PROJECT FINAL REPORT

FULL PROJECT TITLE: ECOTOXICOLOGICAL EFFECTS OF MICROPLASTICS IN MARINE ECOSYSTEMS

Project acronym: EPHEMARE

Period covered: January 2016 – December 2018

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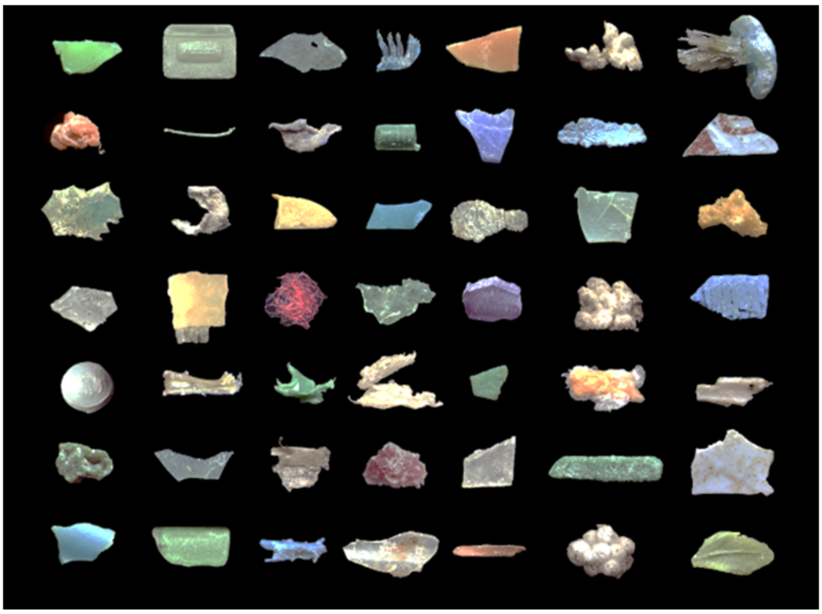

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CONSORTIUM

A European Consortium of 14 partners from 9 European countries constitutes EPHEMARE

PARTNER 1 - **University of Vigo**, Spain

PARTNER 2 - **Spanish Institute of Oceanography** (**IEO**), Spain

PARTNER 3 - **University of Murcia**, Spain

PARTNER 4 - **University of Bordeaux**, France

PARTNER 5 - **University of Heidelberg**, Germany

PARTNER 6 - **University of Antwerp**, Belgium

PARTNER 7 - **Marche Polytechnic University**, Italy

PARTNER 8 – **IAS** (formerly ISMAR) **National Research Council**, Italy

PARTNER 9 - **Interdisciplinary Centre of Marine and Environmental Research** (**CIIMAR**), Portugal

PARTNER 10 - **University of Algarve**, Portugal

PARTNER 11 - **University of Örebro**, Sweden

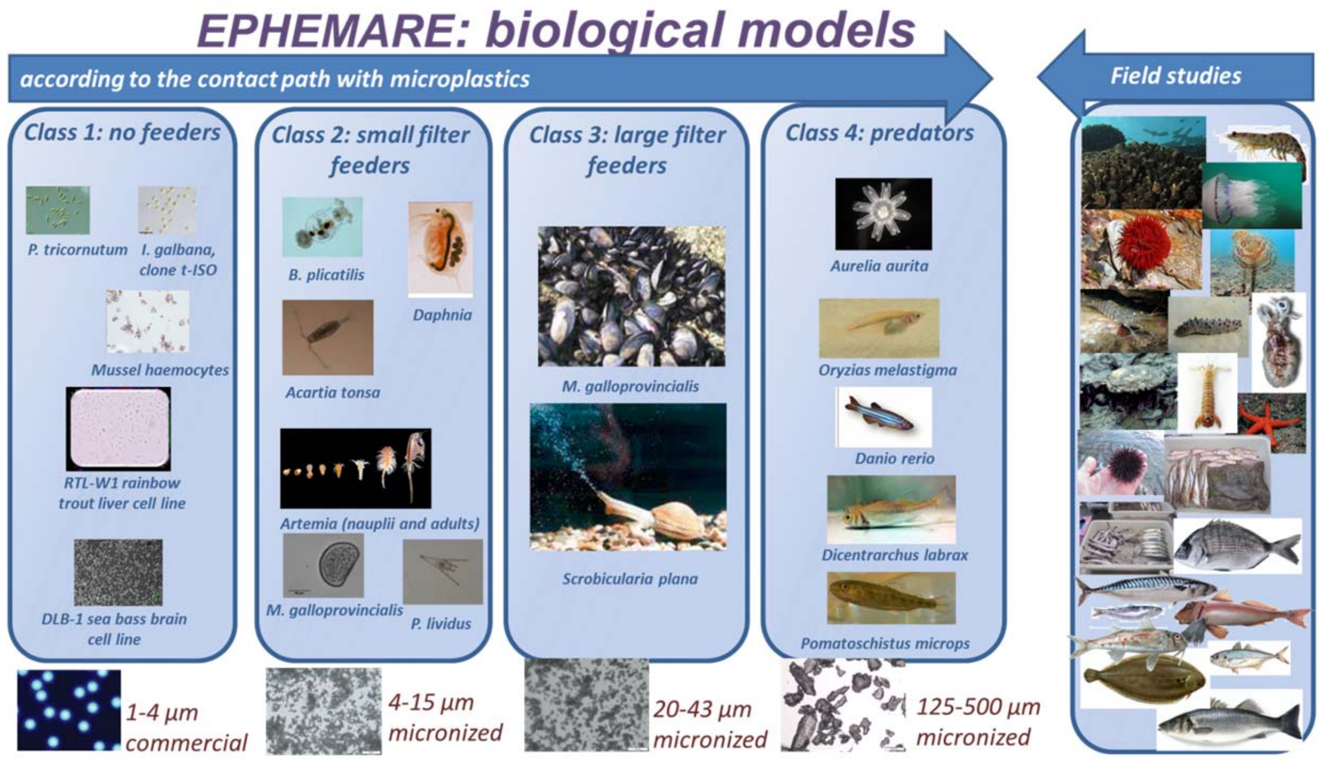
PARTNER 12 - **University of Oslo**, Norway

PARTNER 13 - **University College Cork**, Ireland

PARTNER 14 - **IFREMER**, France

PUBLISHABLE SUMMARY

The EPHEMARE project is one of the four European initiatives approved by the Joint Programming Initiatives Healthy and Productive Seas and Oceans, JPI-Oceans, a strategic platform open to all members of the EU and associated countries that invest in marine and maritime research. EPHEMARE is a consortium of European dimension (14 partners from 9 countries) that deals with the ecotoxicological effects of microplastics (MP) in marine ecosystems. EPHEMARE implemented a **collaborative experimental effort** of unprecedented dimensions in marine ecotoxicology, with **18 of the 53 peer reviewed papers** so far produced **resulting from the joint effort of 2 or more JPI-Oceans funded partners**. The Project targeted, (1) the **uptake**, tissue **distribution**, and **effects** of microplastics in organisms representative of pelagic and benthic ecosystems, (2) the potential role of MP as **vectors** of model contaminants that readily adsorb to their surfaces, and (3) support **private and public stakeholders** with solid scientific grounds for environmentally sounded decisions, and raise public awareness on this issue.



With those aims, model MP of environmentally relevant shape, with or without spiked contaminants were made up as testing materials for all work packages (WP) (**WP1**). Subsequently, MP were used to expose marine species selected according to contact path and feeding mechanism (see Fig. above) to measure their uptake, elimination, accumulation rates (**WP2**), and potential trophic transfer (**WP5**). In these models, the project studied biological effects at molecular, cellular, physiological and organismic levels through the implementation of collaborative experiments among partner laboratories, to allow for detection of effects of microplastics across the main phyla of marine organisms covering most trophic levels, from bacteria to fish. A wide array of ecotoxicological effects (from transcriptomics to cell damage and organism responses), using different typologies of polymers both virgin and previously contaminated, and exposure conditions were assessed (**WP3** and **WP4**). Cell culture and slice tissues have allowed to better elucidate mechanistic relationships, cell expression and enzymatic response as mode of action of microplastics and associated chemical compounds. EPHEMARE's field validation studies (**WP6**) consisted of sampling campaigns in different areas of the Mediterranean and the NE Atlantic coasts of continental Europe, plus the Caribbean territories of the EU in the proximity of the oceanic gyre causing accumulation of marine debris. These data allowed assessing the extent of abundance, distribution (i.e. pelagic vs. benthic species), typology of polymers, and pollutants load, thus linking the ecotoxicological findings from laboratory studies to the environmental scale. A **BASEMAN-EPHEMARE** Partnership Agreement was signed for the standardization of MP monitoring techniques. EPHEMARE activities and findings have been documented (**WP7**) *via* the project social media outlets to communicate to diverse audiences, and project partners took part in several thematic outreach events to engage the public.

EPHEMARE raised awareness through factsheets, newsletters and campaigns such as the successful IMPACT 2017 - EPHEMARE photo competition.

The scientific conclusions reached by EPHEMARE can be summarized as follows:

- MP of environmentally relevant shape (Fig. 1a) are **easily ingested**, but also **easily egested** by filter-feeders and predators. In mussels (Fig. 1b), they are excreted through feces (large ones) or **translocated** from digestive gland into the gills (<2 µm), an excretory organ. Once experimental data fit uptake and distribution models, models predict that there is **no accumulation** of MP in mussels exposed to environmental concentrations. MP are **transferred** from preys to predators but they are egested and **do not bioaccumulate in predators**. This is confirmed by field samples.

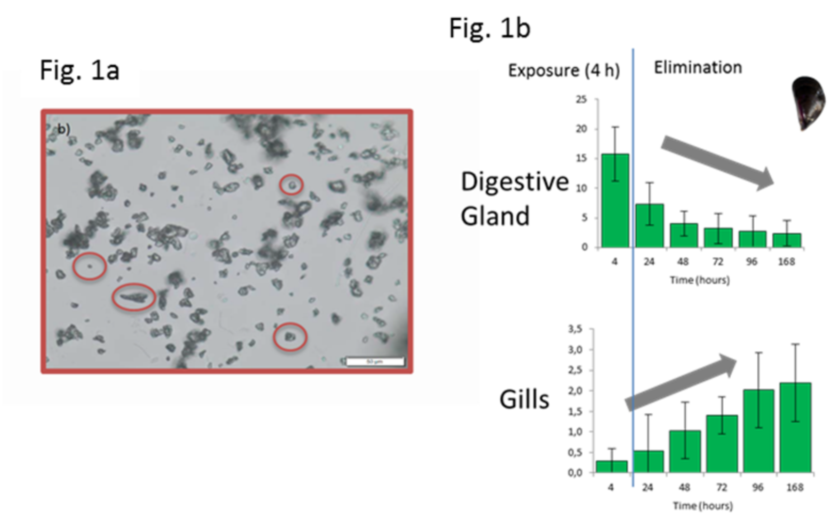


Fig. 1a Fig. 1b

- MP may act as vectors of pollutants but they **do not increase bioavailability** and effects of model chemicals **compared to natural particulate matter**. Fig. 2 shows an example studying the accumulation in the mussel of the hydrophobic organic pesticide chlorpyrifos in absence of particles and in presence of microalgae and microplastics.

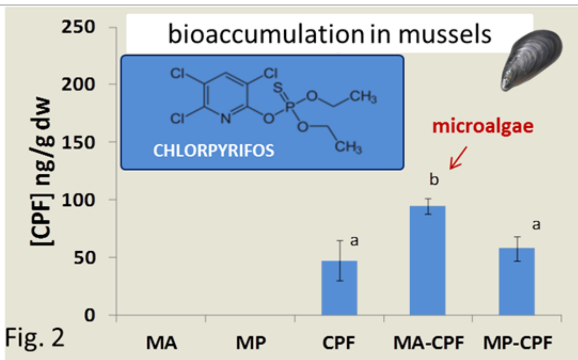


Fig. 2

- Conventional acute toxicity end-points are not sensitive enough and not appropriate for MP Risk Assessment, which should be based on long-term **reproductive**, **immune** and **behavioural** endpoints.

Microplastics may affect **oxidative stress** and **modulate the effects** of other chemical contaminants.

Although polymers are generally inocuous, **chemical additives** may pose ecological risk.

EPHEMARE developed **methods** (Fig. 3) based on chronic effects from early life stages of fish **suitable to assess the toxicity of microplastics**. Those methods can be useful for both **industry** (to develop environmentally friendly materials) and **regulatory agencies** (e.g. ECHA).

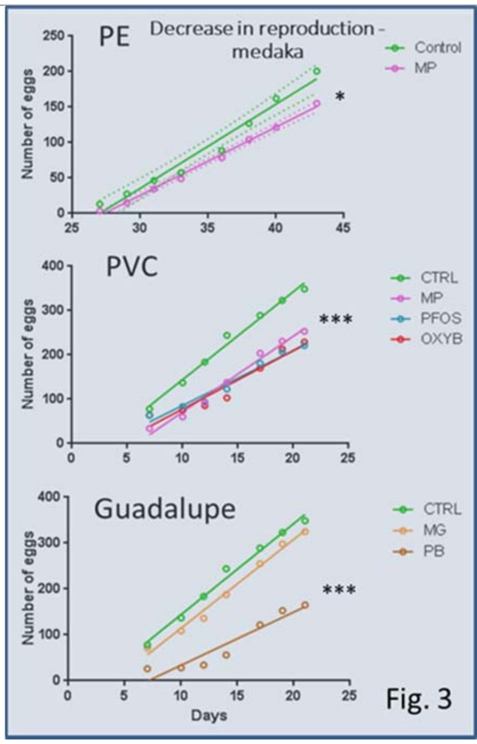


Fig. 3

PART A - SCIENTIFIC REPORT

INTRODUCTION AND AIMS OF THE PROJECT

Global plastic production continues to rise, and both solid waste mismanagement and direct disposal in the environment both contribute to between 4.8 and 12.7 million tons of plastic litter entering the global oceans annualy (Jambeck et al. 2015). Conventional olefinic polymers are not biodegradable and bear the potential to persist in the sea for hundreds of years. However release of plasticizers combined to photoxidation and physical abrasion lead to fragmentation of plastic objects in pieces of increasingly small size (Barnes et al. 2009). This "invisible marine litter" is not monitored using the standard 300 microns nets commonly used in oceanography, but is readily ingested by zooplankton and filter-feeders, thus entering the marine trophic webs (Setälä et al. 2014).

MPs were originally defined as those plastic fragments that are difficult to see at naked eye (<5 mm). MPs originating from physical degradation of larger plastic objects are called secondary microplastics, whereas those used for certain applications, such as personal care products, already commercialised in small particles are termed primary microplastics. Plastics have the potential to sorb hydrophobic pollutants and concentrate them into particles ingestable by biota. Thus, the potential role of plastic particles as vectors of chemicals to organisms has been pointed out since the first studies on marine plastic pollution (Carpenter et al. 1972).

Although conventional polymers are non-reactive and with little toxicity, plastic objects bear in their composition a wide range of chemical additives intended to provide the commercial objects with the properties demanded by the market, including flexibility, physical robustness, resistance to oxidation and chemical insult, resistance to light and heat, non-flammability, color, lack of static electricity, etc. Unlike textiles or food, the composition of a commercial plastic in terms of chemical additives is not disclosed to the consumer. Some chemical additives have been associated with bioaccumulation, biomagnification and endocrine disruption and have been phased out (e.g. polybrominated diphenyl ethers) or restricted from uses such as toys or children feeding bottles (e.g. Bisphenol A, orthophthalates, chlorinated organophosphorus flame retardants). Anyhow, the toxicity of chemical additives to marine organisms remains largely unknown.

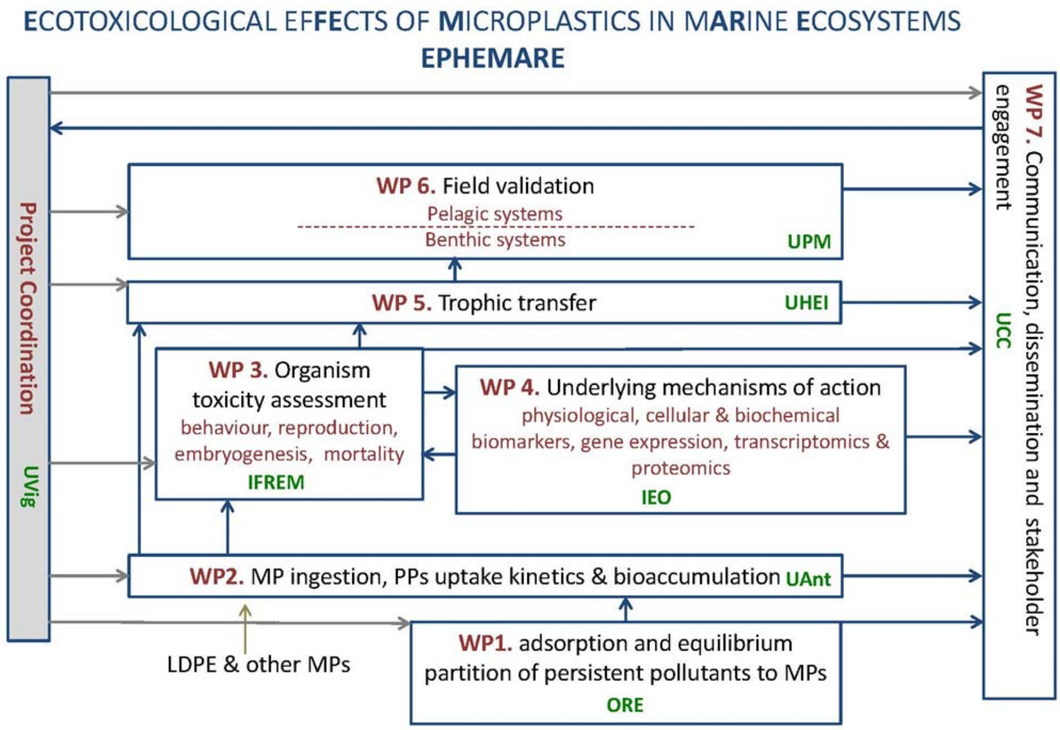
EPHEMARE, dealing with the ecotoxicological effects of microplastics in marine ecosystems, was an experimental project based on standard test species of recognized usefulness in aquatic ecotoxicology, combining internationally accepted standard methods with innovative end-points and test species in order to contribute cutting-edge experimentation specifically focused on the toxicity of plastic particles. EPHEMARE included a wide selection of biological models (from bacteria and primary producers to invertebrates and fish), experimental conditions (cell culture, in vivo laboratory exposure, field studies), and levels of biological organization (from molecular effects to cellular, physiological and organism responses) integrated in a holistic approach. The composition and capacities of the partnership allowed in-depth studies on fundamental mechanisms underlying these effects across the main phyla of marine organisms. Integration of investigated models, biological effect and exposure conditions makes the ecotoxicological data obtained useful for ecotoxicological risk assessment of environmental microplastics, derivation of environmental quality standards, environmental protection regulations and advise for a correct management of marine environments by national and international authorities.

Generally, the objective of EPHEMARE was to investigate the uptake, tissue distribution, final fate and effects of microplastics in organisms' representative of pelagic and benthic ecosystems by achieving the following main objectives:

- To examine the potential role of MPs as vectors of model pollutants that readily adsorb to their surfaces.
- To assess by means of internationally accepted standards and methods whether MP exposure 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 (risk assessment, environmental quality standards) and aquatic (WDF, MSFD) environmental regulations.
- To raise public awareness on the risk that the less visible plastic particles pose to marine ecosystems and, eventually, human health.

To achieve these general aims, EPHEMARE was structured in 7 tightly interconnected WPs:



The goals of EPHEMARE are specifically targeted through its WP structure:

- **WORKPACKAGE 1** aimed to investigate the **sorption equilibrium kinetics** of model pollutants to MPs, in order to test the potential role of MPs as vectors of marine pollutants. This WP **supplied the testing materials** used in the remaining WPs for the uptake, toxicity and trophic transfer studies. Particles of low-density polyethylene (LDPE) and other selected polymers with suitable size and shape were incubated in the presence of model contaminants, prioritizing hydrophobic chemicals posing environmental risk in coastal environments. The use of environmentally irrelevant microspheres was avoided. For each chemical adsorbed to the model particles, two concentrations were prepared and confirmed by up-to date chemical analyses of liquid and solid phases.
- **WORKPACKAGE 2** aimed at measuring the **uptake, elimination and accumulation** rates of small sized MPs (virgin and spiked) across the main phyla of marine organisms covering most trophic levels, from bacteria to fish. Model species included heterotrophic bacteria (*Vibrio fischeri*), unicellular algae (*Tetraselmis chuii*), rotifers, cnidarians (*Aurelia* sp.), copepods (*Acartia* sp.), bivalves (*Mytilus* spp, *Scrobicularia plana*), echinoderms (*Paracentrotus lividus*), and fish (the common goby *Pomatoschistus microps*, European Sea Bass

Dicentrarchus labrax, or zebrafish). Both acute and chronic experimental exposures sought to enhance sensitivity and to mimic ecologically relevant conditions. The experiments and results were directly linked to the work performed in WPs 3 to 6 which deal with effects at various levels of structural and functional organization including trophic transfer and field exposure.

- **WORKPACKAGE 3** aimed to evaluate the **effects** of MPs and sorbed contaminants on several key physiological functions for recruitment: **survival, growth, reproduction** (including sexual differentiation and maturation), **embryo-larval development**, and **behavior**, which allow assessing the abilities of individuals to explore their environment, to find food and partners. Exposures were performed according to procedures agreed by consensus among partners and for some models validated in intercomparison exercises. Data obtained were fit to dose-response models and toxicity thresholds (NOEC/LOEC, EC_{10}) were calculated using standard statistical procedures.
- **WORKPACKAGE 4** aimed to investigate the **underlying toxicity mechanisms** at molecular and cellular levels, using **biochemical, cellular and physiological biomarkers**, from gene expression to energy balance. In addition to the in vivo models, fish and mammalian cell lines already described above, were also used.
- **WORKPACKAGE 5** aimed to provide information as to the relevance of the public concerns about MPs bioaccumulation in marine food through **trophic transfer**. Experiments were designed to find out whether MPs accumulate along food chains and serve as vector for pollutants, thus leading to a **secondary risk** for the consumers. In a proof-of-concept approach, various simple model food chains were compared with respect to their suitability to mimic potential trophic transfer in marine ecosystems.
- **WORKPACKAGE 6** aimed to support results obtained in WPs 1 to 5 by means of validation with relevant **field data** describing the occurrence, distribution, typology and chemical loads of MPs in representative biota of different coastal areas from Mediterranean, North East Atlantic, a North Sea Fjord and a North Sea Estuary. The main species from benthic and pelagic systems were collected, including planktonic organisms, pelagic and benthonic fishes, and invertebrates. The analyzed species included most of the biological models that are characterized in laboratory conditions by WPs 2 to 5.
- **WORKPACKAGE 7** aimed to **communicate and disseminate projects findings** and outputs to relevant stakeholders and general public to increase **awareness** on MPs and associated concerns. Especial attention was paid to produce results useful for public authorities in charge of the implementation of **European Directives** (e.g. **MSFD**) and environmental regulations (e.g. **EU Plastic Strategy**) , the private sector including **industry** seeking environment-friendly alternative polymers, and companies involved in selling and development of instruments for environmental monitoring of MPs.

