94 (PBDE).

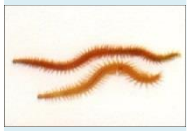
Substance Candidates	Molecular Structure	CASNR	Water Solubility	Log Kow	Uses
Phenanthrene (Ph)		85-01-8	1.15mg/L (25°C)	4.46	Fuels, agrochemical and dyeing industry
Benzo(a)Pyrene (BaP)		50-32-8	$1.62x10^{-3}$ mg/L (25°C)	6.13	Fuels and fuel additives, adhesives and sealant
Oxybenzone		131-57-7	69 mg/L (25°C)	3.79	UV Filter and Stabilizer
Perfluorooctanesulfonic acid (PFOS)		1763-23-1	5.70mg/L (25°C)	N/A	Impregnation agents for textiles, paper, and leather; in wax, polishes, paints, varnishes, cleaning products, metal surfaces, carpets, fire fighting foams and semiconductors
Tris(1,3-dichloro-2-propyl) phosphate (TDCP)		13674-87-8	18 mg/L	3.69	Flame Retardant
Triclosan		3380-34-5	12 mg/L (25°C)	4.8	Antimicrobial in personal-care products, material preservative in plastics, textiles, vinyl
Cadmium **Copper**		7440-43-9 7440-50-8			Stabilizer Electrical Conductor

Field Validation: Results obtained in WPs 1 to 5 will be validated against field data describing the occurrence, distribution, typology and chemical loads of MPs in representative biota of three geographical areas from the Mediterranean (M), the North East Atlantic (NEA), a North Sea Fjord (NSF) and a North Sea estuary (NSE) respectively. The main species from benthic and pelagic systems will be collected, including planktonic organisms, pelagic and benthic fishes, invertebrates (e.g. molluscs, echinoderms, polychaetes, crustaceans). The analysed species will include most of the biological models (and other field collected species) which are characterised in terms of exposure, accumulation and toxicity by WPs 2 to 5.

Biological Models: The project will utilise standard biological models of recognised usefulness in aquatic ecotoxicology. In addition, a number of innovative and mode of action based end-points and ecologically relevant species will be used, providing a cutting edge experimental framework, specifically focused on MP particle toxicity.

ORGANISM	Name	Ref. Lab	ORGANISM	Name	Ref. Lab
Class 1: No Feeders					
	*Phaeodactylum tricornutum (Microalgae)*	*UVigo (Spain)*		*RTL-1; BF-cell; DLEC; DLB-1; H295R; BG1-ERE; T47D-ARE; RTS34; Hepatocytes Primary culture*	*University of Murcia (Spain)*
Class 2: Small Filter Feeders					
	*Brachionus plicatilis (Rotifers)*	*CNR-ISMAR (Italy)*		*Aurelia aurita (Cnidarians)* Life stage: *ephyrae*	*CNR-ISMAR (Italy)*
	*Acartia tonsa (Crustaceans)*	*UVigo (Spain)*		*Tigriopus fulvus (Crustaceans)* Life stage: *nauplii*	*CNR-ISMAR (Italy)*
	*Daphnia magna (Crustaceans)* Life stage: *neonates and adults*	*CIIMAR (Portugal)*		*Paracentrouts lividus (Echinoderms)* Life stage: *plutei larvae*	*UVigo (Spain)*

Biological Models:

ORGANISM	Name	Ref. Lab	ORGANISM	Name	Ref. Lab
Class 3A: Large Filter Feeders					
	*Scrobicularia plana (Molluscs)*	*UAlgarve (Portugal)*		*Mytilus spp. (Molluscs)*	*UPM (Italy)* *UAnt (Belgium)*
Class 3B: Deposit Feeders					
	*Hediste diversicolor (Annelids)*	*UOslo (Norway)*		*Arenicola marina (Annelids)*	*UOslo (Norway)*
Class 4: Predators					
	*Danio rerio (Fish)* Life stages: *embryos, larvae and adults*	*University of Heidelberg (Germany)*		*Oryzias melastigma (Fish)* Life stages: *embryos, larvae and adults*	*IFREMER (France)*
	*Dicentrarchus labrax (Fish)* Life stage: *larvae and juveniles*	*University of Murcia (Spain)*		*Pomatoschistus microps (Fish)* Life stage: *juveniles*	*CIIMAR (Portugal)*

Project Partners:

Spain: University of Vigo and Instituto Español de Oceanografía (IEO) and University of Murcia, **France:** University of Bordeaux (UMR EPOC) and IFREMER La Rochelle, **Sweden:** Örebro University, **Norway:** University of Oslo, **Germany:** University of Heidelberg, **Belgium:** University of Antwerp, **Italy:** Polytechnic University Marche and CNR – ISMAR, **Portugal:** CIIMAR and University of Algarve, **Ireland:** MaREI-University College Cork and associated **UK** project partners from Plymouth University and University of Exeter

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The EPHEMARE Project is seeking collaboration with Industry for mutually beneficial exchange of knowledge.

EPHEMARE Kick off meeting in Murcia, Spain took place on the 19-20th of January 2016.

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This JPI Ocean project is supported by national funding agencies

Belgium: *Belgian Federal Science Policy Office (BELSPO) and the Research Foundation – Flanders (FWO);* ***France:*** *The French National Research Agency (ANR);* ***Germany:*** *Federal Ministry of Education and Research;* ***Ireland:*** *Marine Institute;* ***Italy:*** *Ministero dell'Istruzione, dell'Università e della Ricerca (MIUR);* ***Norway:*** *The Research Council of Norway (RCN);* ***Portugal:*** *Portuguese national funding agency for science, research and technology (FCT);* ***Spain:*** *Ministry of Economy and Competitiveness (MINECO) and* ***Sweden:*** *the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS) and the Swedish Agency for Marine and Water Management (SWaM).*