RESULTS AND DISCUSSION

WORKPACKAGE 1 – ADSORPTION & EQUILIBRIUM PARTITION OF POLLUTANTS TO MPs

The following partners are involved: ***Partner 2, Partner 6, Partner 11*** *(Leader)*

- Biochemodynamic models of metal ion binding to micro- and nanoplastics predict high variability in the relevance of MP as vectors of metals depending on particle composition, size and concentration, but for filter feeders, e.g., mussels, metals released from ingested plastic particles may be significant as compared to metal exposure via the water phase. Considering a typical marine exposure scenario with 0.1 nM of **cadmium** (Cd) and MP in the range 1–100,000 particles per m^3, a mussel with a filtration rate of order 2 L per hour per individual would be exposed to 0.2 nM of Cd per hour via the aqueous phase, and potentially 10^{-5} to 1 nM per hour via ingested MPs (**Town et al. 2018**).
- However, in experimental work conducted by **Partner 11 (on prep.)** it was not possible to reach sorption of Cd to MP after 7 days of exposure under any conditions tested. Rochman et al. (2013) showed that after 12-month exposure of MPs in San Diego Bay a complex mixture of metals, including Cd, can be found on LDPE and PVC. Thus, long-term exposure, different water conditions and weathering may facilitate sorption of Cd on MPs.

- **Mercury** (Hg) was readily sorbed onto LDPE particles, but 70% of the Hg incorporated through MPs were quickly eliminated in the biodeposits. After 7 days depuration, mussels exposed to Hg through MPs showed 235 µg Hg per individual, whereas those exposed to Hg via microalgae of similar size retained 701 µg Hg per individual. Thus, the potential of Hg to bioaccumulate was lower when it was sorbed onto MPs than when it was sorbed onto other seston particles as phytoplankton (**Rivera-Hernández et al. 2019**).
- Concerning the sorption of organics, the following chemicals were tested: **benzo-a-pyrene** (BaP), **oxybenzone** (BP3), **perfluorooctane sulfonate** (PFOS), and **chlorpyrifos** (CPF), and the results are summarized below.
- **PFOS** sorption was linear over 6 months, while BaP adsorbed onto particles decreased over the same period. Decrease of **BaP** levels might be due to its low persistency in water by photodegradation and biodegradation, and its potential sorption to glassware. The investigation of size effect of particles demonstrated an increase of PFOS sorption with a decrease of the size particle (increase of surface area). Sorption of **BP3** on LDPE showed that, unexpectedly, the smaller the particles the less BP3 was adsorbed on the LDPE. Sorption of BaP was not modified by the size of microparticles. Results demonstrated that sorption processes depend on the type of contaminant (e.g. functional groups) but may also depend on the size range of microparticles (**Cormier et al., in prep.**).
- **CPF** very rapidly sorbed to LDPE microparticles, consistently with the high Kow of this chemical. After just 2 h of incubation, more than 70% of CPF was adsorbed onto plastic surfaces. The sorption of CPF to the plastic particles reduced the bioavailability of this chemical to the microalgae. As a consequence, CPF toxicity decreased. For a given CPF dose, the presence of MP decreased by ca. 40% cell growth inhibition (**Garrido et al. 2019**).

Discussion

In our adsorption experiments, BaP in solution was above solubility, and we assume that sorption capacity and sites of the particles were rather quickly occupied, resulting in a decrease in the sorption efficiency of BaP to smaller MP; i.e., the effect of particle size could be suppressed by a quick sorption of available BaP at the surface of the particles (Abdullah et al. 2009). For sorption of BaP on PVC the double amount of BaP in solution was required. PE has a larger Brunauer-Emmett-Teller (BET) surface area than PVC, which may explain a higher sorption affinity for BaP on LDPE. Wang and Wang (2018) showed a similar sorption affinity of the PAH pyrene to PE and PVC. Long-term sorption experiment with BaP on LDPE showed that after a first increase of sorption the concentrations of BaP on LDPE declined until the end of exposure. However, the experiment was conducted under non-sterile conditions at room temperature, and degradation processes cannot be excluded. In contrast to BaP, PFOS sorption was like expected, and less PFOS in solution was necessary to reach the same concentrations on the different size classes of LDPE. In addition, our results suggest that PFOS has a higher sorption rate on PVC compared to LDPE; however, particle sizes were different. Wang et al. (2015) showed a higher sorption rate for PFOS on PVC as well after 7 days of exposure, which was explained by a lower electrostatic repulsion between anionic PFOS molecule and PVC surface. However, the results of the present long-term sorption experiment showed a great increase of PFOS sorption on LDPE after 90 days suggesting that surface properties of the tested plastic material changed over time.

Overall, the experimental results obtained in WP1 show that under the conditions tested sorption processes of environmental pollutants depend on the chemical properties of the compounds, the plastic material and particle size, and resulting sorption kinetics are very different (Llorca et al. 2018, Wang et al. 2015). In addition, sorption behavior under environmental relevant conditions will change as weathering, conductivity, pH and salinity of the surrounding water will change surface properties and sorption, respectively. Therefore, suggesting rather complex and dynamic sorption, desorption and degradation processes of pollutants on MPs and depending most likely on local environmental conditions (Andrady 2011, Brandon et al. 2016, Llorca et al. 2018, ter Halle et al. 2017).

WORKPACKAGE 2 – MP INGESTION, UPTAKE KINETICS & BIOACCUMULATION

The following partners are involved: ***Partner 2, Partner 3, Partner 6*** *(leader),* ***Partner 7, Partner 9, Partner 10, Partner 14***

NO FEEDERS

- No physical interaction or interiorization of MPs was observed for fish cell lines (Romero et al. 2018), or head-kidney leukocytes (HKL) (**Espinosa et al. 2018**).
- *T. chuii* exposed to MP (fluorescent red plastic microspheres 1-5 µm diameter) produced exudates, and heteroaggregates including microalgae exudates, MP, algae cells and cell fragments were formed in test medium. MP were observed on the external wall of the microalgae cells but the observations were inconclusive regarding the presence of MP inside the cells (**Prata et al., 2018**).

FILTER FEEDERS

- When mussels are exposed to MP and microalgae of similar size, there are no differences between the **uptake kinetics** for both types of particles, and a similar filtering rate was recorded. Mussels readily egest the ingested MP. After 120 h exposure, mussels had egested around 80% of the MP ingested. The highest volume of MP **egested** was quantified in faeces recovered within 24 h upon exposure. Subsequently (until 48 h and 120 h of the exposure), a lower volume of MP was recorded in faeces. The higher the average diameter of the MP particles the quicker they are egested, with the highest diameter tested (ca. 10 µm) being observed in MP particles egested after just 4 h of the exposure. After 120 h, from 2 to 6% of the MP ingested was **accumulated in the digestive gland**. The diameter of this particles (ca. 3 µm) was significantly lower than the mean size of the MP offered (8 µm), which suggested a specific removal through faeces of larger MP particles and the retention of smaller ones in the digestive system. Moreover, MPs are translocated from digestive gland into the gills (smaller ones) (**Fernández & Albentosa, 2019a,b**).
- When the dosed MP are previously spiked with CPF, mussels accumulated CPF in a different way depending exposure pathway, with a higher **bioaccumulation** when the chemical is offered **through microalgae**. Furthermore, mussels exposed to dissolved CPF accumulated also less CPF than when the pollutant is transported through the food. It might be concluded that microplastics may act as vectors of pollutants but in a similar way (or even less) as other particles of the seston (Albentosa et al. 2017).
- When mussels are exposed to Hg either dissolved or through previously spiked MP and microalgae, Hg is incorporated via digestive system when exposure is made through particles (both microalgae or MP). On the contrary, waterborne Hg is incorporated via epithelial tissues (gill and mantle). 70% of the **Hg incorporated through MPs is eliminated by the faeces**. However, when Hg is incorporated from microalgae or dissolved, it is mainly maintained in the mussel tissues. For small (<2 µm) MP, a **translocation** from the input tissue (gland and gill) to other tissues (rest and gland) has been observed (**Rivera-Hernández et al. 2019**).
- Partner 10 joint WP2 working with *Scrobicularia plana* clams. When clams with background BaP <1.6 ng g^{-1} dw were exposed to BaP-spiked MP for 14 days, a significant increase in clam tissue BaP compared to control and virgin MP treatment was obtained, reaching 7.3 ± 2.0 ng g^{-1} dw and proving the **transfer of BaP from the plastic to the organism**. This was not the case of BP3, where final body burdens in control and BP3-spiked MP treatments were 23.3 and 15.3 ng g^{-1} ww respectively (**O'Donovan et al. 2018**).
- E-SEM imaging of tissues of MP-exposed mussels was optimized (Partner 6, on prep.).
- *Daphnia magna* was found to take up MP (fluorescent red plastic microspheres 1-5 µm diameter) from test medium; MP were found in the gut, gills and also in the brood chamber. MP elimination from the gut occurred. In acute 96-h and 21-d bioassays (see WP3), *D. magna* specimens were exposed to MP (industrial plastic pellets, LDPE, 125 - 250 µm), virgin LDPE and LDPE contaminated with PFOS (LDPE-PFOS). The results indicated that LDPE-PFOS release PFOS to test medium and that PFOS was up taken from test medium by *D. magna*. MP size, MP concentration, particles aggregation, organism size, among other factors, influence uptake and elimination of MP by *D. magna* (Lopes 2016; **Pacheco et al. 2018; Pacheco et al. in prep.**).

PREDATORS

- In fish exposed to MP, histopathological and morphometric analysis of the intestine and liver resulted in certain levels of damage including liver disorganization and hepatocyte vacuolation as well as goblet cell number and villus alterations. Adsorption of pollutants to MPs did not increase the histopathological effects. No MPs were observed into the tissues (Partner 3, on prep.).

- A novel technique to investigate MP uptake and distribution throughout fish organs was developed. The **Nile Red** dyed MPs retain their fluorescence after ingestion by experimental organisms. In order to evaluate if this method was relevant to monitor labeled MPs in vivo, we have fed zebrafish and marine medaka larvae with PE, PVC and PS MPs labeled with Nile red. We were able to follow efficiently in vivo the ingestion and transit of all these MPs using fluorescence microscopy (**Batel et al. submitted**).
- Juveniles (2 cm length) of the fish *P. microps* **ingested** 1-5 µm and 420-500 µm MP (white, red and black microspheres, diameter). MP **elimination** occurred in ≥ 4 h. Red MP lost their red colour while in the gastrointestinal tract, indicating release of the dye from MP inside the fish gastrointestinal tract. 1-5 µm MP were found in the gastrointestinal tract where particles aggregates were formed. Large aggregates were retained for at least 96 h, whereas isolated particles and some small aggregates were eliminated more rapidly. MP were also found in gills, and evidences of particles presence in dorsal muscle and liver were obtained. MP exposure concentration, MP type and size of the fish influence MP elimination from the gut. *P. microps* juveniles exposed for 96 h to PFOS alone or to LDPE-PFOS were found to have PFOS in their body up to 2.4 ± 0.4 ng/g and 1.4 ± 0.2 ng/g, respectively (**Vieira et al. in prep.**).

Discussion

Marine animals, including filter feeders, deposit feeders and predators, actively ingest MP within the size range of their common food, but they also readily egest them through the faeces (for invertebrates Tosetto et al. 2016, **Fernández & Albentosa 2019a**; for fish Mazurais et al. 2015), and generally no bioaccumulation is observed. Biodynamic models also support this conclusion. For example, for the case of mussels, calculations performed starting from the EPHEMARE results, using a model which integrated parameters such as average filtration rate and average MP concentration in coastal waters, resulted in mussels having an average MP load of 2.4 and 3.6 MP ingested/individual/3 h for *M. edulis* and *M. galloprovincialis* respectively living in the water column. These values compare well to observed MP load per mussel (calculated from records present in literature), which amount to 2.9 MP/individual (excluding microfibres, which frequently come from laboratory contamination of the samples). We must bear in mind though that standard field studies rarely detect small MP due to technical limitations and too time consuming procedures. Therefore, experimental evidence and field observtaions in general do not support accumulation of MPs in organisms exposed to present environmental concentrations. Nevertheless, measures must be taken to decrease MP input in the marine environment, in order to not increase the MP/plankton ratio – the predictions calculated within this study in fact are significant only with present environmental concentrations; if these will increase dramatically in the near future, the threat to filter-feeding biota will indeed become significant.

WORKPACKAGE 3 – ORGANISM TOXICITY ASSESSMENT

The following partners are involved: ***Partner 1, Partner 2, Partner 4, Partner 5, Partner 8, Partner 9, Partner 10, Partner 11, Partner 12, Partner 14*** *(leader)*

NO FEEDERS

- In an intercollaborative study conducted after methodological harmonization among 4 EPHEMARE partners, **no acute toxicity** of LDPE MP was found on *V. fisheri* bacteria or *P. tricornutum* microalgae at levels orders of magnitude above environmentally relevant concentrations. Therefore, no expected environmental risk of those MP on metabolism of heterotrophic marine bacterial or microalgal photosynthesis in the sea. These findings also highlight that the current approach for MP risk assessment in current toxicity tests used by environmental regulators should be revised, by providing alternative endpoints to be included in standardized protocols suitable to monitor the fate and biological effects of MPs (**Gambardella et al. 2019**).

- PE contaminated with PFOS has lower LOEC and NOEC when compared to the non-contaminated PE, which apparently has no negative effect in *V. fisheri*.
- Microalgae **growth was not affected** by the MP, until 25 mg l^{-1}. On the contrary, growth was clearly affected by the exposure to CPF from 2 mg l^{-1} onwards, with a total growth inhibition at concentrations upwards of 3 mg l^{-1}.

After incubation, 80% of CPF was sorbed onto MP surfaces. CPF bioassays showed two different dose-response curves depending on the presence of MP, with lower percentages of inhibition when CPF is offered through to MP. Thus, the adsorption of CPF onto **MP** surfaces **reduced its bioavailability** and toxicity to microalgae (**Garrido et al. 2019**).

- Using the microalga *T. chuii*, no significant differences in the algal growth rate were found up to 41.5 mg MP/l (LOEC > 41.5 mg/l). To investigate the potential effects of MP on the toxicity of chemical pollutants, bioassays were performed using two pharmaceuticals. Procainamide alone significantly reduced *T. chuii* growth rate with a 96h-EC_{50} = 104 mg/l, and chlorophyll content with a 96h-EC_{50} = 143 mg/l, 95 %. Doxycycline alone significantly reduced *T. chuii* average specific growth rate with a 96h-EC_{50} = 22 mg/l, 95 %, and chlorophyll content with a 96h-EC_{50} = 14 mg/l. In the presence of MP, the 96h-EC_{50} values for chlorophyll content significantly decreased to 31 mg/l (95 % CI: 11.8 – 78.7) for procainamide, and 7 mg/l (95 % CI: 3.8 – 11.7 mg/l) for doxycycline. Overall, the results indicate that the MP tested had relatively **low toxicity** to *T. chuii* but when in mixture with procainamide or doxycyline **MP increased the toxicity of both pharmaceuticals** to *T. chuii* (**Prata et al. 2018**).
- Overall the results indicate that conventional acute toxicity end-points are not sensitive enough and not appropriate for MP Risk Assessment.

SMALL FILTER FEEDERS

- In a large collaborative effort among 6 EPHEMARE partners, toxicity of polyethylene (PE) MP of size ranges similar to their natural food to zooplanktonic organisms representative of the main taxa present in marine plankton, including rotifers, copepods, bivalves and echinoderms was evaluated. Early life stages (ELS) were prioritized as testing models in order to maximize sensitivity. Test species included the rotifer *Brachionus plicatilis*, the crustaceans *Tigriopus fulvus*, and *Acartia* sp., and larvae of the sea urchin *Paracentrotus lividus*. Planktonic ELS of the fish *Oryzias melastigma* were also used. Treatments included particles spiked with benzophenone-3 (BP-3), a hydrophobic organic chemical used in cosmetics with direct input in coastal areas. Despite documented ingestion of both virgin and BP-3 spiked microplastics **no acute toxicity** was found at loads orders of magnitude above environmentally relevant concentrations on any of the invertebrate models, although some developmental defects were observed in fish ELS. The results obtained do not support environmentally relevant risk of microplastics on marine zooplankton (**Beiras et al. 2018a**).
- In zooplankton (including not only filter feeders but also predators), the **swimming and feeding behavior** alteration endpoints seem to be particulary sensitive to low levels of MP (**Gambardella et al. 2018**). For example, **pulsation rate** of ephyra stage of two **jellyfish** species, *Aurelia* sp. and *Sanderia malayensis*, resulted to be affected by environmentally relevant concentrations of MP (Costa, 2018).
- Despite active ingestion of MP by *P. lividus* sea-urchin and *A. clausi* copepod larvae, the presence of MP did **not increase the toxicity** of a hydrophobic organic chemical, the 4‑n–nonylphenol (NP) to these sensitive ELS (**Beiras & Tato 2019**).

- **Non-significant effects** of virgin MP were observed on the embryonic development of the Mediterranean mussel. Microplastics spiked with phenanthrene or with BP3 were not toxic at the tested concentrations (from 0.004 to 10 mg microplastics/L), with respect to water or microplastics controls. However, MP spiked with CPF (0.1-0.6 mg MP/L) or with Hg, caused a significant increase in the percentage of abnormal mussel embryos and larvae (LOEC: 0.2 mg MP/L and 1 mg MP/L, respectively). The **remarkable toxicity of MP spiked** with CPF and Hg could be either attributed to the desorption of the toxicant from plastics to water, or to the bioavailability of the toxicant adsorbed to the microplastics. Moreover, in the case of CPF, the presence of virgin MP in the experimental vials was found to significantly **increase the toxicity** of dissolved CPF to mussel embryos (LOEC = 200 µg/L). Further work is being carried out to complete chemical analyses of spiked MP in order to clarify the causal mechanism of the observed toxicity (Bellas et al. 2018).
- *D. magna* 21-day chronic bioassays were carried out to investigate the effects of MP (1 – 5 µm), gold nanoparticles (Au NP), and their mixtures. Mortality, mobility and reproductive fitness endpoints were investigated. MP induced reduction of reproductive fitness with LOEC = 0.02 mg/l. Au **NP were more toxic than MP**, and reduced the reproductive output with LOEC = 0.2 mg/l. In some parameters, the effects of mixtures were higher than the effects induced by MP or Au NP alone. Thus, MP increased the chronic toxic effects of Au NP (**Pacheco et al. 2018**).

- Another collaborative experiment was conducted among 3 EPHEMARE partners using *D. magna* to investigate the acute and chronic effects of LDPE (125 - 250 µm) virgin and spiked with PFOS (LDPE-PFOS). After 96 h of exposure, LDPE did not induce significant mortality (NOEC = 51.2 g/l; LOEC > 51.2 g/l), likely because juveniles did not intake MP due to their size. In the LDPE-PFOS bioassay, the PFOS concentrations measured by chemical analysis in test medium ranged from 1.5 to 146 µg/l. The results already obtained indicate **no acute toxicity of LDPE** to *D. magna*, and that LDPE-PFOS toxicity is mainly due to the **release of PFOS** from the LDPE to test medium followed by PFOS uptake from test medium by *D. magna* juveniles. After 21 days, LDPE did not induce reproductive or growth effects (NOEC = 3.2 g/l). **Waterborne PFOS impaired reproduction** of *D. magna* by significantly increasing the time of first brood release (LOEC = 0.138 µg/l), and decreasing the number of mobile juveniles (LOEC = 0.138 µg/l) at least partially due to the production of immobile juveniles. LDPE-PFOS caused several reproductive adverse effects, including the significant reduction of the number of mobile juveniles produced per female. Overall, these findings indicate that the **LDPE** shows **low toxicity** to *D. magna* but when contaminated with PFOS they are able to release PFOS to the water and this chemical caused reproductive adverse effects (**Pacheco et al. in prep**).

- Overall, the results obtained with phytoplankton and the main phyla composing the zooplankton challenge the hypothetical role of MP as vectors of hydrophobic contaminants to plankton, and point at a low environmental risk of current MP levels to the base of the marine food webs.

LARGE FILTER FEEDERS AND DEPOSIT FEEDERS

- Long-term effects of MP were investigated using the sediment-dwelling bivalves *Ennucula tenuis* and *Abra nitida*. MP extraction from the organisms showed that MPs were **ingested** at all concentrations tested. Despite MP ingestion, **no effects were observed on mortality, condition index or burrowing behaviour** for any treatment. However, significant changes in energy reserves were observed, and total **energy reserves decreased in bivalves exposed to the largest particles** (125 – 500 µm) (**Bour et al. 2018a**).

- For the long-term effects on *Arenicola marina*, no mortality was observed for any condition tested. There were significant differences in feeding behaviour between control and exposed organisms, and decreasing feeding activity over time. MP extraction from organisms and faecal casts show significant ingestion and excretion of MPs. Results on long-term effects on *A. marina* show no changes in energy reserves for any condition tested (Partner 12, unpulished).

PREDATORS

- Fish embryos of marine medaka were exposed from 1 to 13 day-post fertilization (dpf) under slight agitation (27 rpm). Exposure to BaP-spiked MPs **did not induce acute toxicity**. Exposure to PFOS-spiked MP significantly **reduced hatching success** at PFOS “high” 10 mg MPs/L concentration compared to the equivalent virgin MP or waterborne exposure to 556 ng PFOS/L (Fig. 1). Exposure to BP3-spiked MPs significantly reduced hatching success at BP3 “low” 1 mg MPs/L concentration compared to equivalent virgin MP or waterborne BP3 at 0.024 g/L. Waterborne BP3 exposure induced a non-linear dose-response. Exposure to BaP and PFOS coated MPs at 1 mg MP/L did not induce developmental toxicity at both concentrations. However, exposure to BaP-coated MP at 10 mg MP/L **reduced larvae** head **length**, total length and induced **morphological abnormalities** at hatching. Larvae exposed to 24 ng BP3/g of MP also displayed changes in head size at 1 and 10 mg/L and significant increase of deformities at 0.14 ng BP3 / g of MP. For BaP and BP3 exposure main deformities observed were yolk edemas and skeletal curvatures. Exposure to PFOS coated MPs did not alter swimming activity of fish larvae. However, exposure to BaP coated MPs induced hypoactivity of the fish in particular at the highest tested concentration. Exposure to BP3 coated MPs also altered fish behavior with hyperactivity reported both after OFFSET (dark period) and ONSET (light period) at 0.14 ng BP3 / g of MP as illustrated in figure 4B. No significant disruption of the swimming activity was observed at higher exposure concentration of BP3 (**Le Bihanic et al. submitted**).
- Studies with zebrafish ELS were used to test different types of polymers and associated pollutants, to reveal accumulation patterns, and to test the potential role of MP as vectors to zebrafish. An **interlaboratory study** was performed (involving Partners 4, 5, 11 and 14) to test suitability of acute test proceudre (OECD TG 236). In all

experiments, no morphological effects were visible in fish embryos, indicating that there was **no acute toxicity**. CYP 1A induction, neurotoxicity and behavioral changes were observed; however, these changes were only minor, if compared to positive controls or water-borne exposure routes. MP exposure does not seem to induce strong acute toxicities in these sesnsitive models; yet, **chronic** long-term analyses such as **fish early life-stage tests** (OECD TG 210) supplemented by additional endpoints including monitoring of EROD activity, cyp1a gene transcription and swimming behavior of larvaeare more promising as tools to test MP effects (**Cormier et al. submitted**).

- Bioassays with *P. microps* juveniles were carried out testing the effects of MP (0.184 mg/l), cephalexin (1.3, 2.5, 5 and 10 mg/l), their mixtures, and temperature rise (20 ± 1ºC and 25 ± 1ºC). MP induced mortality was 8 % at 20ºC and 33 % at 25ºC. Therefore, **temperature rise increased the toxicity of MP**. The EC_{50} of cephalexin alone was 3.8 mg/L (95% CI 3.00 – 4.74), increasing to 5.2 mg/L (CI 5.11 – 6.96) in the presence of MP. This indicates a slight **reduction in the toxicity of the antibiotic due to the MP** particles (**Fonte et al. 2016**).
- *P. microps* juveniles from two populations (Minho and Lima estuaries) were used to investigate the acute effects of 1-5 µm PE MP (0.14 mg/l), cadmium (3 to 50 mg/l), and their mixtures. Regarding mortality, no significant differences between populations or between the mortality induced by cadmium alone and in mixture with MP were found (overall 96h-LC50 = 8 mg/l). Cd alone and in mixtures with MP significantly decreased the predatory performance of juveniles from both populations (Minho estuary fish LOEC = 6 mg/l: Lima estuary fish LOEC = 3 mg/l). Evidences of antagonism (i.e. **reduction of Cd toxicity in the presence of MP**) were found (**Miranda et al. submit**).
- *P. microps* juveniles were also used (in collaboration with the Örebro University, the Antwerp University and the University of Vigo), to test the effects of LDPE (125 - 250 µm diameter), LDPE-PFOS and waterborne PFOS. **No effects on mortality** were found within the range of concentrations tested after 96 h of exposure to LDPE (NOEC = 80 mg/l), LDPE-PFOS (NOEC = 80 mg/l LDPE + 4.5 µg/l PFOS) or to PFOS (NOEC = 4.5 µg/l). Concerning swimming performance, toxicity thresholds were the following. LDPE: LOEC = 40 mg/l; PFOS: LOEC = 1.1 µg/l; LDPE-PFOS: LOEC = 40 mg/l LDPE + 2.2 µg/l PFOS. Therefore, **LDPE did not modify PFOS toxicity** (**Vieira et al. in prep**).
- Overall, the findings of the studies with *P. microps* juveniles indicated that different types of MP disrupt the behaviour of juveniles, with inhibition of the predatory performance and swimming velocity that are crucial to individual fitness and individual contribution to population growth rate. MP modulate the toxicity of other contaminants, whereas temperature and other biotic and abiotic factors influence MP toxicity and the toxicological interactions of MP with other environmental contaminants.
- Long-term dietary exposures to MP were realized both in marine medaka and in zebrafish and resulted in **reduction of female growth at 4.5 month** (decrease of 10 to 18% depending on MPs compared to control and on species) and a significant **decrease of the reproductive output** was observed when fish were exposed to MPs alone (PVC) or MPs spiked with either PFOS or BP3 (PE and PVC). Survival of offspring of marine medaka was not significantly modified whatever parental exposure but PE-BP3 larvae were smaller at 12 dpf. For zebrafish, a higher larval mortality was observed as well as behavioural defects in PVC-BP3 and Guadalupe collected MPs.

Discussion

Lethal or acute effects of MP at environmentally relevant concentrations have not been observed. MP can though modulate the effects of chemical pollutants in a way similar to natural particulate matter. Modeling these effects in the environment is complicated by the different properties of polymers, additives, sorbed contaminants, biofouling, weathering, etc.

Although testing was conducted also with PVC, PS and some other materials, EPHEMARE focused mainly on the most common polymer in the marine environment, PE. Lithner and co-workers (2011) ranked polymers based on monomer hazard classification, and PE was classified as one of the less hazardous polymers both for humans and the environment. However, whereas the present Project failed to show acute toxicity of PE particles to early life stages of zebrafish, slight alterations of the hatching rate were observed after exposure to MPs contaminated with BP3. A similar experiment using embryonic stage of the marine medaka (*Oryzias melastigma*) exposed to 10 mg/L microplastics spiked with the same concentration of BP3, revealed premature hatching and a **significant decrease in hatching rate** (**Beiras et al. 2018**). The same authors also demonstrated a direct contact of microplastics to villi at the surface of the medaka chorion, which may facilitate the uptake of toxicants. Although villi or similar structures do not exist on the chorion of zebrafish embryos, **Batel et al.** (**2018**) were successful in demonstrating the transfer of benzo[a]pyrene from externally adhering MP particles to zebrafish embryos across the chorion. Regardless, the exposure time might represent another factor for the different responses between both species as it was shown for Japanese medaka and zebrafish (Perrichon et al. 2014). For marine medaka, the embryonic stage lasts until days 10 to 11 dpf (Inoue and Takei, 2002), whereas this period is restricted to 48 to 72 hpf in zebrafish, depending on the temperature (Kimmel et al. 1995). **Short term dietary exposures produced no modification** of any of the measured endpoints (survival, growth, larval photomotor response, EROD, cyp1a induction) in marine medaka. Conversely, **long-term dietary exposures** were realized both in marine medaka and in zebrafish and **resulted in reduction of female growth** at 4.5 month (decrease of 10 to 18% depending on MPs compared to control and on species) and a significant **decrease of the reproductive output** was observed when fish were exposed to MPs alone (PVC) or MPs spiked with either PFOS or BP3 (PE and PVC). Survival of offspring of marine medaka was not significantly modified whatever parental exposure but PE-BP3 larvae were smaller at 12 dpf.

Therefore, **future investigations on MP effects in fish starting from ELS should consider subchronic or even chronic exposures**. Long term growth from embryo to juveniles seemed to be a sensitive endpoint suitable to assess MP risk using fish.

WORKPACKAGE 4 – UNDERLYING MECHANISMS OF ACTION

The following partners are involved: ***Partner 1, Partner 2*** *(leader),* ***Partner 3, Partner 4, Partner 5, Partner 7, Partner 10, Partner 9, Partner 11, Partner 12, Partner 14***

CELL LINES AND BACTERIA

- Sea bass brain cells (DLB-1) supplied by the University of Murcia and rainbow trout liver cells (RTL-W1) were exposed to DMSO extract of virgin PE 20-25 µm at 1 and 10 mg/L MPs and DMSO extract of the same MPs coated with B(a)P 15.07 µg/g, PFOS 46.06 µg/g and BP-3 0.062 µg/g at 1 and 10 mg/L. Cytotoxicity, EROD activity, ROS production and DNA damage were investigated. Three replicates of each exposure were performed. **No cytotoxicity** was observed on DLB-1 and RTLW1 cells exposed to different amount of virgin or coated MPs extracts. Exposure to DLB-1 to 1 and 10 mg/L of virgin or spiked microplastics induced a low ROS production. Only a significant **ROS production** was observed after exposure to 10 mg/L of **B(a)P coated microplastics**. A significant increase in **DNA damage** was detected in DLB-1 for both DMSO extract of virgin and spiked MPs at 1 and 10 mg/L. (Partner 4, unpub.).
- In RTL-W1 cell line, a significant increase of CYP1A1 was reported for virgin microplastics at 1 mg/L and 100 mg/L. No significant CYP1A1 induction was observed for DMSO extract of MP-PFOS or MP-BP-3. A dose-dependent **increase of EROD activity** was reported for **B(a)P-MP** for RTL-W1 cells as already reported in a recent publication (**Pannetier et al. 2019a**). Concerning the transfer of sorbed chemicals, the most hydrophobic EROD inducers such as TCDD or BkF did not seem to desorb from PE MP, which argues **against the role of MP to hypothetically increase pollutant uptake** into aquatic organisms. However, the role of environmentaly relevant **surfactants** should not be overlooked (**Heinrich & Braunbeck, 2019a, b**). Investigation of other *in vitro* endpoints (genotoxicity, cytotoxicity, endocrine effects) proved non-feasible due to insufficient sensitivity of established assays.
- When pollutant-free MPs were added to cells exposed to pollutants *via* the medium, the particles reduced toxic effects, presumably *via* competition for the binding of pollutants to MPs; this effect was dependent on the pollutants' lipophilicities (**Heinrich & Braunbeck, 2019c**). Overall, results mostly agreed with integrative models on sorption of pollutants from and to MPs, the foundations of which − among other technical details − were summarized and discussed in a review article (**Heinrich & Braunbeck, 2019c**).
- Viability of sea bream or sea bass primary cultures of leucocytes (HKL), erythrocytes or cell lines (SAF-1 and DLB-1) was slightly affected by MP exposure in vitro. MP of virgin or oxidized PE larger than 20-25 µm were toxic for sea bass HKL only, but not to sea bream HKL, and never for cell lines or erythrocytes. Immunity of HKLs was not affected by either MP or MP with adsorbed PFOS. At gene level, MP failed to show inflammation but results suggest some level of cellular and **oxidative stress**. The effects of MP with PFOS were quite similar to those for only PFOS indicating **no additive toxicological effects for MP** (**Espinosa et al. 2018**).

- The *Salmonella typhimurium* strains TA98 and TA100 were used with or without exogenous metabolic activation (S9 induction by β-naphthoflavone/phenobarbital) to measure frameshift mutations and base pair substitutions, respectively. The extracts were diluted with DMSO on each plate to reach a concentration range between 62.5 µg/L and 2 mg/L MPs equivalents per test medium. Each concentration was tested in triplicate. The bacteria were diluted in exposure medium and exposed to extracts, 2% DMSO serving as solvent control, and a positive control. Mixture sample was composed of a mixture of BaP and PFOS at a concentration range from 2.19 µg/mL to 70 µg/mL for BaP, and from 9.38 µg/mL to 300 µg/mL for PFOS. LDPE and PVC without pollutants did not induce mutagenicity in the Ames fluctuation assay. Test with the BaP in solution induced significant mutagenicity at 35 to 70 µg/mL, using TA100 with exogenous metabolic activation. Similar mutagenic effects were found testing the 1:1 mixture of PFOS and BaP after exposure to the same concentrations; however, using TA98 with exogenous metabolic activation. BaP is known to induce mutagenicity after exogenous metabolic activation as S9, and it is used as positive control in the OECD 471 guideline to investigate mutagenicity of chemicals. For all other samples, **no significant mutagenic effect was detected under any conditions tested**. Therefore, the Ames test seems to be inappropriate to determine genotoxicity of contaminated MPs and further investigations may consider other bioreporter systems to detect genotoxic effects (Partner 11, unpub.).

FILTER FEEDERS

- Filtration rates and the functionality of digestive gland were affected in any of **CPF** exposures, and consequently the physiological biomarker **scope for growth** (SFG) **was reduced** (Partner 2, in prep).
- Results on long-term effects on sediment-dwelling bivalves shows significant **decrease in energy fractions** in organisms exposed to MPs, with different patterns depending on the species, MP size and concentration (see WP3) (**Bour et al. 2018a**).
- Concerning enzymatic biomarkers, **Acetylcholinesterase (AChE) activity** in digestive gland and gills was significantly **inhibited** at all **CPF** treatments, disregarding exposure time. Levels of **GST** activity in the digestive gland in the three CPF treatments (CPF, MA+CPF and MP+CPF) after 7 days exposure were significantly **higher** than levels in treatments without CPF. However, after 21 days exposure, GST activity in the controls significantly increased, and differences with controls disappeared. For GST in gills, a significant increase in activity was observed in the MP, CPF and MA-CPF treatments after 7 days, compared to the MA control. When the nine biomarkers recorded are combined using the Integrated Biomarker Response (IBR) index a similar response in the three CPF treatments is initially observed (7 d), but after 21 d an enhanced response in observed in the MA+CPF and MP+CPF treatments only. In conclusion, AChE inhibition was similar in all CPF treatments disregarding the presence of particles. However, both MP and MA particles in CPF-exposed mussels produced in the long term an increase in biomarker response compared to waterborne exposure. Therefore, **MP seem to play a similar role than natural organic particles** as vectors of organics to marine organisms (**Vidal Liñán et al. in prep.**).
- Concerning immune and cytotoxicity, we found that most of the immune activities studied (protease, peroxidase and bactericide activities) increase upon exposure to MP, disregarding the presence of CPF. The effect went on upon 21 of exposure, probably due to the fact that MP kept in the tissues inducing these effects. High levels of immune activities impair the ability to trigger a proper immune response upon a pathogen. Moreover, high levels of oxidative enzymes, activities need to induce pathogen death, also establish a high oxidative status in the tissues, as shown with the biochemical biomarkers. These data point to **immune functions as good biomarker** of biological deregulation upon **MP exposures** (**Espinosa et al. 2016**).
- Exposure of mussels to MPs did not significantly affect lysosomal membrane stability (LMS) or phagocytosis responses. Significant differences were demonstrated after in vitro co-exposure to Hg (<250 µg·L-1 FSW) and MPs on LMS and phagocytosis for some cases, suggesting the existence of an enhanced toxicity when MPs and Hg are concurrent in the extracellular medium (Partner 2, in prep).
- Concerning endocrine disruption, in vertebrates vitellogenin (Vtg), a precursor of the egg yolk synthetized in the liver of oviparous females, is commonly used as a biomarlker of effects. The presence of Vtg in male or juvenile individuals is interpreted as indicative of estrogenic endocrine disruption, such as that induced by certain plastic additives (e.g. bisphenol A). In molluscs Vtg was traditionally quantified using the colorimetric ALP technique. Partner 1 demonstrated that this method is unreliable and showed that **shotgun proteomics**, unlike the classical ALP method, **was suitable for the identification and quantification of Vtg** in marine mussels (**Sánchez Marín et al. 2017**).

- Results of BaP bioavailability and biomarkers analyses were further elaborated within a quantitative and software-assisted **weight of evidence** (**WOE**) model which, using weighted criteria, provided synthetic hazard indices, for both chemical and cellular results, before their final integration in a combined index. Elaboration of data summarized as Severe the hazard level for bioavailability in mussels exposed to BaP or BaP contaminated LDPE at all exposure periods. On the other hand, considering the magnitude of variations observed for various biomarkers, their statistical significance and the toxicological relevance of each biological endpoint, the model summarized the **hazard** for cellular responses as Slight for organisms exposed to BaP, virgin and contaminated LDPE, and Moderate only for organisms exposed to BaP after 14 days. The integration of hazard indices elaborated for bioavailability and biomarker data resulted in a combined WOE effect classified as Slight for mussels exposed to virgin LDPE and Major for those treated with both contaminated LDPE and BaP alone, without variations at different times of exposure; it is quite obvious that the final evaluation of the risk caused by virgin and contaminated LDPE was greatly influenced by the marked accumulation of BaP. The overall results suggest that **microplastics induce a slight cellular toxicity** under short-term (28 days) exposure conditions. However, **modulation of immune responses**, along with bioaccumulation of BaP, pose the still unexplored risk that these particles, under conditions of more chronic exposure (months to years) or **interacting with other stressors**, may provoke long-term, subtle effects on organisms' health status. (**Pittura et al. 2018**)
- Effects of virgin and BaP-spiked PE MPs on the infaunal bivalve *S. plana* were assessed. A battery of biomarkers was recorded in the gills and digestive gland of the clams upon exposure. Results indicate that the accumulation of smaller size MP (4-5 µm) was higher than on MPs with 20-25 µm, without or with BaP. Oxidative stress was size and tissue specific and antagonistic effects were detected for BaP contaminated MPs. Integrated biomarker approach (IBR version 2) and the Health Index revealed that the effect was more important for smaller MPs with higher IBR levels for the gills exposed to MPs contaminated with BaP and the opposite occur in the digestive gland. In addition, effects of 14 d exposure to 20 µm PS MP were also tested. **PS MP induced neurotoxicity** (AChE inhibition) **and oxidative stress** in *S. plana* (**Ribeiro et al. 2017**).
- A proteomic approach was carried out in the gills of *S. plana*. In virgin LDPE MPs 28 proteins were up-regulated and 12 down-regulated compared to controls. In BaP treated MPs, 46 proteins were up-regulated and 21 down-regulated in clam gills compared to uncontaminated clam gills indicating that **LDPE contaminated with BaP induce more protein changes than virgin LDPE**. The statistical analysis (Kruskal-Wallis) indicates that a significant statistical difference exists for 20 proteins between unexposed, virgin and BaP contaminated MPs conditions. (**Bebianno et al. in prep**).
- The ecotoxicological effects of exposure to LDPE microplastics with and without adsorbed BP-3 were investigated in the *Scrobicularia plana* clam. The clams were exposed for 14 days to 1 mg L^{-1} MP with a size range of 11–13 µm spiked with an environmentally relevant concentration of BP-3 (82 ng g^{-1}). A tissue specific response in **oxidative stress** was observed in clams in both virgin and BP-3 contaminated MP exposures. The integrated biomarkers index (IBR) and health index indicated that **gills were more affected than digestive gland**, and biomarkers alterations are apparently more related to the **toxicity of adsorbed chemicals** than LDPE itself. Synergistic effects of LDPE and adsorbed chemicals are not clear. (**O'Donovan et al. submitted**).

PREDATORS

- In the 96 h bioassays testing the effects of **MP**, **cephalexin**, their mixtures and temperature rise on *P. microps* juveniles (see WP3), the activity of the enzyme acetylcholinesterase (AChE), as neurotoxicity biomarker, and the levels of lipid peroxidation (LPO) as biomarker of lipid oxidative stress and damage, were determined. At 20ºC, juveniles exposed to MP had 21 % of **AChE inhibition** but with no significant differences in relation to the control group and no significant differences in LPO levels. At 25ºC, no significant differences in AChE or LPO levels among treatments were found. However, **increases of** AChE activity (14 %) and **LPO** (72 %) **in fish exposed to the MP-cephalexin mixture** containing the highest cephalexin concentration were found. The integrated data analysis (of the two bioassays) indicated significant interactions between MP and cephalexin for both biomarkers, and **significant interactions** among all stressors (i.e. temperature, MP and cephalexin) for LPO (**Fonte et al. 2016**).
- In the 96 h bioassays testing the effects of **MP** and cadmium (**Cd**) in *P. microps* juveniles from two populations (Minho and Lima estuaries), the activity of the enzymes AChE and glutathione S-transferases (GST) (involved in biotransformation), and LPO levels were determined. GST activity or LPO levels were not affected, but in fish from the Lima estuary **AChE was inhibited by MP** alone (LOEC = 0.14 mg/l) **and by MP-Cd mixtures** (LOEC = 6 mg/l Cd + 0.14 mg/l MP) (**Miranda et al. submitted**).

- In the 96 h bioassay carried out to assess the effects of **LDPE**, **PFOS** and **LDPE-PFOS** on *P. microps* juveniles (in collaboration with Partners 1, 6 and 11), the activity of AChE, several antioxidant enzymes, and LPO levels were determined. **LDPE** alone **and LDPE-PFOS** caused significant **AChE inhibition** in fish brain (LDPE: LOEC = 80 mg/l; LDPE-PFOS: LOEC = 40 mg/l LDPE + 2.2 µg/l PFOS) but not PFOS alone (NOEC = 4.5 µg/l). Juveniles exposed to the **LDPE-PFOS** also showed alterations in antioxidant enzymes and significant increase of liver LPO levels (LOEC = 40 mg/l + 2.2 µg/l PFOS) indicating lipid **oxidative damage** (**Vieira et al. in prep**).
- *Dicentrarchus labrax* brain AChE activity and muscle cholinesterases (ChE) from bioassays carried out by the University of Murcia to test the effects of LDPE, PFOS, benzo[a]pyrene (BaP), and LDPE contaminated with PFOS or BaP. The results finding was that LDPE inhibited AChE of this species, thus causing neurotoxicity.
- Dietary intake of PVC or PE by gilthead sea bream or European sea bass resulted in histopathological alterations in the gut and liver. **No translocation** of MPs was observed. No important changes were observed in the immune response after exposure to MPs. Biochemical markers showed little alterations and suggested some liver damage and **chronic stress**. Gene expression failed to show inflammation but also suggested some cellular and **oxidative stress**. When PFOS or BP-3 were adsorbed to PE-MPs the effects were very similar to those found with MPs or the contaminants alone at histopathological, immunological and transcription levels (**Espinosa et al. 2017**).
- In zebrafish and marine medaka larvae acutely exposed to virgin or spiked (BaP-, PFOS- or BP3) MP or DMSO extracts, **no significant CYP1A1 induction** was reported. Exposure to 1 and 10 mg/L of virgin or spiked MP (particles and DMSO extracts) did not induce significantly DNA damage (**LeBihanic et al. in prep**).
- In marine medaka and zebrafish, brain, liver, gonad and blood samples have been collected at the end of long-term exposures. We observed **no evidence of genotoxicity** or oxidative stress, and **no induction of cyp1a** in the liver in marine medaka. In the case of MP-PFOS, we observed an **increase in circulating estradiol** concentration in both females and males. These results suggest that life-long exposure to MPs can trigger physiological disruptions in fish which may impair recruitment and population sustainability.

Discussion

Recent publications have documented low or little acute toxicity of virgin microplastics on marine organisms (**Beiras et al., 2018**; Jovanovic et al., 2018, **Pannetier et al. 2019b**) and especially on fish cells (**Espinosa et al., 2018**) but those studies mainly investigated the direct contact with virgin MP particles and not with the MP extracts. It has been documented that concentration levels of additive chemicals are relatively high in new plastics. **Oliviero et al.** (**2019**) showed that while **virgin PVC** polymer **did not result toxic** on *P. lividus* embryos, commercial PVC MP did exert an evident **toxic effect** due to leaching **of chemical additives** used to manufacture the plastic in the medium.

Since the release of pollutants from MPs is primarily driven by distribution equilibria (see WP1), the particular circumstances chosen in tests are crucial for the environmental relevance of the results obtained. Employing a cell culture with a medium supplemented with serum may reflect conditions similar to many organismal fluids such as blood or interstitial fluid, but the harsh conditions in the gut cannot be readily reproduced due to cytotoxic effects of low pH and high detergent concentrations. Desorption of pollutants potentially due to natural surfactants is relevant only for compounds with an intermediate lipophilicity (log KOW < 6), while such with higher lipophilicity are barely or not at all released, which agrees with thermodynamic models of the sorption mechanism. However, bringing these results into context with the findings on binding of pollutants, it has been shown that – under environmentally relevant conditions – only pollutants with high lipophilicity (log K_{OW} > 5.5) have the potential for significant accumulation on MP, which indicates that **increased uptake of pollutants via MP is highly unlikely**. However, the **role of natural surfactants** present in the digestive tract remains to be assessed. In our model, detergents increased bioavailability of pollutants less than two-fold, but detergent concentrations were below those expected in organisms.

Inhibition of AChE activity, increased **oxidative stress**, and **behavioural disruption**, but no marked effect on bioaccumulation of sorbed chemicals, are common findings observed in fish exposed to MP (e.g. Barboza et al. 2018a,b). Therefore, rather than a risk by themselves, MP may contribute to general stress and interact with other environmental challenges. Thus, **effects of MP should be assessed within a holistic approach** encompassing the main anthropogenic pressures on the marine ecosystems.

WORKPACKAGE 5 – TROPHIC TRANSFER

The following partners are involved: ***Partner 5*** *(leader),* ***Partner 6, Partner 8, Partner 9, Partner 14***

- Trophic transfer was documented in various organisms indicating complex MP accumulation and transfer patterns in environmental food webs. Very small MPs are yet ingested by unicellular organisms, indicating an accumulation at the first level of food webs. Transfer was shown to be very sensitive in early life-stages of fish, and trophic transfer might represent a dominant MP exposure pathway throughout a whole life-cycle. Furthermore, it was shown **in adult fish stages** that **MPs can be taken up at very high amounts via food chains**; however, in all experiments, **no acutely toxic effects** were seen in fish. MPs were rapidly excreted with no further indications of stress or negative effects on fish health.
- Both in fish larvae and adult fish, pollutants associated with MPs were transferred to organisms, however, only at lower amounts compared to waterborne exposure routes. Likewise, long-term chronic feeding experiments with MPs and adult fish also showed no effect on fish health, and **histological analyses revealed no tissue transfer of any size of MPs**, despite reports in corresponding literature.
- As a conclusion, MPs were shown to be transferred in food chains at high rates; MPs were ingested by even unicellular organisms, filtered by zooplankton and transferred to higher trophic organ-isms, leading to a potential whole-life exposure beginning from the first feeding. However, **a negative apical impact was not detectable** in fish. Using these methods, a fish full life-cycle test with additional sensitive endpoints such as reproduction similar to that made in WP3 should be conducted to further test on potential MP effects transferred from preys in fish.
- The development and validation of protocols aimed to investigate MP trophic transfer, using larvae of the crustacean *Artemia* sp. and *Tigriopus fulvus* as preys, and the ephyrae stage of the jellyfish *Aurelia* sp. as predator, were assessed. Trophic transfer of MPs could only be demonstrated in the simplified two-level chain formed by copepod nauplii and jellyfish ephyrae. Therefore, it is important to study different preys to clarify MP trophic transfer. **Although MP transfer occurred from copepods to ephyrae**, no ecotoxicological effects were detected in terms of immobility and behavioural responses (frequency of pulsations), indicating that a **negative impact was not detectable** in this trophic chain.
- *Paramecium* efficiently transferred at very high amounts 1 - 5 µm particles only, whereas *Artemia* transferred both 1 - 5 and 10 - 20 µm particles. Zebrafish and marine medaka larvae were feeding from the very first day of active food intake (2/3 days post hatching) on Paramecium with ingested MPs and from 6/7 days post-hatch on *Artemia* nauplii with ingested MPs. Following MP ingestion, neither transfer to tissues nor accumulation of MPs could be detected with MPs egestion within hours following ingestion. Yet, BaP was efficiently transferred *via* trophic transfer, with higher exposure rates for small 1 - 5 µm MPs when ingested *via Paramecium*. Induction of cyp1a transcription revealed that BaP transferred from MPs was bioavailable in fish larvae. Given the dependence of the transfer rates on MP size and also re-desorption rates of chemicals depending of plastic type, **very small** (1-20 µm) **MP** and – most likely – nanoplastic particles might thus **pose a significant threat for both early life-stages and juveniles** of fish until adulthood with ongoing exposure *via* trophic transfer (**Batel et al. 2016**).

WORKPACKAGE 6 – FIELD VALIDATION

The following partners are involved: ***Partner 1, Partner 6, Partner 7*** *(leader),* ***Partner 10, Partner 12***

- In three years of the EPHEMARE project, Partner 7 has conducted sampling activities in the areas included in the project (North, Central, and South **Adriatic Sea**). Respect to the original EPHEMARE schedule, additional sampling activities were included. In summer 2017 UPM researchers participated to the international tour "LESS PLASTIC MORE MEDITERRANEAN" carried out by GREENPEACE in order to gather direct data on pollution from plastic in our seas and to inform public opinion about this environmental emerging issue. During the Italian tour of the campaign (started on June 24th from Genoa and finished in Ancona on 9th of July) different marine organisms were collected in collaboration with local fishermen, with the main aim to provide useful information on the microplastics distribution in the **Tyrrhenian Sea** biota: organisms were collected in the areas of Genoa, Talamone, Giglio and Ventotene Island, Naples.

- The organisms collected from 3 different sites of Adriatic Sea (**North, Central and South Adriatic**) have been processed, with a total of 259 fish representative of thirteen commercial species, and 216 invertebrate organisms belonging to twelve species. Concerning the vertebrates, 216 organisms were analysed and the 27% were positive to MP ingestion, 71% showed 1 particle and 29% 2 particles. The shape of isolated particles was largely dominated by **fragments** (43%), followed by films (33%), lines (17%) and pellets (7%); 26% of extracted microplastics were of the smaller size class between 0.01 and 0.1mm, 34% was between 0.1 and 0.5 mm, 7% between 0.5 and 1 mm, and 31% between 1 and 5 mm. The extraction of microplastics from invertebrate species highlighted their presence in 24.3% of the 259 examined specimens. The majority of the positive organisms (71%) showed **1 particle in the tissues**, while 21% contained **2 particles**, 5% contained 3 particles and 3% had 4 particles. The shape of the plastic particles was mostly characterized by fragments (59%), followed by lines (28%), films (9%) and pellets (3%); 34% of extracted microplastics exhibited the smaller size class (lower than 0.1mm), 30% was between 0.1 and 0.5 mm, 14% between 0.5 and 1 mm, and 21% between 1 and 5mm. µFT-IR analyses on microplastics isolated from fish showed that the 48% of extracted polymers were composed by **PE**, followed by polypropylene (PP) (15%), polyamide (PA) (10%), polyester (7%); a lower frequency was observed for other 7 polymers (polyurethane (PU), ethylenevinyl acetate (EVA), PS, PVC, PET, Polyacrylic, polyisoprene). Regarding invertebrates, results indicate that PE, PP, polystyrene (PS) and polyester were the main extracted polymers with a frequency of 24, 21, 13 and 10% respectively. The remaining percentage was covered by other 13 plastic polymers including PVC, PET, PA, EVA, Polyisoprene, PU, epoxydic resin, polybuthylene terephthalate, polyterpenic rubber, polyvinyl acetate (PVA), silicone and copolymers (Avio et al. 2018).
- Clustering the species in relation to the habitat in pelagic, benthopelagic and benthonic species, there is not a significant difference in terms of number of items per individual, but considering the frequency, results suggest that **pelagic and benthopelagic** species are more subject to ingestion respect to benthonic ones, in all the investigated areas. There is no a clear trend in terms of shape, while benthonic organisms ingest in general smaller particles of high density polymers (PVC, PA, polyesters) (Avio et al. 2018).
- The study on the Adriatic Sea shows that MPs ingestion is a widespread phenomenon: in the Center and South, microplastics ingestion is more frequent but not higher than in North, suggesting that **frequency can be a more appropriate index than number of ingested particles to monitor** the presence of microplastics in organisms. Particles in organisms from Central and Southern Adriatic are smaller than those ingested by the Northern organisms; hydrographic characteristics, such as runoff of northern rivers and waters circulation, might cause a higher accumulation of plastics debris in Central and South sector. Overall no differences were related to feeding strategies or trophic level.
- Concerning the **Tyrrhenian Sea**, on a total of 157 fish 46 specimens contained at least **1 particle**, thus revealing an overall frequency of approximately 30% of organisms positive to microplastics ingestion. Similar percentages (on a lower number of specimens) were obtained for invertebrates, with 13 organisms containing microplastics on a total of 44 analysed (29.5%) (Fig. 8). Overall these values of frequency are comparable to those described for the central and southern sectors of Adriatic Sea, with 25-30% of marine organisms containing microplastics. The shape was quite homogeneous being largely dominated by fragments (typically >55%), followed by lines and films which (together) prevailed only in organisms from Napoli. The most common size classes were those smaller than 0.5 mm which generally accounted for at least 60% of all ingested microplastics: once again, the only exception was for fish from Napoli, where 50% of extracted particles were between 1 and 5 mm and related to the elevated abundance of lines and films. The µFT-IR results indicated a certain heterogeneity of the polymer composition, especially in those sites represented by a large number of analysed organisms (Genoa and Naples); **PE** is the most represented chemical typology followed by polyester, EVA, PA and PP, which might reflect the influence of both specific local activities, or hydrographic conditions.
- The campaign “Less Plastic more Mediterranean” gave us the possibility to investigate the variations of MP pollution in a well-defined case study related to the removal of the **wreck of the Costa Concordia** from the Giglio Island. Results obtained during the campaign in 2017 were compared with those already obtained in a previous work when fish had been collected in a reference site and near to the wreck in 2014 after the end of rescue operations, when the ship was finally towed away to Genova (**Avio et al., 2017a**). At that moment, benthic fish sampled in the wreck site exhibited a frequency of 95% of organisms with ingested microplastics and an average content of 4 ± 1.8 particles. Overall, these results suggest that, compared to the previous monitoring study performed in 2014, a

significant **improvement** has occurred in 2017 in the site impacted by the operations for the wreck removal, with a **lower number of organisms positive to the MPs ingestion** (35% versus 95%) and a lower number of ingested particles (1.16 ± 0.4 versus 4 ± 1.8 particles). More comparable, but still higher numbers have been obtained in 2014 also in the Giglio reference site, which had previously shown a frequency of 77% positive fish compared to 60% in 2017 and a content of 2.5 ± 2 particles compared to 1.66±1.1 in 2017. In this case, the difference could be related to the different sampling period which, in 2014 occurred in mid-September, at the end of summer touristic season.

- Another extra activity has been carried in collaboration with the Race for Water Foundation when on board of the RACE FOR WATER trimaran. Personnel form Partners 1, 4 and 7 collected marine organisms from the **Caribbean Sea** around Guadalupe and Bermuda Islands. In addition to water and sediment samples, MP extraction has been performed in 30 specimens of *Holocentrus adscensionis* (Squirrel fish) collected at two different locations: Petit Bourg and Marie Galante. **More than 90%** in mass of the plastics found in beaches were **PE** (**Pannetier et al. 2019a**). Results suggest that the level of ingested MPs is those organisms was in line with evidence obtained from other investigated geographical areas, with a frequency of **33% of organisms ingested 1 MP**.
- The South Portugal survey sampled specimens of *Carcinus maenas*, *Mytilus galloprovincialis* and *Scrobicularia plana* from 2 locations, Praia de Faro and Tavira, in Ria Formosa lagoon, Portugal. In addition, the fish *Mullus surmuletus* was obtained from local fisherman. Around 150 samples were shipped to Partner 7 for microplastics identification and quantification analysis. No microplastics were detected in the crabs *Carcinus maenas* nor in the clams *S. plana*. Results indicate that in mussels percentage of MPs ranged from 7 to 17% with 1.5 to 2 items per mussel. Size ranged from 290 µm and the MP polymers found were PVA, EVA and PE. In *Mullus barbatus* fish MPs of 250 µm of PE were detected. In the gills of one crab a 280 µm of PP blue was detected but not in the hepatopancreas. An additional survey was carried out where only mussels *Mytilus galloprovincialis* were collected from seven sites of in the Southern Coast of Portugal. Around 40 mussels were collected. The percentage of MPs detected in mussels ranged from 60 to 100% with a range of 0.6 to 2.2 items per mussel. Types of plastic detected were PA and PP. Results are on process (Partner 10, in prep.).
- The Oslofjord survey sampled ten sediment-dwelling and epibenthic species representative of different habitat, feeding modes and trophic levels within the inner Oslofjord (Oslo, Norway). Analysed species included fish, bivalves, echinoderms, crustaceans and polychaetes. MPs were present in all the species with a frequency up to 65% of positive individuals for some species. In most cases, 1 or 2 MPs were found per individual, but some organisms contained up to 7 particles. A total of 8 polymer typologies were identified, with PE and PP being the most common ones. Occurrence of MPs in analysed biota is not influenced by organism habitat or trophic level, while characteristics and typology of polymers might be significantly affected by feeding mode of organisms (**Bour et al. 2018b**).
- On 1st June 2018, a Partnership Agreement between JPI-Oceans funded projects **BASEMAN** and **EPHEMARE** was signed for the standardization of MP monitoring techniques, where EPHEMARE took in charge the **standardization** of methods for **MP analysis in biota**. Thus, both consortia benefited from the **Training courses** organized by Partner 7 in Ancona in 2017 and 2018 on “Extraction and characterization of microplastics from marine organisms”.

WORKPACKAGE 7 – COMMUNICATION, DISEMINATION & STAKEHOLDER ENGAGEMENT

The following partners are involved: ***Partner 1, Partner 2, Partner 3, Partner 4, Partner 5, Partner 6, Partner 7, Partner 8, Partner 9, Partner 10, Partner 11, Partner 12, Partner 13*** *(leader),* ***Partner14***

- EPHEMARE operational project website from January 2016 till November 2018: provided visitors general information about the project in addition to generating over 56 news items featuring the wide range of partner activities such as conferences, published papers, outreach events, public appearances, TV interviews)
- EPHEMARE outreach material such as four factsheets, project brochure and three yearly newsletters are available to download from the project website
- EPHEMARE social media outlets included dedicated Facebook and twitter accounts to effectively support the project science communication, project information distribution and stakeholder engagement
- IMPACT 2017 – International Microplastics Photo Contest, offered 1000 € in prizes, invited submissions in 2017 from January till end of May, and received 41 Entries from 5 countries, which subsequently featured in

exhibitions and outreach events about microplastics in our oceans e.g. Cork Science Festival, Ireland's Science Week, Dingle Oceanworld Aquarium, the Italian Festival of Science in Genoa and selected entries featured in the Ocean Plastics Lab travelling exhibition.

- EPHEMARE Stakeholder workshop took place on the 21st of February in 2018 in Antwerp, Belgium and involved 7 Industry representatives, 6 Representatives for Policy/Regulation, in addition to representations from JPIO, PLASTOX, WEATHER-MIC, R4W and the Ocean Plastics Lab. 11 EPHEMARE representatives actively engaged with workshop participants on current research findings, relevant existing and emerging EU regulation, policy and legal requirements, the direction future research should take and exploring of effective and implementable solution that can address adverse impacts of micro-plastics on marine life.
- A briefing note post EPHEMARE stakeholder workshop 'Preliminary Outcomes of the EPHEMARE Stakeholder Workshop Concerning the Direction of Future Microplastic Research', was disseminated to project stakeholders including the JPIO and national funding bodies.
- Dissemination of projects findings and outputs to a range of audiences such as public authorities relevant to European Directives, relevant private sector organizations and Industry, academia in related fields of expertise to support associated research as well as the general public to increase awareness of micro plastics and associated concerns.

CONCLUSIONS

- ### Microplastic ingestion is widespread in marine organisms but they are also egested

  MPs of suitable size are **easily ingested**, but also **easily egested** by filter-feeders and fish. In mussels, they are excreted through feces (large ones) or **translocated** from digestive gland into the gills (< 2µm). Once experimental data fit uptake and distribution models, models predict that there is **no accumulation** of MPs in mussels exposed to environmental concentrations. This has been confirmed by field samples.

- ### Microplastics can be transferred from preys to predators but do not biomagnify across aquatic food webs

  In experimental food chains MPs **are transferred** from preys to predators, but they are egested and **do not bioaccumulate in predators**.

- ### Microplastics can vehicle contaminants but they are not a major source of exposure

  MPs of conventional polymers such as polyethylene **do not increase bioavailability** and effects of model chemicals **compared to natural particulate matter**. In fact accumulation in the mussel of a hydrophobic organic pesticide (chlorpyrifos) is higher in presence of microalgae than with microplastics.

- ### Microplastics may cause oxidative stress, behavior and reproductive disruption, and modulate effects of other chemicals

  Despite lack of acute effects in standard tests, MPs can cause **oxidative stress**, **behavior** disruption and **reproductive effects** upon chronic exposure, elicit subtle **immune responses**, **modulate the cellular effects** of chemicals, and cause interaction between chemical and physical challenge.

- ### EPHEMARE developed toxicity test methods specifically suitable for microplastics.

  EPHEMARE developed dedicated methods based on chronic effects and early life stages suitable to assess the toxicity of microplastics (e.g. Beiras et al. 2018b). Those methods can be useful for both **industry** to develop **new polymers** based on environmentally friendly materials, and **regulatory agencies** to set **environmental standards** for plastics.

- **“Microplastic” is a too generic term for environmental risk assessment**
  The term “microplastic” is too broad, emcompasing a variety of particles in terms of size, shape and chemical composition with very different ecotoxicological properties and interactions with biota. Considering size, for zooplankton and filter feeders the fraction more effectively ingested ranges between 2 and ca. 100 µm. Generally, **the smaller the microplastics the more ecotoxicological risk they may pose**.

REFERENCES OTHER THAN THE EPHEMARE PUBLICATIONS (LISTED BELOW)

Abdullah MA, Chiang L, Nadeem M. 2009. Comparative evaluation of adsorption kinetics and isotherms of a natural product removal by Amberlite polymeric adsorbents. Chemical Engineering Journal; 146: 370-376.

Barboza LGA, Vieira LR, Branco V et al. 2018a Microplastics cause neurotoxicity, oxidative damage and energy-related changes and interact with the bioaccumulation of mercury in the European seabass, Dicentrarchus labrax (Linnaeus, 1758). Aquatic Toxicology 195: 49–57.

Barboza LGA, Vieira LR, Guilhermino L. 2018b. Single and combined effects of microplastics and mercury on juveniles of the European seabass (Dicentrarchus labrax): Changes in behavioural responses and reduction of swimming velocity and resistance time. Environmental Pollution 236: 1014-1019. Barnes, D.K.A., Galgani, F., Thompson, R.C., Barlaz, M. 2009. Accumulation and fragmentation of plastic debris in global environments. Philo. Trans. R. Soc. 364, 1985-1998.

Brandon J, Goldstein M, Ohman MD. 2016. Long-term aging and degradation of microplastic particles: Comparing in situ oceanic and experimental weathering patterns. Marine Pollution Bulletin; 110: 299-308.

Carpenter, E.J., Anderson, S.J., Harvey, G.R., Miklas, H.P., Peck, B.B. 1972. Polystyrene Spherules in Coastal Waters. Science. 178, 749.Kim S, Choi K. Occurrences, toxicities, and ecological risks of benzophenone-3, a common component of organic sunscreen products: A mini-review. Environment International 2014; 70: 143-157.

Inoue K, Takei Y. 2002. Diverse adaptability in oryzias species to high environmental salinity. Zoolog Sci. 2002 Jul;19(7):727-34.

Jambeck, J.R., R. Geyer, C. Wilcox, T.R. Siegler, M. Perryman, A. Andrady, R. Narayan, K.L. Law, 2015. Plastic waste inputs from land into the ocean, Science, 347, 768.

Jovanovic B., Gökdag K., Güven O., et al. 2018. Virgin microplastics are not causing imminent harm to fish after dietary exposure. Mar Pollut Bull 130: 123-131.

Kimmel CB, Ballard WW, Kimmel SR, Ullmann B, Schilling TF. 1995. Stages of embryonic development of the zebrafish. Developmental Dynamics; 203: 253-310.

Llorca M, Schirinzi G, Martínez M, Barceló D, Farré M. 2018. Adsorption of perfluoroalkyl substances on microplastics under environmental conditions. Environmental Pollution; 235: 680-691.

Mazurais D, Ernande B, Quazuguel P. 2015. Evaluation of the impact of polyethylene microbeads ingestion in European sea bass (*Dicentrarchus labrax*) larvae. Mar Environ Res 112, 78-85.

Perrichon P, Le Bihanic F, Bustamante P, Le Menach K, Budzinski H, Cachot J, et al. 2014. Influence of sediment composition on PAH toxicity using zebrafish (*Danio rerio*) and Japanese medaka (*Oryzias latipes*) embryo-larval assays. Environ Sci Pollut Res; 21: 13703-13719.

Rochman CM, Hoh E, Hentschel BT, Kaye S. 2013. Long-Term Field Measurement of Sorption of Organic Contaminants to Five Types of Plastic Pellets: Implications for Plastic Marine Debris. Environ Sci Technol; 47: 1646-1654.

Setälä, O., Fleming-Lehtinen, V., Lehtiniemi, M. 2014. Ingestion and transfer of microplastics in the planktonic food web. Environ. Pollut. 185, 77-83.

ter Halle A, Ladirat L, Martignac M, Mingotaud AF, Boyron O, Perez E. 2017. To what extent are microplastics from the open ocean weathered? Environmental Pollution; 227: 167-174.

Tosetto L, Brown C, Williamson JE. 2016. Microplastics on beaches: ingestion and behavioural consequences for beachhoppers. Mar Biol, 163:199.

Wang F, Shih KM, Li XY. 2015. The partition behavior of perfluorooctanesulfonate (PFOS) and perfluorooctanesulfonamide (FOSA) on microplastics. Chemosphere; 119: 841-847.

Wang W, Wang J. 2018. Comparative evaluation of sorption kinetics and isotherms of pyrene onto microplastics. Chemosphere; 193: 567-573.

PART B - STATISTIC REPORT

LIST OF SCIENTIFIC QUALIFICATIONS (PHD, MSC AND BSC THESES)

Abel, Serena. 2017. MSc Thesis at Polytechnic University of Marche, titled “Occurrence and characterization of microplastics in marine organisms from Adriatic coast” Master's Degree in Marine Biology and Ecology. Supervisor: Stefania Gorbi.

Alborino, Pasquale. 2019. MSc Thesis at Polytechnic University of Marche, entitled “Characterization of microplastics in marine organisms sampled along the Tyrrhenian coast” Master's Degree in Marine Biology and Ecology. Supervisor: Francesco Regoli.

Amorello, Sonia. 2017. MSc Thesis Polytechnic University of Marche, entitled “Analysis of the presence and characterization of microplastics in marine organisms sampled in northern Adriatic” Master's Degree in Marine Biology and Ecology. Supervisor: Francesco Regoli.

Barreiro García, J. L. Problemática de los microplásticos como contaminantes en el medio marino. Master Thesis, University of Murcia, June 2017.

Barreiro Simón, Mateo. Microplásticos en biota marina. BSC Thesis. IEO-Facultade de Ciancias do Mar, Universidade de Vigo, July 2017. Supervisor: R. Beiras-J. Gago.

Batel, Annika. Microplastics in the aquatic environment – Abundance, accumulation and the transfer of persistent organic pollutants (POPs) to aquatic organisms. Dissertation Ruprecht-Karls University Heidelberg. Supervisor: T. Braunbeck.

Benito Garrido, I. Efecto endocrino de aditivos plásticos, como los filtros orgánicos ultravioleta, en el modelo ecotoxicológico marino *Paracentrotus lividus*. BSc Thesis, University of Vigo. Supervisors: P. Campoy, R. Beiras.

Borchert, Flora. MSC thesis on “Mechanism specific toxicity of contaminated microplastic after simulated digestion” as internship student from RWTH Aachen University, Germany.

Cormier, Bettie. PhD thesis on “Investigation of the chemical and ecotoxicological behavior of microplastics” as a collaboration between Örebro University and Bordeaux University.

Costa E. 2018. Investigating the potential of ephyrae jellyfish (Cnidaria) as model organism in ecotoxicology for sea water quality assessment. PhD in Marine Science. University of Genoa, Italy. Supervisor: Faimali M.

García-Argudo García, E.. Microplásticos en aguas residuales. BSC Thesis. Facultade de Ciancias do Mar, Universidade de Vigo, July 2017. Supervisor: R. Beiras.

Heinrich, Patrick. Microplastic as a vector of checmicals in fish cell cultures. June 2019. Dissertation, Ruprecht-Karls University Heidelberg. Supervisor: T. Braunbeck.

Herguedas Jorge, A.. EVALUACIÓN ECOTOXICOLÓGICA DE MICROPLÁSTICOS DE PVC MEDIANTE BIOENSAYOS DE EMBRIOGÉNESIS DEL ERIZO DE MAR *Paracentrotus lividus*. BSc Thesis. Facultade de Ciancias do Mar, Universidade de Vigo, July 2018. Supervisor: R. Beiras

Hess, Sebastian. Uptake and transfer of microplastics and associated benzo[a]pyrene via paramecia to zebrafish larvae. December 2016. Bachelor thesis, Ruprecht-Karls University Heidelberg. Supervisor: T. Braunbeck.

Le Roux, Ezvin. MSC thesis on “A comparison of specific effects between an in vivo and in vitro test after exposure to PFOS and BaP found in microplastic particles” as internship student from Bordeaux University, France.

Linares, M. Efecto del polietileno sobre la toxicidad del clorpirifós en la microalga Isochrysis galbana, clone t-ISO. Master Thesis, IEO, Centro Oceanográfico de Murcia, June 2017. Supervisor: M. Albentosa.

Lopes, A. P. 2016. Ecotoxicological effects of gold nanoparticles and microplastics in *Daphnia magna*. Master Thesis of the Master of Bioengineering, Faculty of Engineering and Institute of Biomedical Sciences of Abel Salazar of the University of Porto, Portugal. Supervisor: Prof. Lúcia Guilhermino.

Lopez Ibañez, Sara, 2018. Evaluación ecotoxicológica de contaminantes orgánicos y microplásticos mediante bioensayos de supervivencia con el copépodo marino Acartia clausi. MSc Thesis. Máster en Biotecnología Avanzada. Universidade de A Coruña. Supervisor: R. Beiras.

Marino, Gianmarco. 2018. MSc Thesis at Polytechnic University of Marche, titled “Presence and characterization of microplastics in marine organisms from the southern Adriatic Sea” Master's Degree in Marine Biology and Ecology. Supervisor: Stefania Gorbi.

Michelangeli, Maria Elisabetta. 2018. MSc Thesis at Polytechnic University of Marche, titled “Ecotoxicological effects of microplastics on mussels: transfer of pollutants and cellular responses”. Master's Degree in Marin Biology and Ecology. Supervisor: Francesco Regoli.

Misurale F. 2016. Indagine ecotossicologica sugli effetti delle microplastiche in invertebrati marini. Bachelor Thesis, University of Genoa (Degree in Biology). Tutor: Gambardella C.

Misurale F. 2017-2018 (6 months). Extraction, identification and effects of microplastics in various aquatic species. Applied to the study of contamination of the food web in the Seine estuary. PlasticSeine and Ephemare projects. Master 2 ERASMUS Biologie – University of Genoa. Supervisor : F. Le Bihanic (50%) and J. Cachot (50%).

Morante Jiménez, M. 2018. Evaluación del papel de los microplásticos como vectores de mercurio en mejillones de la especie *Mytilus galloprovincialis*, Master Thesis, IEO-University of Murcia, July 2018. Supervisors: Romero D, Albentosa M.

Morgana S. 2017. An innovative monitoring tool to assess marine pollution. European PhD in Marine Science. University of Genoa, Italy. Supervisor: Faimali M.

Mykytka, R. 2018. Feeding behavior of the mussel *Mytilus galloprovincialis* exposed to microplastics. Master Thesis, IEO-University of Murcia, July 2018. Supervisors: Romero D, Fernández Galindo B.

Nuttal, Luisa. Microplastic as vector for the insecticide cypermethrin and potential effects on the model organism Danio rerio. May 2018. Bachelor Thesis Ruprecht-Karls University Heidelberg. Supervisor: T. Braunbeck.

O’Donovan, S. 2018. Investigating the ecotoxicological effects of polyethylene microplastics on the clam *Scrobicularia plana* (da Costa 1778) using a multibiomarker approach. MSc in Marine Biology. University of Algarve.

Olmos, A. Utilización de larvas de *Cyprinodon variegatus* para detectar disrupción endocrina. BSc Thesis, University of Vigo. Supervisors: A. Martínez-Schönemann, R. Beiras.

Pittura, Lucia. 2018. PhD Thesis at Polytechnic University of Marche, titled “Ecotoxicological approach as a tool to suggest strategies for risk management of microplastics in the marine environment” PhD in Life and Environmental Sciences. Supervisor: Regoli Francesco.

Poddine S. 2017. Valutazione degli effetti eco tossicologici di microplastiche di polietilene su efire di *Aurelia* sp. Bachelor Thesis, University of Genoa (Degree in Biology). Supervisor: Costa E.

Pollicardo C. 2017. Effetti ecotossicologici di diverse tipologie di microplastiche nel rotifero Brachionus plicatilis. Bachelor Thesis, University of Genoa (Degree in Biology). Supervisor: Gambardella C.

Prata, J. C. 2016. “Avaliação da toxicidade do antibiótico doxiciclina isoladamente e na presença de microplásticos na microalga marinha *Tetraselmis chuii*”. Stage/Thesis of the Master of Veterinary Medicine of the Institute of Biomedical Sciences of Abel Salazar of the University of Porto, Portugal. Supervisor: Prof. Lúcia Guilhermino; Co-supervisor: Dr. Beatriz Lavorante.

Reinwald, H. 2016: Investigation on the uptake and effects of microplastic associated benzo[a]pyrene during embryonal development of zebrafish (*Danio rerio*). Bachelor Thesis Ruprecht-Karls University Heidelberg, Supervisor: T. Braunbeck.

Ribeiro, F. 2016. Polystyrene microplastics accumulation and biomarkers response in *Scrobicularia plana*. MSc thesis. MSc in Marine Biology. University of Algarve, 76 pp.

Rodrigues, A.R.P. (on going). Influence of particle size on the ecotoxicity of low density polyethylene (LDPE) microplastics with and without absorbed benzo-a-pyrene (BaP) in the clam *Scrobicularia plana*. MSc in Marine Biology. University of Algarve.

Salvaneschi L. 2017. Ecotoxicological effects of emerging contaminants (microplastics) and environmental matrices (marine sediments) on marine organisms. Master Thesis, Pierre and Marie Curie University - Paris 6 Degree in Oceanography and Marine Environment. Supervisor: Garaventa F.

Santos de los Ríos, P. 2018. Ingestión y eliminación de Hg adsorbido a microplásticos en mejillón silvestre (*Mytilus galloprovincialis*). Master Thesis, IEO-University of Murcia, July 2018. Supervisors: Romero D, Santos Echeandía J.

Tarasco, Marco. How microplastics and adsorbed pollutants affect zebrafish development? PhD on Marine and Environmental Sciences, University of Algarve

Thalmann, S. 2016: Mikroplastik in der aquatischen Umwelt: Chemisch-physikalische Eigenschaften sowie Risiken einer Weitergabe von Schadstoffen an aquatische Organismen. Masters Thesis Ruprecht-Karls University Heidelberg. Supervisor: T. Braunbeck.

Portela Diéguez, Sofía, O lanzón, Alepisaurus ferox, unha especie fortemente afectada polo lixo mariño. BSc Thesis. IEO-Facultade de Ciencias do Mar, Universidade de Vigo, Septemebre 2017. Supervisor: R. Beiras.

Vital, S. 2018. Mapeamento de microplásticos na espécie *Mytilus galloprovincialis*, na costa sul de Portugal. BSC Project on Marine Bioloy, University of Algarve.

LIST OF EPHEMARE PUBLICATIONS

Avio C.G., Cardelli L.R., Gorbi S., Pellegrini D., Regoli F. 2017a. Microplastics pollution after the removal of the Costa Concordia wreck: First evidences from a biomonitoring case study. Environmental Pollution 227, 207-214.

Avio C.G., Gorbi S., Regoli F. 2017b. Plastics and microplastics in the oceans: From emerging pollutants to emerged threat. Marine Environmental Research, 128, 2-11.

Batel A., Lisa Baumann, Camilla C. Carteny, Bettie Cormier, Steffen H. Keiter, Thomas Braunbeck. Chemical, enzymatic and histological analyses of microplastics uptake after chronic feeding of differently sized microplastics spiked with benzo(a)pyrene in zebrafish (*Danio rerio*). Submitted.

Batel A., Arno Bringer, Sebastian Hess, Lucette Joassard, Marie-Laure Bégout, Thomas Braunbeck, Xavier Cousin. Bioavailability of benzo[a]pyrene transferred via microplastics to early life-stages of fish through experimental trophic food chains. In preparation.

Batel, A., Linti, F., Scherer, M., Erdinger, L., & Braunbeck, T. 2016. Transfer of benzo [a] pyrene from microplastics to Artemia nauplii and further to zebrafish via a trophic food web experiment: CYP1A induction and visual tracking of persistent organic pollutants. Environmental Toxicology and Chemistry, 35(7), 1656-1666.

Batel A., Borchert F, Reinwald H, et al. 2018. Microplastic accumulation patterns and transfer of benzo[a]pyrene to adult zebrafish (Danio rerio) gills and zebrafish embryos. Environmental Pollution 236, 1014-1019.

Bebianno MJ, Vera M. Mendes, Sarit O'Donnavan, Camila, C. Carteny, Stephen Keiter and Bruno Manadas. Impact at the proteome level of MPs with and without benzo(a)pyrene adsorbed on the gills of the peppery furrow shell clam *Scrobicularia plana*. In prep.

Beiras R. 2018. Plastics and other solid wastes. Chapter 6. In : Marine Pollution. Sources, fate and effects of pollutants in coastal ecosystems. 1st ed. Elsevier. pp. 69-88.

Beiras R., T. Tato. 2019. Microplastics do not increase toxicity of a hydrophobic organic chemical to marine plankton. Mar. Pollut. Bull. 138:58-62.

Beiras R., Muniategui-Lorenzo S., Rodil R., Tato T., Montes R., López-Ibáñez S., Concha-Graña E., Campoy-López P., Salgueiro-González N., Quintana J.B. Polyethylene microplastics do not increase bioaccumulation or toxicity of nonylphenol and 4-MBC to marine zooplankton. Submitted.

Beiras, R., Bellas, J., Cachot, J., Cormier, B., Cousin, X., Engwall, M., Gambardella, C., Garaventa, F., Keiter, S., Le Bihanic, F., López-Ibáñez, S., Piazza, V., Rial, D., Tato, T., Vidal-Liñán, L. 2018a. Ingestion and contact with polyethylene microparticles does not cause toxicity on marine zooplankton. Journal of Hazardous Materials, 30: 452-460.

Beiras, R., Tato, T., López-Ibáñez, S. 2018b. A 2-Tier Standard Method to Test the Toxicity of Microplastics in Marine Water Using *Paracentrotus lividus* and Acartia clausi Larvae. Environmental Toxicology and Chemistry 9999 (9999): 1–8.

Bour, A, Avio, CG, Gorbi, S, Regoli, F, Hylland, K. 2018b. Presence of microplastics in benthic and epibenthic organisms: Influence of habitat, feeding mode and trophic level. Environmental Pollution, 243, Part B, 1217-1225.

Bour A, Haarr A, Keiter S, Hylland K. 2018a. Environmentally relevant microplastic exposure affects sediment-dwelling bivalves. Environ Poll 236, 652-660.

Cormier B, Batel A, Cachot J, Bégout ML, Braunbeck T, Cousin X, Keiter SH. 2019. Hazard assessment of contaminated microplastic particles by means of an enhanced fish embryo test with the zebrafish (*Danio rerio*). Submitted to Frontiers in Environmental Science, section Marine Pollution.

Cormier B, Kärrman A, Larsson M, Yeung L, Keiter SH. 2019. Sorption of benzo[a]pyrene, oxybenzone and perfluorooctanesulfonate on different microplastic particles. In preparation.

Durán, I., R Beiras. 2017. Acute water quality criteria for polycyclic aromatic hydrocarbons, pesticides, plastic additives, and 4-Nonylphenol in seawater. Environmental Pollution 224:384-391.

Espinosa C, Cuesta A, Esteban MA. 2017. Effects of dietary polyvinylchloride microparticles on general health, immune status and expression of several genes related to stress in gilthead seabream (*Sparus aurata* L.). Fish Shellfish Immunol. 2017 68:251-259.

Espinosa C., Esteban M.A., Cuesta A. 2016. Microplastics in aquatic environments and their toxicological implications for fish. InTech ed. Toxicolog (ISBN 978-953-51-4878-4).

Espinosa C, García Beltrán JM, Esteban MA, Cuesta A. 2018. In vitro effects of virgin microplastics on fish head-kidney leucocyte activities. Environmental Pollution, 235: 30-38.

Fernández, B., Albentosa, M. 2019a. Insights into the uptake, elimination and accumulation of microplastics in mussel. Environmental Pollution 249, 321-329.

Fernández, B., Albentosa, M. 2019b. Tracking the accumulation and mobilization of small polyethylene microplastics (≤10 µm) in digestive gland and gills of mussel after a pulse-chase exposure. Marine Pollution Bulletin (in press).

Fonte, E., Ferreira, P., Guilhermino, L. 2016. Temperature rise and microplastics interact with the toxicity of the antibiotic cefalexin to juveniles of the common goby (Pomatoschistus microps): post-exposure predatory behaviour, acetylcholinesterase activity and lipid peroxidation. Aquatic Toxicology 180: 173-185.

Galgani L, Beiras R, Galgani F, Panti C, Borja A. 2019. Editorial: Impacts of marine litter. Frontiers in Marine Science, 6: 1-4. Doi: 10.3389/fmars.2019.00208

Gambardella, C., Piazza, V., Albentosa, M., Bebianno, M.J., Cardoso, C., Faimali, M., Garaventa, F., Garrido, S., González, S., Pérez, S., Sendra, M., Beiras, R. 2019. Microplastics do not affect standard ecotoxicological endpoints in marine unicellular organisms. Marine Pollution Bulletin 143, 140–143.

Gambardella C, Morgana S, Bramini M, Rotini A, Manfra L, Migliore L, Piazza V, Garaventa F, Faimali M. 2018. Ecotoxicological effects of polystyrene microbeads in a battery of marine organisms belonging to different trophic levels. Marine Environmental Research 141, 313-321.

Garrido, S., Linares, M., Campillo, J.A., Albentosa, M. 2019. Effect of microplastics on the toxicity of chlorpyrifos to the microalgae *Isochrysis galbana*, clone t-ISO. Ecotoxicology and Environmental Safety 173:103–109.

Giraldo, A., Montes, R., Rodil, R., Quintana, J.B., Vidal-Liñán, L., Beiras, R. 2017. Ecotoxicological evaluation of the UV filters ethylhexyl dimethyl p-aminobenzoic acid and octocrylene using marine organisms *Isochrysis galbana*, *Mytilus galloprovincialis* and *Paracentrotus lividus*. Archives of Environmental Contamination and Toxicology 72:606–611.

Hanke G. et al (incl. F. Regoli) Considerations for MSFD implementation and in preparation of TG Marine Litter monitoring guidance update. (MS in prep.)

Heinrich, P., Braunbeck, T. 2018. Genetically engineered zebrafish liver (ZF-L) cells as an in vitro source for zebrafish acetylcholinesterase (zfAChE) for the use in AChE inhibition assays (2018), Toxicology in vitro 52, 52-59

Heinrich, P., Braunbeck, T. 2019a. Microplastic testing in vitro: Realistic loading of pollutants, surfactant-free solid surface-dosing and bioanalytical detection using a sensitivity-optimized EROD assay, Toxicology in vitro 54, 194-201.

Heinrich, P., Braunbeck, T. 2019b. Bioavailability of microplastic-bound pollutants in vitro: Role of adsorbate lipophilicity and modulation by surfactants. Comparative Biochemistry and Physiology, 221C: 59-67.

Heinrich, P., Braunbeck, T. 2019c. Microplastic alleviates pollutant toxicity in vitro by competing with tissue for highly lipophilic compounds (in revision)

Heinrich, P., Hanslik, L., Kämmer, N., Braunbeck, T. The Tox is in the detail: technical fundamentals for designing and interpreting experiments on toxicity of microplastics and associated substances (review article, in preparation)

Le Bihanic F., Clérandeau Ch., Cormier B., Crebassa J.-C., Morin B., Beiras R., Bégout M.-L., Cousin X., Cachot J. Microplastics as vectors of organic contaminants to fish early life stages. Submitted.

Miranda, T., Vieira, L.R., Guilhermino, L. Neurotoxicity, behaviour and lethal effects of cadmium, microplastics and their mixtures on *Pomatoschistus microps* juveniles from two wild populations - implications to environmental and human risk assessment (submitted to International Journal of Environmental Research and Public Health).

Oliviero, M, Tato, T., Schiavo, S., Fernández, V., Manzo, S., R BEIRAS. 2019. Leachates of micronized plastic toys provoke embryotoxic effects upon sea urchin *Paracentrotus lividus*. Environmental Pollution 247: 706-715.

O’Donovan S, Mestre NC, Abel S, Fonseca TG, Garcia AR, Ilharco LM, Carteny CC, Groffen T, Blust R, Cormier B, Keiter S, Bebianno MJ. 2018. Ecotoxicological effects of organic contaminants adsorbed to microplastics in the clam *Scrobicularia plana*. Frontiers in Marine Science, section Marine Pollution 5 (143), 1-15.

O’Donovan, S., Mestre, N.C., Abel, S., Fonseca, T.G., Carteny, C.C., Cormier, B., Keiter, S., Bebianno, M.J. Ecotoxicological effects of the UV filter, oxybenzone, adsorbed to microplastics in the clam *Scrobicularia plana*. Marine Environmental Research. Submitted.

Pacheco, A., Martins, A., Guilhermino, L. 2018. Toxicological interactions induced by chronic exposure to gold nanoparticles and microplastics mixtures in *Daphnia magna*. Science of the Total Environment 628-629, 474-483.

Pacheco, A., Cunha, S., Keiter, S., Cormier, B., Fernandes, J., Beiras, R., Guilhermino, L. Assessment of acute and chronic toxicity of industrial low density polyethylene pellets, virgin and contaminated with PFOS, and PFOS. (in prep.)

Pannetier P, Cachot J, Clérandeau C, et al. 2019a. Toxicity assessment of pollutants sorbed on environmental sample microplastics collected on beaches: Part I-adverse effects on fish cell line. Environmental Pollution 248 : 1088-1097.

Pannetier P, Cachot J, Clérandeau C, et al. 2019b. Environmental samples of microplastics induce significant toxic effects in fish larvae. submitted to Environment International.

Pittura L, Avio CG, Giuliani ME, d’Errico G, Keiter SH, Cormier B, Gorbi S, Regoli F. 2018. Microplastics as Vehicles of Environmental PAHs to Marine Organisms: Combined Chemical and Physical Hazards to the Mediterranean Mussels, *Mytilus galloprovincialis*. Frontiers in Marine Science, section Marine Pollution 5 (103), 1-15.

Prata, J.C., Lavorante, B.R.B.O., Montenegro, M.C.B.S.M., Guilhermino, L. 2018. Influence of microplatics on the toxicity of the pharmaceuticals procainamide and doxycycline on the marine microalgae *Tetraselmis chuii*. Aquat. Toxicol. 197, 143-152.

Ribeiro, F., Garcia, A.R., Pereira, B.P., Fonseca, M., Mestre, N.C., Garcia, T., Ilharco, L., Bebianno, M.J. 2017. Microplastics effects in *Scrobicularia plana*. Marine Pollution Bulletin 122, 379-391.

Rivera-Hernández JR, Fernández B, Santos-Echeandía J, et al. 2019. Biodynamics of mercury in mussel tissues as a function of exposure pathway: natural vs microplastic routesScience of the Total Environment 674: 412-423.

Sánchez-Marín, P, Fernández-González, L.E., Mantilla-Aladana, L., Diz, A.P., R Beiras. 2017. Shotgun proteomics analysis discards alkali labile phosphate (ALP) as a reliable method to assess vitellogenin levels in marine mussel gonads. Environmental Science and Technology 51 (13), 7572–7580.

Tato, T., González, S., Salgueiro, N., León, V., Beiras, R. 2018. Ecotoxicological evaluation of the risk posed by bisphenol A, triclosan, and 4-nonylphenol in coastal waters using early life stages of marine organisms (*Isochrysis galbana*, *Mytilus galloprovincialis*, *Paracentrotus lividus*, and *Acartia clausi*). Environmental Pollution 232:173-182.

Tato T, Beiras R. The use of the marine microalga *Tisochrysis lutea* (T-iso) in standard toxicity tests; comparative sensitivity with other test species. (submitted to Frontiers in Marine Science).

Town, R.M., van Leeuwen, H.P., Blust, R. 2018. Biochemodynamic features of metal ions bound by micro- and nano-plastics in aquatic media. Frontiers in Chemistry 6: 627.

Vidal-Liñán, L., Villaverde-Sáa, E., Rodil, R., Quintana, J.B., R Beiras. 2018. Bioaccumulation of UV filters in *Mytilus galloprovincialis* mussel. Chemosphere 190: 267-271.

Vieira, L.R., Carteny, C. C., Blust, R., Keiter, S., Cormier, B., Beiras, R., Guilhermino, L. Short-term effects of industrial pellets, virgin and contaminated with PFOS, and PFOS on juveniles of the common goby (*Pomatoschistus microps*). In prep.

LIST OF EPHEMARE CONFERENCE PRESENTATIONS

Albentosa, M. Una nueva amenaza al medio marino: Las Basuras Marinas. Presentation of the Project to the students of the Institute Manuel Tárraga of San Pedro the Pinatar, March 27, 2017.

Albentosa, M. EPHEMARE Project: effects of microplastics in marine ecosystems. Presentation of the project to a delegation of Ministry of the Environment from Turkey, 16 participants. 7-10 November 2016

Albentosa, M., León-León, V.M., Bellas, J., Santos, J., Campillo, J.A. 2017. Comparative exposure of mussels to chlorpyrifos through microplastic and microalgal particles. 16th International Conference on Chemistry and the Environment (ICCE), Oslo (Norway) from the 18th to the 21st of June 2017.

Albentosa M., C.G. Avio, A. Batel, M. Bebianno, M.L. Begout, R. Beiras, J. Bellas, R. Blust, T. Braunbeck, J. Cachot, C.C. Carteny, B. Cormier, X. Cousin, A. Cuesta, M.A. Esteban, M. Faimali, F. Garaventa, S. Gorbi, L. Guilhermino, K. Hylland, S. Keiter, K. Kopke, B. Morin, L. Pittura, F. Regoli, R.M. Town. 2019. Ecotoxicicological effects of microplastics in marine ecosystems: insights from the EPHEMARE project. 20th International Symposium on Pollutant Responses In Marine Organisms (PRIMO20). Charleston, SC USA, May 19 – 22 May. (oral presentation)

Avio C.G., Fattorini D., Di Carlo M., Gorbi S., Regoli F. Distribution and ecotoxicological effects of microplastics in marine organisms. Sixth International Marine Debris Conference, 12-16 March. San Diego, California, USA 2018. (oral presentation)

Avio C.G, Pittura L., Fattorini D., Di Carlo M., Gorbi S., Regoli F. Levels and distribution of microplastics along Mediterranean marine species. Euromarine workshop "Modelling ocean plastics litter in a changing climate: challenges and mitigations. 26-27April, Oporto, Portugal. 2018. (oral presentation)

Avio C.G., Pittura L., Gorbi S., Abel S.M., Amorello S., Regoli F. Distribution of microplastics in Adriatic food webs. International Conference on Microplastic Pollution in the Mediterranean Sea (µMED), Capri, Italy, 26-29 September 2017. (oral presentation)

Avio C.G., Cardelli L., Berlino M., Gorbi S., Pittura L., Benedetti M., Regoli F. Presence, distribution and characterization of microplastics in marine organisms. 30th ESCPB congress, New European Society of Comparative Physiology and Biochemistry, 4-7 September, Barcelona, Spain. 2016. (oral presentation)

Avio C.G., Gorbi S., Berlino M., Regoli F. Presence, distribution and characterization of microplastics in commercial organisms from Adriatic Sea. International Conference:" Fate and Impact of Microplastics in Marine Ecosystems From the Coastline to the Open Sea". 25-27 May, Lanzarote, Canary Islands, Spain. 2016. (Oral presentation)

Avio C.G., Pittura L, Gorbi S., Marino G., Keiter S., Cormier B, Regoli F. Distribution and ecotoxicological effects of microplastics in marine organisms from the Adriatic Sea. MICRO2018 Fate and Impact of Microplastics: Knowledge, action and solutions, 19-23 November, Lanzarote, Spain. 2018. (oral presentation)

Avio C.G., Gorbi S., Cardelli L., Pellegrini D., Regoli F. Extraction and characterization of microplastics in marine organisms sampled at the Giglio island after the costa Concordia Wreck. International Conference:" Fate and Impact of Microplastics in Marine Ecosystems From the Coastline to the Open Sea". 25-27 May Lanzarote, Canary Islands, Spain. 2016. (oral presentation).

Batel, A., Scherer, M., Linti, F., Braunbeck, T. Microplastic uptake in adult zebrafish (*Danio rerio*) in a simulated two-organism food chain. SETAC Europe 25th Annual Meeting, Barcelona (poster presentation).

Batel, A., Borchert, F., Reinwald, Braunbeck, T. Alternative pathways of microplastic exposure – microplastics and associated POPs on zebrafish gills (*Danio rerio*) and zebrafish eggs. SETAC Europe 26th Annual Meeting, Nantes. (Poster presentation).

Batel, A., Scherer, M., Linti, F., Braunbeck, T., Trophic transfer of microplastics and associated POPs. SETAC Europe 26th Annual Meeting, Nantes. (Oral presentation).

Batel, A., Bringer, A., Hess, S., Joassard, L., Bégout, M.L., Braunbeck, T., Cousin, X. Trophic transfer of microplastics in fish larvae. SETAC Germany Annual Meeting, Mutterstadt. (Poster presentation).

Bebianno, M.J., Ribeiro, F., Sendra, M., Mestre, N.C., Garcia, A.R., Ilharco, L., 2016. Estão os bivalves em risco devido à presença de microplásticos nos oceanos? Microplásticos 2016 – 1º Congresso Português sobre Microplásticos: Contaminação Ambiental por Microplásticos e suas Implicações para a Saúde dos Ecossistemas, Animal e Humana. 19-20 December, Porto, Portugal. (Oral presentation).

Bebianno, M. J., 2018. WP 3 & WP 4 - Assess the ecotoxicological effects of exposure to LDPE, with and without adsorbed chemicals BaP, BP3 and PFOS in the clam *Scrobicularia plana*, 4th EPHEMARE Meeting Lanzarote, Spain, 19th November (Oral presentation)

Bebianno, M. J., O'Donovan, S., Ribeiro, F., Rodrigues, A. R., Abel, S., Fonseca, T. G., Carteny, C. C., Blust, R., Cormier, B., Keiter, S. S., Mestre, N. C. 2018. Are microplastics facilitating the accumulation of organic pollutants in benthic bivalves? Micro2018 International Conference, Fate and Impacts of Microplastics: Knowledge, Actions and Solutions, Lanzarote, Spain, 19-23 November (Oral presentation).

Beiras R., Sara Pérez, Tania Tato, Noelia Salgueiro-González, E. Concha-Graña, S. Muniategui-Lorenzo . Do microplastics really act as vectors of organic pollutants to marine zooplankton? Experiments with pyrene and nonylphenol spiked polyethylene using *Paracentrotus lividus* larvae. (Oral presentation). SETAC Europe 27th annual meeting. Brussels. 7-11 May 2017.

Beiras R., L. Mantilla-Aldana, T. Tato, P. Campoy, L. Vidal-Liñán. Bioassays stress the ecotoxicological differences between polymers and plastics additives in the marine environment. (Poster) SETAC Europe 28th annual meeting. Rome. 13-17 May 2018.

Beiras R., T. Tato, S. González, L. Vidal-Liñán, P. Sánchez-Marin. Toxicity of the biocide and plastic additive Triclosan to marine organisms: environmental risk assessment (Poster) SETAC Europe 26th anual meeting. Nantes, France. 22-26 may 2016.

Beiras, R., S. Keiter, R. Blust, X. Cousin, M. Albentosa, T. Braunbeck, F. Regoli, K. Kopke. 2018. Ecotoxicological effects of microplastics in marine ecosystems (EPHEMARE); Synthesis of results. MICRO 2018. Fate and impact of microplastics: Knowledge, actions and solutions, Lanzarote, Spain, 19-23 November 2018. (Oral presentation).

Beiras, R., M. Oliviero, T. Tato. A standard protocol for the assessment of microplastics toxicity using planktonic marine organisms. MICRO 2018, Arrecife (Canary Islands). 19-23 November 2018. Cabildo de Lanzarote, UVSQ, Plymouth University, AWI, Cornell University, Università di Siena, Marine Sciences for Society. (Oral presentation).

Bellas, J., D. Rial, L. Vidal-Liñán, J.A. Campillo, V. M. León, M. Albentosa. 2018. Are microplastics a real environmental threat? Impact on marine invertebrate embryos and larvae, ISMS, International Symposium on Marine Sciences.Vigo, 20-22 junio 2018

Bellas, J., J.A. Campillo, D. Rial, S. Garrido, L. Vidal-Liñán, V.M. León, E. Chaves, B. Fernández, M. Albentosa. 2018. Microplastics as vectors of organic contaminants in the marine environment. MICRO 2018. Fate and impact of microplastics: Knowledge, actions and solutions. Lanzarote, Spain, 19-23 Noviembre 2018.

Bellas, J., Albentosa, M. 2018. Toxicity Assessment. JPIO-Microplastics Projects Joint Final Meeting, Lanzarote, Spain, 20 November 2018.

Blust, R. 2018. Plastic in de oceaan - Wat is het probleem en wat kunnen we doen. Ocean Plastics Lab public debate, Brussels, Belgium, 17 April 2018 (Oral presentation)

Cachot, J), UHei (Batel, A.; Heinrich, T.; Braunbeck, T.), UMU (Espinosa, C.; Esteban, M.A.; Cuesta, A.), UiO (Bour, A.; Hylland, K.), UVi (González, S., Beiras, R.). 2017. Toxicity assessment, WP3 Organism level, WP4 Cellular and Molecular levels – No feeders, planktonic and benthic organisms. 2nd JPI Oceans Conference, Lisbon 26th October.

Campoy-López P, Messinetti S, Mantilla-Aldana L, Ricardo Beiras. Possible estrogenic effects of ethynil estradiol on gonadal maturation in edible sea-urchin *Paracentrotus lividus* L. (Poster) VI International Symposium on Marine Sciences. Vigo. 20-22 June 2018. Universidade de Vigo.

Campoy López P., E. Pereira-Pinto, L. Mantilla-Aldana, R. Beiras. Estrogenic effects of an organophosphorous Flame Retardant (TCPP) on Edible Sea Urchin "*Paracentrotus lividus*". (Poster) SETAC Europe 28th annual meeting. Rome. 13-17 May 2018.

Catarci Carteny, C., Albentosa, M., Bervoetsa, L., Blust, R. 2017. Development of a dynamic uptake model for virgin and contaminated microplastics in the Mediterranean mussel (*Mytilus galloprovincialis*). SETAC Europe 27th Annual Meeting, Brussels, 7-11 May 2017. (Poster)

Catarci Carteny C, Town RM, Blust R. 2018. Furthering the dynamic uptake model for microplastics in blue and Mediterranean mussels. MICRO 2018 International Conference, Fate and Impacts of Microplastics: Knowledge, Actions and Solutions, Lanzarote, Spain, 19-23 November 2018. (Oral presentation).

Catarci Carteny, C., Blust R. 2018. EPHEMARE's activities, Aquimer CONFERENCE on OCEAN MICROPLASTICS ISSUE AND THE BIO-BASED PLASTICS SOLUTION, Brussels, Belgium, 27 June 2018. (Oral presentation)

CIIMAR (Vieira, L; Guilhermino, L.), IFREMER (Crebassa, J-C.; Bégout, M.-L; Cousin, X.), ORU (Cormier, B.; Keiter, S.), UBor (Le Bihanic, F.; Cachot, J.), UHei (Batel, A.; reinwald, H.; Braunbeck, T.), UMur (Espinosa, Esteban, M.A.; Cuesta, A.) 2017. Toxicity assessment, WP3 Organism level, WP4 Cellular and Molecular levels – Fish. 2nd JPI Oceans Conference, Lisbon 26th October.

CIIMAR (Pacheco, A; Guilhermino, L.), IEO (Rial, D.; Garrido, S.; Linares, M.; Bellas, J.; Albentosa, M.), ISMAR (Gambardella, C.; Piazza, V.; Garaventa, F.; Costa, E.), UAlg (O'Donovan, S.; Mestre, N.; bebianno, M.J.), UBor (de Lima, N.; Clérandeau, C.; Morin, B.;

Cormier B, Cabar M, Zapata S, Lagarde F, Morin B, Dubocq F, Clérandeau C, Keiter SH, Bégout ML, Cachot J, Cousin X (2019). Toxicological effects in different stages of zebrafish after direct and trophic exposures to microplastics collected from two Guadeloupe beaches. YES SETAC Meeting, Ghent, Belgium.

Cormier B, Keiter SH, Engwall M, Larsson M, Yeung L, Cachot J (2018). Effets toxiques de microplastiques industriels primaires, en tant que vecteur de pollutants modèles, utilisant le poisson zèbre (Danio rerio). Polymères et Océans, Montpellier, France.

Cormier B, Le Bihanic F, Keiter SH, Engwall M, Larsson M, Yeung L, Clérandeau C, Crebassa JC, Morin B, Bégout ML, Cousin X, Cachot J (2018). EPHEMARE : Méthodologie pour étudier les effets toxiques des microplastiques sur les téléostéens. ECOBIM, 22-25 May 2018, Bordeaux, France. Poster.

Cormier B, Le Bihanic F, Joassard L, Keiter S, Cachot J, Bégout ML, Cousin X (2019) Conséquences physiologiques d'une exposition chronique de poissons à des microplastiques vierges ou contaminés. Polymères et Océans, June24-26, 2019, Créteil, France.

Cormier B., Larsson M., Yeung L., Clérandeau C., Kärrman A., Morin B., Magnus E., Bégout M-L., Cousin X., Cachot J., Keiter S., 2018. Sorption of model pollutants on microplastics and toxicity assessment using early life stage of zebrafish (Danio rerio). SETAC Europe, 28th annual meeting, Rome, May 14-17, 2018 (oral)

Cormier B., Larsson Maria, Yeung Leo, Clérandeau Christelle, Kärrman Anna, Morin Bénédicte, Engwall Magnus, Bégout Marie-Laure, Cousin Xavier, Cachot Jérôme and Keiter Steffen H., 2018. Sorption of model pollutants on microplastics and toxicity assessment using early life stage of zebrafish (Danio rerio). SETAC, Rome, Italy.

Cormier B, Le Bihanic F, Keiter SH, Engwall M, Larsson M, Yeung L, Clérandeau C, Crebassa JC, Morin B, Bégout ML, Cousin X, Cachot J (2018). Toxicité comparée des microplastiques pour les premiers stades de développement de deux poissons modèles. SEFA, Montpellier, France.

Cormier B., Larsson M., Yeung L., Clérandeau C., Kärrman A., Morin B., Engwall M., Bégout M.-L, Cousin X., Keiter S., Cachot J. Toxic effects of industrial primary microplastics, spiked with model pollutants, using zebrafish (Danio rerio). Polymères et Océans, Montpellier, 15-17 January 2018, France (oral)

Cormier B, Le Bihanic F, Zapata S, Keiter SH, Bégout ML, Cousin X, Cachot J (2018). Differential effects of pollutant-spiked Cormier B., Le Bihanic F., Zapata S., Keiter S., Bégout M.-L., Cousin X., Cachot J., 2018. Toxicity assessment of microplastics in early life stages of zebrafish (Danio rerio) and marine medaka (*Oryzias melastigma*). MICRO2018: Fate and Impacts of Microplastics: knowledge, actions and solutions. Lanzarote 19-23 Novembre 2018 (oral).

Cormier B., Cabar M., Zapata S., Lagarde F., Morin B., Dubocq F., Clérandeau C., Keiter S., Bégout M.-L., Cachot J., Cousin X., 2019. Toxicological effects in different stages of zebrafish after direct and trophic exposures to microplastics collected from two Guadeloupe beaches. YES 2019. Ghent 5-10 February 2019 (oral)microplastics on two model fish, zebrafish and marine medaka. MICRO, Lanzarote, Spain.

Costa E, Gambardella C, Piazza V, Lavorano S, Garaventa F, Faimali M. 2018. Are ephyrae jellyfish to be affected by polyethylene microplastics? 8th Biannual ECOtoxicology MEeting (BECOME 2018) Managing aquatic and terrestrial environments: an ecotoxicological perspective. Livorno, Italy, 26-28 November 2018.

Costa E, Piazza V, Gambardella C, Garaventa F, Faimali M. 2016. Trophic transfer of cadmium nitrate in a simplified marine food chain: experimental feeding rate of gelatinous zooplankton *Aurelia* sp. on crustacean Artemia sp. 7th Biannual ECOtoxicology MEeting (BECOME 2016) Managing aquatic and terrestrial environments: an ecotoxicological perspective. 22-24th November 2016, Livorno, Italy.

Costa E, Gambardella C, Piazza V, Lavorano S, Faimali M, Garaventa F. 2018. Trophic transfer of Cadmium nitrate in a simplified marine food chain: experimental feeding rate of gelatinous zooplankton *Aurelia* sp. and Sanderia malayensis on crustacean Artemia sp. Society of Enviromental Toxicology and Chemistry (SETAC), Roma, Italy, 13-17 May 2018

Costa E, Gambardella C, Piazza V, Lavorano S, Faimali M, Garaventa F. 2018. May polyethylene microplastics affect ephyrae jellyfish survival and behaviour? Micro 2018, Lanzarote, Spain, 19-23 November 2018.

Espinosa, C.; CUESTA A; ESTEBAN M .A. POLYVINYLCHLORIDE MICROPARTICLES ADMINISTERED IN DIET TO SPARUS AURATA SPECIMENS AFFECT THE EXPRESSION OF STRESS MARKERS. I CONGRESO DE BIODIVERSIDAD Y CONSERVACIÓN DE LA NATURALEZA. ALMERÍA, SPAIN. 2016.

Espinosa, C.; CUESTA A; ESTEBAN M .A. EFFECT OF POLYVINYLCHLORIDE MICROPARTICLES ON THE LEVELS OF PEROXIDASE AND IMMUNOGLOBULIN PRESENT ON SERUM AND SKIN MUCUS OF GILTHEAD SEABREAM. I CONGRESO DE BIODIVERSIDAD Y CONSERVACIÓN DE LA NATURALEZA. ALMERÍA, SPAIN. 2016.

Espinosa, C.; CUESTA A; ROMERO GARCIA, D.; MESEGUER, J.; ESTEBAN M.A. EFFECT OF DIETARY MICROPLASTICS ON EUROPEAN SEA BASS LIVER AND GUT GENE EXPRESSION. MICROPLÁSTICOS 2016. OPORTO, PORTUGAL. 2016.

Espinosa C, ROMERO D, GURADIOLA FA, ESTEBAN MA, CUESTA A. IN VITRO EFFECTS OF POLYETHYLENE (PE) MICROPARTICLES ON TELEOST FISH LEUCOCYTES. 2017 ICSS & EMN NANOPARTICLES. SAN SEBASTIAN, SPAIN.

Espinosa, C.; GUARDIOLA, FA; CORMIER, B.; KEITER, S.; ESTEBAN M.A.; CUESTA A. EFFECTS OF PERFLUOROOCTANE SULFONATE AND POLYETYLENE MICROPARTICLES ON EUROPEAN SEA BASS (DICENTRARCHUS LABRAX L) IMMUNE STATUS. AQUACULTURE EUROPE 2017, DUBROVNIK, CROATIA.

Espinosa, C.; CORMIER, B.; KEITER, S.; ESTEBAN M.A.; CUESTA A. PERFLUOROOCTANE SULFONATE AND POLYETYLENE MICROPARTICLES ADMINISTERED IN DIET AFFECT THE IMMUNE SYSTEM AND STRESS MARKERS OF EUROPEAN SEA BASS

(DICENTRARCHUS LABRAX L.). 90TH SIBS NATIONAL CONGRESS ON EXPERIMENTAL BIOLOGY IN BASIC AND APPLIED RESEARCH TO THE ENVIRONMENT AND HUMAN HEALTH. TRAPANI (ITALY). 2017.

Fernández González LE, Sánchez-Marín P, Grueiro Noche G, Muniategui Lorenzo S, Diz AP, R Beiras. Endocrine disruption in *Mytilus galloprovincialis*: Is ethynilestradiol a vitellogenin inducer? (Poster) SETAC Europe 28th annual meeting. Rome. 13-17 May 2018.

Fernández, B., M. Albentosa. 2018. Uptake, egestion and accumulation of microplastic in mussel after an experimental exposure. SETAC Europe 28th Annual Meeting, Roma, Italy, 13-17 May 2018.

Fernández, B., R. Mykytka, S. Garrido, M. Albentosa. Feeding behaviour of mussel exposed to microplastics. 2018. ISMS, International Symposium on Marine Sciences.Vigo, 20-22 June 2018.

Fernández, B., M. Morante, S. Garrido, J. Rivera-Hernández, J. Santos-Echeandía, M. Albentosa. 2018. Uptake and distribution of mercury in tissues of mussels exposed to metal-loaded microplastics. SIQUIMAR XIX Iberian Marine Chemistry Seminary.Vigo, 20-22 June 2018.

Fernández-Gonzalez L. E., P. Sanchez Marin, L. Mantilla-Aldana, A. P Diz, R. Beiras. Application of label-free shotgun proteomics to identify and quantify vitellogenin in marine mussels. (Oral presentation). SETAC Europe 27th annual meeting. Brussels. 7-11 May 2017.

Fernández-González L.E., P. Sánchez-Marin, L. Mantilla-Aldana, A.P. Diz, R. Beiras. COMPARISON OF PROTEOMIC AND SPECTROPHOTOMETRIC METHODS FOR VITELLOGENIN MEASUREMENT IN *Mytilus galloprovincialis*. (Poster) V International Symposium on Marine Sciences . Alicante, Spain. 20-22 July 2016. Universidad de Alicante.

Fernández-González LE, Sánchez-Marín P, Vidal-Liñán L, et al. Proteomic and biochemical alterations in mussel gills after exposure to the organophosphate flame retardant TDCPP. SETAC-Helsinki, 2019. Poster.

Gambardella C, Morgana S, Garaventa F, Faimali M. 2018. Swimming behaviour as a new endpoint to assess microplastic effects on marine invertebrates. Micro 2018, Lanzarote, Spain, 19-23 November 2018.

Gambardella C, Morgana S, Ferrando S, Bramini M, Piazza V, Garaventa F, Faimali M. 2016. Lethal and sublethal effects of polystyrene microbeads in marine planktonic crustaceans. 7th Biannual ECOtoxicology MEeting (BECOME 2016) Managing aquatic and terrestrial environments: an ecotoxicological perspective. 22-24th November 2016, Livorno, Italy.

Gambardella C, Costa E, Piazza V, Morgana S, Garaventa F, Faimali M. 2018. Effects of microplastics in marine zooplankton. 8th Biannual ECOtoxicology MEeting (BECOME 2018) Managing aquatic and terrestrial environments: an ecotoxicological perspective. Livorno, Italy, 26-28 November 2018.

Gambardella C, Costa E, Piazza V, Morgana S, Estevez-Calvar N, Ghigliotti L, Stifanese R, Faimali M, Garaventa F. 2016. Microplastics in sea water: preliminary ecotoxicological and field-monitoring evaluation. 7th Bilateral Seminar Italy-Japan, Minamiboso, Japan, 29th November- 2nd December 2016.

Garaventa F, Gambardella C, Piazza V, Morgana S, Costa E, Merotto L, Lavorano S, Parodi R, Pisano V, Fontana M, Iovino E, Bertolotto R, Regoli F, Gorbi S, Cardellini M, Faimali M. 2016. Invisible signs in the future of the sea – Educational laboratory on microplastics during the Italian Science Festival. 2nd International Marine Science Communication Conference, CommOcean 2016, Bruges, Belgium, 6-7th December 2016.

Garaventa F., Maso S., Alborino P., Avio C.G., Costa E., Faimali M., Gambardella C., Mezzelani M, Morgana S., Nardi A., Pittura L., Regoli F., Gorbi S. Less Plastic more Mediterranean": a Research and Awareness campaign in the Mediterranean Sea. 2018 (oral presentation)

Garrido, S., M. Linares, J.A. Campillo, M. Albentosa. 2018. Effect of microplastics on the toxicity of chlorpyrifos to the microalgae Isochrysis galbana, clone t-ISO. SIQUIMAR XIX Iberian Marine Chemistry Seminary, Vigo, 20-22 junio 2018.

González Silvera, D.; KEITER, S.; CORMIER, B.; ESTEBAN M.A.; CUESTA A. IMPAIRED IMMUNE RESPONSE OF EUROPEAN SEA BASS AFTER INGESTION, COMBINED OR SEPARATELY, OF POLYETHYLENE MICROPLASTICS AND OXYBENZONE. SIBIC2018. VII IBERIAN CONGRESS OF ICHTHYOLOGY. ALGARVE, PORTUGAL. 2018.

González Silvera, D.; KEITER, S.; CORMIER, B.; ESTEBAN M.A.; CUESTA A. ANTIOXIDANT AND IMMUNE STATUS OF EUROPEAN SEA BASS AFTER INGESTION, COMBINED OR SEPARATELY, OF POLYETHYLENE MICROPLASTICS AND OXYBENZONE. MICRO2018. LANZAROTE, SPAIN.

Guilhermino, L. 2018. Effects of microplastics and interactions with other contaminants in a warming world: opportunities and challenges for modelling. Workshop ModelPlastics - Modelling Ocean Plastic Litter in a Changing climate: Challenges and Mitigations. Euromarine – European Marine Research Network e CIIMAR. CIIMAR, 26-27 de abril de 2018. (oral communication by invitation).

Guilhermino, L. 2016. Efeitos de microplásticos em organismos marinhos e de água doce: implicações para o funcionamento dos ecossistemas e saúde humana. CPLM - 1ª Conferência Portuguesa sobre Lixo Marinho & Workshop de Investigação sobre Microplásticos. Lisbon, Portugal, 15 September 2016. Abstract Book, 12. (oral communication by invitation).

Keiter S, Cormier B, Borchert F, Hylland K, Kärrmann A, Larsson M, Yeung L, Engwall M (2018). Sorption and bioavailability of model pollutants on microplastics. MICRO, Lanzarote, Spain.

Kopke, K.; Power, S. and Carteny, C.,C. 2018. 'Putting the 'Work' back into Workshop – the EPHEMARE stakeholder workshop on microplastics in the marine environment', Micro2018, 22nd of November, Lanzarote, Spain. (Presentation)

Kopke, K. and Dozier, A. 2018. 'Communication, Dissemination and Stakeholder Engagement for EPHEMARE', JPI Oceans joint final meeting – Microplastics research projects, 20th of November, Lanzarote, Spain. (Presentation).

Kopke, K. and Dozier A., 2018. 'Making Microplastics a Macro Issue'. Communicating Activties in the EPHEMARE Project', JPI Oceans joint final meeting – Microplastics research projects, 20th of November, Lanzarote, Spain. (Poster) 19th -23rd of November.

Lavorante, B.R.B.O.; Prata, J.C.; Montenegro, M.C.B.S.; Guilhermino, L. 2016. Impacts of the pharmaceutical procainamide and microplastics on environmental health: effects on the marine microalgae *Tetraselmis chuii*. ICOETOX – International Conference of Environmental and Occupational Health & IBAMTOX – Ibero-American Meeting on Toxicology and Environmental Health. Porto, Portugal, 21 – 23 June 2016. Abstract Book, 109. (Poster)

Le Bihanic F., Cormier B., Clérandeau C., Crebassa J-C., Morin B., Bégout M-L., Cousin X., Cachot J., 2018 Toxicité comparée des microplastiques pour les premiers stades de développement de deux poissons modèles le médaka marin (*Oryzias melastigma*) et le poisson zèbre (Danio rerio). 14ème colloque international francophone en écotoxicologie aquatique, Ecobim 2018, Bordeaux 22 au 25 mai 2018 (oral)

Le Bihanic F., Clérandeau C., Lima N., Jeannette P., Pannetier P., Crebassa J.-C., Bégout M.-L., Morin B., Cousin X., Cachot J. Quelle toxicité des microplastiques pour les poissons et les lignées cellulaires? GDR Ecotoxicologie Aquatique, Lyon, 22-23 Juin 2017, France (Oral)

Le Bihanic F., Cormier B., Misurale F., Bringer A., Joassard L., Keiter S., Cachot J., Bégout M-L., Cousin X., 2018. Conséquences physiologiques de l'exposition de medaka marin à des microplastiques. 14ème colloque international francophone en écotoxicologie aquatique, Ecobim 2018, Bordeaux 22 au 25 mai 2018 (oral)

Le Bihanic F., Cormier B., Misurale F., Joassard L., Keiter S., Cachot J., Bégout M.-L., Cousin X., 2018. Physiological consequences of chronic exposure of marine medaka to microplastics. MICRO2018, Fate and Impacts of Microplastics: knowledge, actions and solutions. Lanzarote 19-23 Novembre 2018 (oral).

Le Bihanic F., Clérandeau C., Crebassa J.-C., Bégout M.-L., Morin B., Cousin X., Cachot J. Toxicité des microplastiques pour les premiers stades de développement d'un poisson modèle le médaka marin. Polymères et Océans, Montpellier, 15-17 January 2018, France (oral).

Loio Marques, N.; Martins, A.; Guilhermino, L. 2016. Introducción y efectos combinados de la contaminación y alteraciones derivadas del cambio climático global: implicaciones para la salud ambiental, animal y humana. Simposio Salud Ambiental que decorreu a 27 de outubro de 2016, incluído no V Congresso Internacional de la Federación Latinoamericana de Psiconeuroinmunoendocrinologia. Cidad de Mexico, Mexico, 27-29 October 2016. (invited lecture)

López-Ibáñez S, González S., Ricardo Beiras. Ecotoxicological evaluzation of microplastics and hydrophobic organic pollutants by survival bioassays with th emarine copepod Acartia clausi. (Poster) VI International Symposium on Marine Sciences. Vigo. 20-22 June 2018. Universidade de Vigo.

López-Ibáñez S, Beiras, R. IMPACT OF RECOVERED MARINE DEBRIS: ECOTOXICOLOGICAL ANALYSIS USING MARINE PLANKTON. (Poster) MICRO 2018. Arrecife (Canary Islands). 19-23 November 2018. Cabildo de Lanzarote, UVSQ, Plymouth University, AWI, Cornell University, Università di Siena, Marine Sciences for Society.

Mantilla-Aldana L, Pereira-Pinto E, Campoy-López P, Ricardo Beiras. New approach to a quantitative method to estimation of the gametogenic conditions in the edible sea urchin *Paracentrotus lividus* by image analysis. (Oral presentation). Aqua 2018. Montpellier. 25-29 August 2018. World Aquaculture Society.

Mestre, N.C., O'Donovan, S., Abel, S., Fonseca, T.G., Garcia, A.R., Ilharco, L.M., Carteny, C.C., Groffen, T., Blust, R., Cormier, B., Keiter, S., Bebianno, M.J. 2017. Ecotoxicological effects of microplastics with adsorbed contaminants in the clam *Scrobicularia plana*. 2nd JPI Oceans conference. 26 October, Lisbon, Portugal (Poster presentation).

Mestre, N.C., Bebianno, M.J. 2017. WP3&WP4 - Organism toxicity assessment and underlying mechanism of action: *Scrobicularia plana*. EPHEMARE 2nd meeting. 30-31 March, Genova, Italy (Oral presentation).

Mestre, N.C. 2017. Effects of microplastics in the clam *Scrobicularia plana*. Awareness Rising Night: Marine Debris. 6 December 2017, University of Algarve, Faro, Portugal (Oral presentation).

Mestre, N.C. 2017. Potencial impacto dos microplásticos em organismos aquáticos. 2 February 2017. Comemoração do dia Mundial das Zonas Húmidas. ICNF Centro de Educação Ambiental de Marim, Olhão, Portugal (Oral presentation).

Mestre, N. C., O'Donovan, S., Abel, S., Fonseca, T. G., Bebianno, M. J., 2018. Serão os microplásticos fontes de acumulação de poluentes orgânicos em organismos marinhos? Encontro Ciência 2018, Lisbon 8-10th July. (Oral presentation)

Mezzelani M., Avio C.G., Pittura L., Giuliani M.E., Lanzoni I., Nardi A., d'Errico G., Benedetti M., Gorbi S., Regoli F. Emerging pollutants and new challenges for marine ecotoxicology. 7th Bilateral seminar Italy-Japan, 29 November – 2 December, Minamiboso, Japan. 2016. (oral presentation)

Misurale F., Le Bihanic F., Clérandeau C., Morin B., Gambardella C., Cachot J., 2018. Ingestione di microplastiche in molluschi bivalvi e crostacei decapodi campionati nell'estuario della Senna. 49° Congress of the Italian Society of Marine Biology (SIBM), Cesenatico, Italy, 4-8 June 2018.

Misurale F., Le Bihanic F., Clérandeau C., Morin B., Cachot J., 2018. Ingestion de microplastiques par des espèces d'intérêt commercial dans l'estuaire de Seine. 14ème colloque international francophone en écotoxicologie aquatique, Ecobim 2018, Bordeaux 22-25 May 2018 (Poster).

Morgana S, Piazza V, Gambardella C, Costa E, Garaventa F, Faimali M. 2018. Relevance and suitability of invertebrates swimming behavior as sub-lethal endpoint to be considered for ecotoxicological investigation. Society of Enviromental Toxicology and Chemistry (SETAC), Roma, Italy, 13-17 May 2018.

Moscoso-Pérez C, Fernández-González V, Andrade Garda JM, Muniategui-Lorenzo S, Beiras, R. TÉCNICAS ANALÍTICAS PARA LA IDENTIFICACIÓN Y CARACTERIZACIÓN DE PLÁSTICOS DE JUGUETES (Poster) XXIV Encontro Luso-galego de química. Porto. 21-23 November 2018. Sociedade Portuguesa de Química.

Pacheco, A.; Keiter, S.; Cormier, B.; Guilhermino, L. 2018. Effects of low density polyethylene microplastics contaminated with PFOS on *Daphnia magna*. MICRO 2018 – Fate and impact of microplastics: knowledge, actions and solutions. Lazarote, Espanha, 19-23 de novembro de 2018. (oral communication)

Pacheco, A.; Martins, A.; Guilhermino, L. 2018. Reproductive and developmental toxicity caused by gold nanoparticles on the biological model *Daphnia magna*. ICOETox 2018 – 4th International Congress on Occupational & Environmental Toxicology. Matosinhos, Portugal, 24 – 26 de outubro de 2018. Book of Abstracts, 43. (oral communication)

Pacheco, A.; Martins, A.; Guilhermino, L. 2018. Reproductive and developmental effects of microplastics, gold nanoparticles and their mixtures in the crustacean *Daphnia magna*. "Limnologia 2018 – XIX Congresso da Associação Ibérica de Limnologia – Águas interiores e desafios do XXI século: do conhecimento científico à gestão ambiental". Coimbra, Portugal, 24 – 29 julho de 2018. Book of Abstracts, 164. (oral communication)

Pacheco, A.; Martins, A.; Guilhermino, L. 2018. Chronic effects of microplastics and nanoparticles on *Daphnia magna*. CICTA 2018 - 11st Iberian and 8th Iberoamerican Congress of Environmental Contamination and Toxicology – Environmental protection in a

global changing world: technological, scientific and social challenges". Madrid, Espanha, 11 – 13 de julho de 2018. Book of Abstracts, 64. (oral communication)

Pacheco, A.; Guilhermino, L. 2018. Toxicity of low density polyethylene microplastics to the biological model *Daphnia magna*. ICOETox2018 – 4th International Congress on Occupational & Environmental Toxicology. Matosinhos, Portugal, 24-26 de outubro de 2018. Abstract Book, 105. (poster)

Pacheco, A.; Martins, A.; Guilhermino, L. 2016. Effects of emergent contaminants on *Daphnia magna* reproduction: gold nanoparticles and microplastics. Limnología 2016 – XVIII Congress of the Iberian Association of Limnology. Tortosa, Spain, 4-8 July 2016. Book of Abstracts, 51. (oral communication)

Pannetier P., Cachot J., Clérandeau C., Chapelle C., Chouvelon F., Salihu I., Bourgeois J.P, Faure F., Van Arkel K., de Alencastro L.F., Sciacca F. et Morin B. Les plastiques collectés sur nos plages sont-ils toxiques pour les poissons ? Polymères et Océan, 15-17 January 2018, Montpellier (Poster, first price)

Pittura L., Avio C.G., Giuliani M.E., d'Errico G., Keiter S., Cormier B., Gorbi S., Regoli F. Microplastics as Vehicles of Environmental PAHs to Marine Organisms: Combined Chemical and Physical Hazards to the Mediterranean Mussels, Mytilus galloprovincialis. 31st Congress of the European Society of Comparative Physiology and Biochemistry, Porto, 9-12 September 2018 (oral presentation).

Pittura L., Avio C.G, Gorbi S., Abel S.M., Fattorini D., Giuliani M.E., Di Carlo M., Regoli F. Presence and ecotoxicological risk of microplastics in Mediterranean organisms. 19th Congress of Pollutant Responses In Marine Organisms (PRIMO), 30 June – 3 July, Matsuyama, Japan. 2017. (oral presentation)

Pittura L., Avio C.G., Gorbi S., Fattorini D., Di Carlo M., Giuliani M.E., Regoli F. Long term exposure of Mytilus galloprovincialis to benzo(a)pyrene-contaminated LD-PE microparticles. International Conference on Microplastic Pollution in the Mediterranean Sea (µMED), Capri, Italy, 26-29 September 2017. (oral presentation)

Pittura L., Foglia A., Avio C.G., Fatone F., Benedetti M., Regoli F., Sabbatini S., Stipa P., A.L. Eusebi, Gorbi S. Detection, characterization and removal of microplastics in wastewater treatment plants: conventionale vs innovative process. MICRO2018 Fate and Impact of Microplastics: Knowledge, action and solutions, 19-23 November, Lanzarote, Spain. 2018. (poster presentation)

Prata, J.C.; Lavorante, B.R.B.O.; Montenegro, M.C.B.S.; Guilhermino, L. 2016. Effects of microplastics and doxycycline on the marine microalgae *Tetraselmis chuii*. 50ª Reunião Anual da Sociedade Portuguesa de Microscopia. Porto, Portugal, 29-30 June 2016. (Poster)

Regoli, S. Keiter, R. Blust, M. Albentosa, X. Cousin, A. Batel, K. Kopke, R. Beiras. Fate and impact of the microplastics in marine ecosystems: from the coastline to the open sea. (Poster) MICRO 2016 International Conference. Lanzarote, Spain. 25-27th May 2016. UNESCO MaB Programme.

Regoli, F. Keiter, S, Blust, R., Albentosa, M., Cousin, X., Batel, A., Kopke, K, Beiras, R. 2016. Toxicological effect of microplastics in marine environment-EPHEMARE. MICRO 2016, Fate and Impact of Microplastics in Marine Ecosystems: from the coastline to the Open Sea, Lanzarote, Spain, 25-27 May 2016.

Ribeiro, F. G.; Mestre, N.C.; Cardoso, C.; Fonseca, T. G.; Rocha, Thiago Lopes; Fonseca, M.; Pereira, B.; Bebianno, M. J., 2016. Effects of Polystyrene microplastics in *Scrobicularia plana*. 30th ESCPB Congress - unraveling complexity: from molecules to ecosystems, 4-7th September, Spain (Poster presentation).

Rivera-Hernández, J., P. Santos de los Ríos, B. Fernández, S. Garrido, J. Santos, M. Albentosa. 2018. Sorption and desorption kinetics of mercury onto microalgae and microplastics. SIQUIMAR XIX Iberian Marine Chemistry Seminary. Vigo, 20-22 junio 2018

Romero D, Espinosa C, Esteban MA, Cuesta A. In vitro effects of polyethylene microplastics on primary cell cultures and cell lines of fish. MICRO2018. Lanzarote, Spain. (Poster)

Sánchez-Marin P., L. Fernández-González, L. Mantilla-Aldana, A.P. Diz,R. Beiras. Is alkali labile phosphate (ALP) a suitable biomarker forendocrine disruption in marine mussels? (Oral presentation) SETAC Europe 26th anual meeting. Nantes, France. 22-26 May 2016.

Santos-Echeandía, J. Calblanque parque natural…de plásticos. Centro Social Los Belones, Cartagena, 30 June 2018.

Santos-Echeandía, J., B. Fernández, J. Rivera-Hernández, J. Bellas, S. Garrido, L. Vidal-Lián, D. Rial, C. Martínez-Gómez, M. Albentosa. 2018. Adsorption of mercury to microplastics and vectorization to marine organisms. MICRO 2018. Fate and impact of microplastics: Knowledge, actions and solutions. Lanzarote, Spain, 19-23 Noviembre 2018.

Tarasco, M., Gavaia P.G., Bebianno, M. J., Cancela, M. L., Laizé, V., 2018. Osteotoxic effects of polycyclic aromatic hydrocarbons adsorbed to microplastics. Micro2018 International Conference, Fate and Impacts of Microplastics: Knowledge, Actions and Solutions, Lanzarote, 19-23 November (Poster presentation).

Tato T., N. Salgueiro-González, S. González, S. Muniategui-Lorenzo, R. Beiras. Behavior and toxicological effects of bisphenol A onmicroalga (Isochysis galbana), echinoderm (*Paracentrotus lividus*) and crustacean (Acartia clausi) species. (Poster) SETAC Europe 26th anual meeting. Nantes, France. 22-26 may 2016.

Town, R.M., van Leeuwen, H.P., Blust, R. 2019. Potential impact of micro- and nanoplastic particles on metal speciation and bioavailability in aquatic media. SETAC Europe 29th annual meeting, Helsinki, Finland, 26-30 May 2019 (oral presentation)

Verdejo E, Albein, S., Lázaro, A., Ruiz, J., Del Saz, M., Beiras, R., López-Ibáñez, S., Ferrer, E., López-Samaniego, E., Rodríguez, R., Miranda, F.J. REPESCAPLAS: "Valorización material de residuos plásticos recuperados del mar: caracterización, aplicaciones y desarrollo de producto." (Poster) CONAMA. Madrid. 26-29 November 2018. Ministerio de Fomento, Gobierno de España.

Vidal-Liñán, L., J.A. Campillo, B. Fernández, M. Albentosa, J. Bellas. 2018. Comparative role of microalgae and microplastics in the effects of chlorpyrifos on molecular biomarkers in marine mussels. SETAC Europe 28th Annual Meeting, Roma, Italia, 13-17 mayo 2018.

Vieira, L.R, Guilhermino, L. 2019. The presence and effects of microplastics on marine zooplankton: a review. 1st Meeting of the Iberian Ecological Society & XIV AEET Meeting. Barcelona, Spain, 4-7 February. Abstract Book, 322.

LIST OF EPHEMARE NON-SCIENTIFIC, POPULARIZED PUBLICATIONS

Beiras R, Pérez, S. 2017. Microalgae Test Intercalibration conducted in the Ephemare Project with the species Phaeodactylum tricornutum and Isochrysis galbana (T-ISO clone). July-October 2016. Ephemare Report.

Beiras R, Pérez S, Feijoo MP, 2017. Report on the Brachionus plicatilis toxicity tests conducted by UVigo. (July 2016 - March 2017). Ephemare Report.

Ephemare 2018- Articles on the results from Greenpeace campaign:

https://www.greenpeace.org/italy/comunicato-stampa/2362/nuova-ricerca-microplastiche-mediterraneo/

http://www.greenreport.it/news/rifiuti-e-bonifiche/nel-tirreno-microplastica-anche-in-pesci-e-invertebrati-greenpeace-univpm-e-ismar-cnr/

https://www.repubblica.it/ambiente/2018/04/23/news/grenpeace-cnr_in_italia_microplastiche_in_mare_come_negli_oceani_siamo_messi_male_perfino_alle_tremiti_-194610995/

https://www.ilfattoquotidiano.it/2018/04/23/isole-tremiti-e-portici-napoli-come-il-nord-pacifico-alti-picchi-di-microplastiche-nelle-acque-del-mare/4310826/

Ephemare. Technical report of microtox test inter-laboratory comparison between the University of Algarve team, CNR and the University of Vigo.

Ephemare. Preliminary Results and Impacts of EPHEMARE For workshop Handout: http://jpi-oceans.eu/sites/jpi-oceans.eu/files/public/EPHEMARE/Images/About/Antwerp%20Factsheet%20Final.pdf

EPHEMARE Educational Factsheet: http://jpi-oceans.eu/sites/jpi-oceans.eu/files/public/EPHEMARE/Images/About/EducationalFactsheet%2020180403.pdf

EPHEMARE Microplastic Poster for public events: http://jpi-oceans.eu/sites/jpi-oceans.eu/files/public/EPHEMARE/Images/About/MicroplasticsPoster_General.pdf

EPHEMARE contributed entries from the IMPACT 2017 Photo Competition to the Ocean Plastics Lab which exhibited in Turin (Italy), Paris (France), Brussels (Belgium), Washington D.C (USA), Ottawa (Canada) and Berlin (Germany)

EPHEMARE researcher Steffen Keiter of Örebro University presented to King Carl XVI Gustav of Sweden on microplastics and the results of the EPHEMARE project.

EPHEMARE scientists took part in the 'Less Plastic more Mediterranean' mission with Greenpeace in 2017.

MaREI UCC researchers exhibited the EPHEMARE IMPACT 2017 International Microplastics Photo Competition as part of the Science of Sustainability event during the Cork Science Festival, Ireland in 2017.

Vidal Touza, V., Beiras, R. 2018. Efectos dos microplásticos nos ecosistemas mariños. Cerna 78:20-22.

LIST OF EPHEMARE WORKSHOPS, STAKEHOLDER MEETINGS (ETC) (BY APPROX CHRONOLOGICAL ORDER)

Organization of **Ephemare Kick-off Meeeting** in Murcia (Spain), 19-20 January 2016, including talks with stakeholders.

The laboratory of Ecotoxicology of Marche Polytechnic University (UPM) participated in the event "**TIPICITÀ IN BLU**", which was held in Ancona in 2016 and included several teaching laboratories were organised for students, to disseminate information about the Adriatic Sea (ADRIATICOLAB).

EPHEMARE researchers from CNR ISMAR and Marche Polytechnic University participated in the **Italian Festival of Science** (October 27th to November 6th) in **2016**, in Genoa and organised an educational laboratory titled: "Can you tell me where plastics end up?" and a public conference "An ocean of microplastics: invisible signs into sea future".

MICROPLÁSTICOS 2016 - 1º **Congresso Português sobre Microplásticos**: Contaminação Ambiental por Microplásticos e suas Implicações para a Saúde dos Ecossistemas, animal e Humana. Porto, 19 and 20 December 2016. (also in the scope of two other projects) https://www4.icbas.up.pt/microplasticos16/

1st **training course** within the European project EPHEMARE, entitled "Extraction and characterization of microplastics from marine organisms" 27-29 March 2017, Ancona, Italy.

Avio CG, Pittura L, Gorbi S, Regoli F. Technical Document: Training course on "Extraction and characterization of microplastics from marine organisms" Ancona, 27-29 March 2017, 25 pp.

Organization of **2nd Ephemare Annual Meeeting** (2017) in Genoa (Italy), 30-31 March 2017

EPHEMARE scientists from the University of Heidelberg gave a **public talk** about microplastics on board the MS Wissenschaft in 2017.

At the PRIMO meeting "Pollutant Responses in Marine Organisms" in Japan, 30 June – 3 July 2017 Lucia Pittura PhD Student at Polytechnic University of Marche, received the "**Student Presentation Award**" sponsored by Society for Environmental Toxicology & Chemistry (SETAC) for the oral presentation "PRESENCE AND ECOTOXICOLOGICAL RISKS OF MICROPLASTICS IN MEDITERRANEAN ORGANISMS". Lucia presented data derived from the EPHEMARE Project.

EPHEMARE researchers participated in the **'Race for Water' Odyssey** in 2017, harvesting, sampling and analysing microplastics in waters around Bermuda (July) and Guadeloupe (October) and interacted with local stakeholders and residents of both Bermuda and Guadeloupe.

Kathrin Kopke (MaREI UCC) presented EPHEMARE at the **Ocean Teacher Global Academy** (OTGA) course: Ocean Literacy and Story Telling Maps Training Course in Santa Marta, Columbia in September 2017.

Keiter SH, Albentosa M, Avio CG, Batel A, Bebianno M, Begout ML, Beiras R, Bellas J, Blust R, Braunbeck T, Cachot J, Carteny CC, Cormier B, Cousin X, Cuesta A, Faimali M, Garaventa F, Gorbi S, Guilhermino L, Hylland K, Kopke K, Morin B, Pittura L, Regoli F, Town R (2017): EU-projektet EPHEMARE- ekotoxikologiska effekter av mikroplaster i marina ekosystem. **Renare Mark Symposium** – Framtida problem, Östersund, Sweden.

EPHEMARE researchers from CNR ISMAR and Marche Polytechnic University participated in the **Italian Festival of Science** in **2017**, in Genoa which included an educational laboratory 'Plastoc contacts' and organized a public conference about marine litter and microplastics 'Aliens are among us'.

Dr Ricardo Beiras (Ephemare coordinator) was invited by the EC (**DG Research**) to the **Blue Growth Research and Innovation - Horizon 2020 Societal Challenge 2 Information Week**. He presented the project and took part in the discussions. Brussels, Nov 2017.

Organization of the **3rd Ephemare Annual Meeeting** and the **EPHEMARE Stakeholder workshop**, February 2018, Antwerp Belgium, facilitated and implemented by MaREI UCC.

EPHEMARE researchers Camilla Carteny (University of Antwerp), Marco Faimali (ISMAR), Kathrin Kopke and Sophie Power (University College Cork) visited the **Ocean Plastic Lab** exhibition in Brussels, and directly engage with visitors at Container 3, which exhibits the EPHEMARE contributions in April 2018.

Carteny, C.C. 2018. Plastic pollution in our ocean - why is it a problem and what be done about it. **Ocean Plastics Lab public debate**, Brussels, Belgium, 11 April 2018 (Oral presentation)

Carteny, C.C. 2018. Plastique dans l'océan - quel est le problème et que pouvons-nous faire. **Ocean Plastics Lab public debate**, Brussels, Belgium, 18 April 2018 (Oral presentation)

Dr Ricardo Beiras (UVigo), Dr Lucia Guilhermino (CIIMAR) and Dr Francesco Regoli (Marche Polytechnic University) were presenting EPHEMARE at the **EuroMarine Foresight Workshop**: 'Modelling Ocean Plastics Litter in a Changing Climate: Challenges and Mitigations', providing a forum to discuss the issue of plastic pollution in the marine environment in April 2018

EPHEMARE researchers Camilla Carteny (University of Antwerp), Marco Faimali (ISMAR), Kathrin Kopke and Sophie Power (University College Cork) attended the **SEARICA conference Mission Ocean: Science and Innovation for a Healthy Ocean** on the 10th of April 2018 at the **European Parliament**. The conference focused on discussing the issue of marine plastic pollution with international and cross-sectorial guests and coincided with the Ocean Plastics Lab visit to the European Parliament as part of its travelling exhibition.

Participation to **Poly Talk 2018** (Malta, 26-27 April 2018) organized by Plastics Europe to engage with stakeholders to prevent marine litter in the world. Marco Faimali (IAS-CNR) participated to a panel discussion on "Improving efficiency and accelerating innovation to increase circularity-research and innovation"

Dr Marco Faimali, EPHEMARE researcher at CNR-ISMAR attended **PolyTalk 2018** hosted in St. Julians, Malta and was part of a panel discussion in the session 'Improving resource efficiency and accelerating innovation to increase circularity - research and innovation'.

EPHEMARE researchers Jerome Cachot and Xavier Cousin joined artist Roman Kroke to hosted a **student workshop** titled "Microplastics and Medusae: expeditions into H2O." in May 2018.

S. Keiter was invited on behalf of the EPHEMARE consortium to the **ECHA Stakeholder Workshop on Microplastic**, held in Helsinki (Finland) on 30-31 May 2018, where he presented: Keiter SH, Albentosa M, Avio CG, Batel A, Bebianno M, Begout ML, Beiras R, Bellas J, Blust R, Braunbeck T, Cachot J, Carteny CC, Cormier B, Cousin X, Cuesta A, Faimali M, Garaventa F, Gorbi S, Guilhermino L, Hylland K, Kopke K, Morin B, Pittura L, Regoli F, Town R (2018): Knowledge gaps for the ecotoxicological assessment and modelling of microplastics in the sea – Conclusions of the EPHEMARE project.

EPHEMARE researchers from the Spanish Oceanographic Institute (Oceanographic Centre of Murcia) gave a **public talk** about the problem of plastics in the Calblanque Region Park on the 30th of June, 2018 that included a practical session held at a local beach including collection and the study of the plastics found in the sand of the beach.

EPHEMARE representative Camilla C. Carteny gave a **presentation to middle and high-schoolers** demonstrating what microplastics are and how they can effect the marine environment at the by UNESCO, the IOC, and the Surfrider Foundation organized stellar event for World Oceans Day on 8 June where over 200 students attended.

EPHEMARE has given several informative and entertaining seminars about the project at The Oceanographic Center of Murcia (COMU). The presentations took the format of a gastro-scientific seminar to go along with COMU's Friday 'tapas' series. These events are part of the current "**Pint of Science**" initiative, designed to disseminate scientific work to science and beer lovers. June and July 2018

2nd **training course** within the EPHEMARE-BASEMAN European projects, entitled “Extraction and characterization of microplastics from marine organisms” 24-26 July 2018, Ancona, Italy. The event was coordinated by C. G. Avio, L. Pittura, S. Gorbi, and F. Regoli, and with the technical support of Perkin Elmer Italia.

EPHEMARE researchers from CNR-ISMAR attended ***La Festa del Mare*** in Rapallo, Italy August, 2018 with an educational laboratory on the life cycle of plastic.

EPHEMARE researchers from CNR-ISMAR participated in an **educational laboratory** (title: “Plastic Changes”) at FdS2018 in Genova, Italy, from 25 October - 5 November.

EPHEMARE researchers from CNR-ISMAR were present at **Maker Faire 2018** in Rome, Italy with a stand dedicated to explain the problem of marine litter in the environment and the Ephemare project.

EPHEMARE researchers from University of Antwerp were invited as speakers and panelists at the consecutive ‘Plastic Pollution in our Oceans’ series of talks at the **Brussels Royal Museum for Natural Sciences**. The three talks were delivered in English, French and Dutch, with researchers Camilla Carteny and Professor Ronny Blust (both University of Antwerp) representing the EPHEMARE project and their research to the public.

R. Beiras, EPHEMARE coordinator, was invited to the MICRO 2018 side event: **ECHA meeting on REACH restriction on intentional use of microplastics** in the EU, organized by P. Simpson (ECHA) in Lanzarote, Nov 2018.

Putting the ‘Work' back into Workshop – the **EPHEMARE stakeholder workshop** on microplastics in the marine environment. Kopke, K., Power, S., and Carteny, C.C. (In preparation)

LIST OF EPHEMARE PUBLIC ACTIVITIES - FLYERS, BROCHURE, VIDEO/FILM

Bellas, J. *El IEO y la Universidad de Vigo estudian el efecto de los ´microplásticos´ en la ría*. Newspaper: El Faro de Vigo, 18 January 2016.

Bellas, J. *Vivir o mar*. TV: program, Televisión de Galicia, 7 February 2016.

Bellas, J. *Micropartículas de plástico: cuando tu pasta de dientes es un peligro para el medio ambiente.* Newspaper: El Mundo, 15 February 2016.

Bellas, J. España Directo. TV: program. Televisión Española. 8 June 2016.

Bellas, J. *Los microplásticos son ya parte del ecosistema*. Newspaper: ABC 14 October 2016.

Bellas, J. *Plástico, La nueva especie invasora*. Newspaper: Faro de Vigo, 21 May 2017.

Bellas, J. *La Era de Plástico*. TV: program, ‘Equipo Investigación’, La Sexta, 27 May 2017.

Bellas, J. *La sexta noticias*. TV: News program. La Sexta, 22 June 2017.

Albentosa, M. *Microespeferas presentes en la pasta de dientes, detergentes, cremas…un peligro para el medio ambiente y para las personas*. TV: La Sexta News, 6 September 2017. https://www.lasexta.com/noticias/ciencia-tecnologia/pasta-de-dientes-detergentes-cremas-todos-tienen-microesferas-de-plastico-un-peligro-para-elmedioambiente_2017090359ac04f00cf27a5b1bd0ac0d.html

Campillo, J.A., Santos-Echeandía, J., Albentosa, M. *Los microplásticos y su interacción con metales pesados en el medio ambiente*. Newspaper: La Verdad, 23 January, 2018.

Beiras R. Interview and documentary Video for Galicia webcite (GCiencia) “A Sea of plastic”: 2016. http://www.ecotox.gal/es/un-mar-de-pl%C3%A1stico-0

Beiras R. Interview for Spanish Radio (RNE-Radio 5) 2016: “Españoles en la Mar” Programme – “EPHEMARE Project”

Beiras R. Interview and Documentary Film for Spanish TV (La Sexta): "La Era del Plástico". 2018. https://www.lasexta.com/programas/equipo-investigacion/avances/podriamos-vivir-sin-plastico-este-viernes-en-equipo-de-investigacion_201705235924b0410cf20292e7da75f2.html

Beiras R. Interview and Documentary Film for Spanish TV (La Cuatro): "En el punto de mira". 2018. https://www.cuatro.com/enelpuntodemira/punto-mira-completo-HD_2_2625030190.htm

Beiras R. Interview for Spanish Radio (RNE-Radio 5) 2018: " Españoles en la Mar" Programme – "Lanzarote MICRO Congress". http://www.rtve.es/alacarta/audios/espanoles-en-la-mar/espanoles-mar-micro-2018-23-11-18/4854099/

Beiras R. Interview for Spanish Radio and Documentary (Cadena COPE) 2019. https://www.cope.es/ultimo-grito-contra-el-plastico

Beiras R. Report in the newspaper La Voz de Galicia, Especial día del medio ambiente, 5th June 2019, p. 3. https://www.lavozdegalicia.es/noticia/biodiversa/2019/06/05/impacto-poco-treinta-anos-habra-plastico-oceanos-peces/0003_201906G5E2992.htm

Bellas, J. *Herrera en COPE*. Radio: program, COPE, 29 May 2018.

Bellas, J. *El gran cambio global de los océanos*. Newspaper: La Voz de Galicia, 8 June 2018.

Bellas, J. *Los microplásticos colonizan las Cíes*. Newspaper: Faro de Vigo, 9 December 2018.

Martínez-Gómez, C. *Científicos de la Región avanzan en la batalla contra los microplásticos*. Newspaper: La Verdad, 21 January 2019.

Bellas, J. *Basura en España: un problema al cubo*. TV: program, 'La Sexta columna', La Sexta, 29 January 2019.

Blust, R. Drijvende vuilniskar gaat strijd aan met plasticsoep, Gazet van Antwerpen, 9 September 2018

Carteny, C.C. Microplastics zijn overal: tegen 2050 zal er wellicht meer plastic dan vis in de oceanen zitten, vrt NWS, 22 May 2018

We moeten onze oceanen nú beschermen. UAntwerp magazine, December 2017.

https://www.uantwerpen.be/images/online/magazine/MUA26/files/assets/basic-html/index.html#42

Detailed Project Information: http://jpi-oceans.eu/sites/jpi-oceans.eu/files/public/EPHEMARE/Images/News/EPHEMARE_SummaryFactsheets_edited.pdf

Dissemination activity at SHARPER 2018, European Researchers' Night, Ancona, 28 settembre 2018.

Dissemination activity at Inauguration of the Academic Year 2018/19, Università Politecnica delle Marche: inaugural address by Prof.ssa Stefania Gorbi entitled "Pericoli emergenti e pericoli emersi, nuove minacce per la salute del mare". https://www.youtube.com/watch?v=sNgNiIS21qU&index=3&list=PL0fKordpLTjLsYU0A4pph6ZiHdW8Fuk0E

Dissemination activity at the CNR Workshop "FATTI DI PLASTICA" titled "Microplastiche negli organismi marini: distribuzione, effetti e rischi lungo le reti trofiche", Roma, 5 June 2018

Dissemination activity at the workshop "Allarme blu. Oceani: il futuro da salvare" entitled: "Plastiche e microplastiche negli oceani: da contaminanti emergenti ad emergenza ambientale", Padova University, 8 June 2018.

Dissemination activity at SHARPER 2017, European Researchers' Night, Ancona, 29 settembre 2017.

Dissemination activity at SHARPER 2016, European Researchers' Night, Ancona, Italy, 30 September 2016.

Dissemination activity at Italian Festival of Science, Genova, Italy, 27th October.

EPHEMARE researcher Marina Albentosa from the Spanish Institute of Oceanography featured on local TV channel TV7 on the programme 'Country Journal', on how plasics in the sea affect marine fauna. http://webtv.7tvregiondemurcia.es/divulgativos/diario-del-campo/2018/martes-10-de-abril/

EPHEMARE's Camilla C. Carteny, University of Antwerp was interviewed by Belgian newscast (RTL) highlighting EPHEMARE and explaining the science of the OPL exhibitions which exhibited the pictures from the EPHEMARE organised contest in April 2018.

EPHEMARE partners at UPM attended the annual academic inauguration 2018/2019 at Polytechnic University Ancona on 26 March. The discussion was framed around the topic "Pericoli emergenti e pericoli emersi… nuove minacce per la salute del mare." https://www.youtube.com/watch?v=sNgNiIS21qU

EPHEMARE featured in an article in the regional newspaper La Verdad, published on January 23, 2018. EPHEMARE scientists Juan Santos-Echeandía and Juan A. Campillo spoke about metal pollution in the Mediterranean, while Marina Albentosa comments on the studies that are being carried out under the EPHEMARE project on the role of microplastics as heavy metal transporters.

Italian Festival of Science 2018 - http://festival2018.festivalscienza.it/site/home.html

Italian Festival of Science 2017 - http://festival2017.festivalscienza.it/site/home.html

Italian Festival of Science 2016 - http://festival2016.festivalscienza.it/site/home.html

Results on Greenpeace campaign 2018 https://www.youtube.com/watch?v=pSD3IRIjkPs

Italian Festival of, Genova, Italy, seminar entitled "Meno Plastica più Mediterraneo", 27 October 2018. http://www.festivalscienza.it/site/home/programma/meno-plastica-piu-mediterraneo.html

InTOUR 2017. "Plastiche e microplastiche negli oceani: da contaminanti emergenti ad emergenza ambientale" Milan 23 May, Rome 25 May 2017. file:///C:/Users/ufficio/Downloads/INTour_Flyer_-2017_IT_MILANO.pdf; http://www.chimiciroma.it/files/Corsi_altri_enti/Locandina_25_05_2017_PerkinElmer_Ordine.pdf

Kärrman A, Keiter SH, Rotander A (2017): Microplastic in the Baltic Sea – a small problem with big consequences. Seminar for the Swedish King Carl XVI Gustaf at Örebro University, Sweden. https://www.oru.se/nyheter/nyhetsarkiv/nyhetsarkiv-2017/kunskap-fran-fyra-forskare-ar-kungens-70-arspresent/

Newsletter 2016: http://jpi-oceans.eu/sites/jpi-oceans.eu/files/public/EPHEMARE/Images/News/EPHEMARE%20E-Newsletter%20Issue%201%20(December%202016).pdf

Newsletter 2017: http://jpi-oceans.eu/sites/jpi-oceans.eu/files/public/EPHEMARE/Images/News/Newsletter%202017_A4.pdf

Newsletter 2018: http://jpi-oceans.eu/sites/jpi-oceans.eu/files/public/EPHEMARE/Ephemare_Newsletter_2018_Final.pdf

Participation to the oceanographic cruise in the Mediterranean organized by Greenpeace "Less Plastic more Mediterranean"and organization of dissemination activity during the OPEN BOAT DAY in Genova, Pozzuoli and Ancona. July 2017: https://www.cnr.it/it/nota-stampa/n-8073/nel-mediterraneo-livelli-di-microplastiche-paragonabili-a-quelli-dei-vortici-di-plastica-del-pacifico; http://www.greenpeace.org/italy/it/ufficiostampa/rapporti/Microplastic-investigation-in-water-and-trophic-chain-along-the-Italian-coast-/; https://tg24.sky.it/ambiente/2018/04/23/greenpeace-microplastiche-mediterraneo.html; http://www.repubblica.it/ambiente/2018/04/23/news/grenpeace-cnr_in_italia_microplastiche_in_mare_come_negli_oceani_siamo_messi_male_perfino_alle_tremiti_-194610995/; http://www.rinnovabili.it/ambiente/microplastiche-nel-mediterraneo-picchi/; http://www.repubblica.it/ambiente/2018/04/23/foto/dalle_cinque_terre_alle_tremiti_a_caccia_di_microplastiche-194615405/1/#1; http://www.today.it/ambiente/mare-plastica-italia-2018.html; http://www.greenpeace.org/italy/it/ufficiostampa/comunicati/Microplastica-anche-in-pesci-e-invertebrati-lo-conferma-una-ricerca-GreenpeaceUNIVPMISMAR-CNR----/; http://www.greenpeace.org/italy/it/ufficiostampa/rapporti/Microplastic-investigation-in-water-and-trophic-chain-along-the-Italian-coast-/; http://www.repubblica.it/ambiente/2018/06/21/news/greenpeace_microplastiche_in_un_quarto_di_pesci_e_invertebrati-199626226/; http://www.lasicilia.it/news/sostenibilita/169511/microplastiche-anche-in-pesci-e-invertebrati.html; https://tg24.sky.it/ambiente/photogallery/2018/06/21/greenpeace-microplastiche-mar-tirreno.html; https://www.ilfoglio.it/adn-kronos/2018/06/21/news/microplastiche-anche-in-pesci-e-invertebrati-201687/; http://247.libero.it/focus/44654135/1/microplastiche-anche-in-pesci-e-invertebrati/; http://www.rinnovabili.it/ambiente/inquinamento-da-microplastiche/

Participation to the research activities in collaboration with Race 4 Water Foundation, to evaluate distribution of microplastics in marine organisms from Guadalupe, October 2017: http://www.greenreport.it/news/rifiuti-e-bonifiche/race-for-water-catamarano-solare-caccia-microplastiche-nel-mare-gauadalupe-video/; http://www.vivereancona.it/2017/10/13/guadalupe-proseguono-i-campionamenti-dellunivpm-sul-race-for-water/656719/; https://www.rivieraoggi.it/2017/11/26/254597/race-for-water-in-corsaper-salvare-i-mari-dallinquinamento/; https://www.facebook.com/UNIVPM/videos/738235416364010/; https://www.youtube.com/watch?v=9_zp8q2qnLI.

Participation at the national television broadcast “Mi manda RAI 3” (from minute 02:24:36) http://www.raiplay.it/video/2016/12/Mi-Manda-Raitre-3c344b99-6b65-4419-86d7-5a40cb881f55.html

Project Overview Brochure: http://jpi-oceans.eu/sites/jpi-oceans.eu/files/public/EPHEMARE/Images/About/EPHEMARE%20Brochure%2023102017.pdf

Seminar by invitation: “Plastiche e Microplastiche negli Oceani, una nuova minaccia per la salute del mare” (Relatore Prof. Stefania Gorbi), organized by Rotary Club Ancona e Rotary Club Ancona-Conero, Teatro delle Muse 2 October 2018, Ancona.https://www.disva.univpm.it/sites/www.disva.univpm.it/files/disva/files/news/plastiche%20e%20microplastiche.jpg

LIST OF EPHEMARE SOCIAL MEDIA ACTIVITIES

2017 - Participation to the campaign "Less Plastic, More Mediterranean" promoted by Greenpeace, aimed at monitoring the status of plastic contamination in sea water and arise public opinion attention about this problem.

2017 - Participation to the campaign “Odyssey” promoted by “Race for Water”, aimed at monitoring the status of plastic contamination in sea water and arise public opinion attention about this problem.

2017- Participation of Marco Faimali to the Italian TV program “Rai News 24” on April 2017 https://www.youtube.com/watch?v=EKMD4SD5ZL0

2017- Interview of Francesca Garaventa published in the magazine “The Medi Telegraph” on June the 2017 http://www.themeditelegraph.com/it/green-and-tech/pollution/2017/06/22/beware-microfragments-poisoning-the-sea-Fyr9FAjNY8iqpzu7Otj0aP/index.html

2018- Participation of Francesca Garaventa to the Italian TV program “Geo&Geo” on May the 3rd 2018 and Radio 24 (http://www.ismar.cnr.it/eventi-e-notizie/notizie/le-plastiche-nel-mediterraneo, from minute 1:41:30; http://www.ismar.cnr.it/file/divulgazione/radio-e-tv/GARAVENTA%20EDIT%20Kiss%20kiss%20radio%2024%2004%2018.mp3/at_download/file)

Ana Luísa Ribeiro; Alexandre Pacheco and Lúcia Guilhermino, L. organized in collaboration with the “Núcleo do Porto dos Estudantes de Bioquímica” the Workshop “Ferramentas bioquímicas em estudos ambientais: avaliação de efeitos neurotóxicos de poluentes em moluscos” that included na introduction talk and a laboratorial session where the methods and results of the EPHEMARE project (and other projects) were disseminated. XI ENEBIQ – Encontro Nacional de Estudantes de Bioquímica. ICBAS-UP, Porto, Portugal 26th March 2018.

Bebianno, M. J. Plásticos menores do que 0,5 mm encontrados em bivalves. TVI Portuguese televisión cannel, 30th December 2018.

Bebianno, M.J. Combater o plástico na UALG, 16th November 2018.

Bebianno, M. J. UALG estuda o impacto dos microplásticos em espécies marinhas. Dia Mundial dos Oceanos, TVI Portuguese television channel, 12 de Junho 2018

Bebianno, M. J. Efeitos de microplásticos em seres marinos, 24th May 2018, RTP1 Television Channel.

Bebianno, M. J., UALg elimina plásticos de cantinas e bares. 15th of November 2018 RTP1 Television Channel

Bebianno, M. J Microplásticos encontrados em mexilhões e ostras no Algarve - Revista Sábado 19th November 2018

“EPHEMARE - Ecotoxicological effects of microplastics in marine ecosystems” on Research Gate. https://www.researchgate.net/project/EPHEMARE-Ecotoxicological-effects-of-microplastics-in-marine-ecosystems. 106 followers and 987 reads (latest checked February 15th, 2019).

EPHEMARE Twitter: 454 followers since its launch in 2017, on average 24 new followers per month, on average 44 tweets per month, reached over 145 000 people since its launch of the EPHEMARE twitter account

EPHEMARE Facebook: 493 followers since its launch in 2016, on average 24 new likes per month, on average 15 posts per month and reached over 105 000 people

Gastro-scientific seminars intends to combine social activities we carry out at the IEO, the snack on Fridays, with scientific activities. In the relaxed environment provided by the snack, we showed the advances that EPHEMARE has produced. This initiative is part of the current 'Pint of Science' started in England in 2013 whose objective is to disseminate scientific work to science and beer lovers. Among the most characteristic pinchos of our region is the marinera (Russian salad mounted on a bread donut and topped with an anchovy), hence the title of this cycle of seminars: 'A round of EPHEMARineras'

Guilhermino, L. 2018. “Ferramentas bioquímicas em estudos ambientais: avaliação de efeitos neurotóxicos de poluentes em moluscos - Introdução”. Workshop “Ferramentas Bioquímicas em estudos ambientais: avaliação de efeitos neurotóxicos de poluentes em moluscos.” XI ENEBIQ – Encontro Nacional de Estudantes de Bioquímica. ICBAS-UP, Porto, Portugal 26th March 2018. (Talk)

Guilhermino, L. 2017. Efeitos de microplásticos em organismos aquáticos – projeto EPHEMARE. # EU in My Region, An Open Sea for Innovation, Talks with Science. CIIMAR, Matosinhos, Portugal, 13th May 2017.

Guilhermino, L. 2017. Effects of microplastics, nanomaterials, pharmaceuticals, and temperature in freshwater and estuarine organisms. Lecture in the advanced course on “Disturbed streams”. University of Coimbra, Portugal.

Guilhermino, L., Vieira, L.R. 2017. Ecotoxicological Effects of Microplastics in Marine Ecosystems – EPHEMARE / Efeitos ecotoxicologógicos de microplásticos. Printed summary (in Portuhiese) of the project EPHEMARE distributed in several dissemination/outreach activities.

Guilhermino, L. Lectures with case studies of project experiments in several courses of BSc, Master and PhD Programes of the University of Porto, other Universities in Portugal and abroad. 2007 and 2018.

Vieira, L.R. 2017. “Lixo marinho: um problema global”. Introductory talk to the activity “Limpeza de Praia/ Beach Cleaning” organized by SeaLife Porto and CIIMAR. Porto, Portugal, 22th September 2017.

As a result of the 2015 call for research proposals 'Microplastics in the marine environment', four projects (BASEMAN, EPHEMARE, PLASTOX and WEATHER-MIC) were funded under the framework of JPI Oceans by the following ministries and funding agencies:

belspo

AGENCE NATIONALE DE LA RECHERCHE ANR

Bundesministerium für Bildung und Forschung

Marine Institute Foras na Mara

MIUR MINISTERO DELL'ISTRUZIONE DELL'UNIVERSITA' E DELLA RICERCA

NWO Netherlands Organisation for Scientific Research

The Research Council of Norway

FCT Fundação para a Ciência e a Tecnologia

GOBIERNO DE ESPAÑA MINISTERIO DE ECONOMÍA, INDUSTRIA Y COMPETITIVIDAD

FORMAS

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