Strategies for MarIne Litter and Environmental
prevention of sea pollution in coastal areas

Marine litter: più gestione a terra meno rifiuti in mare

Approcci e soluzioni a partire dal progetto Life+ SMILE

Focus sulle microplastiche: caratterizzazione e rischi

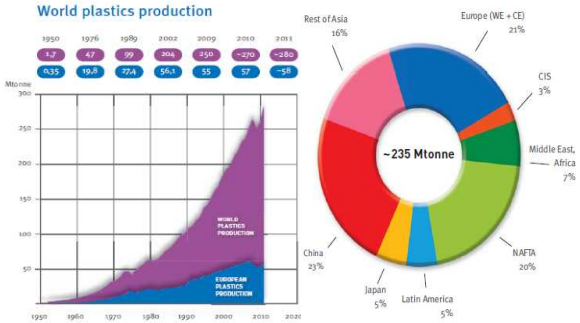
Prof. Francesco Regoli

Dipartimento di Scienze della Vita e dell'Ambiente

Università Politecnica delle Marche

ECOMONDO 03.06 NOVEMBRE 2015 RIMINI - ITALY
THE GREEN TECHNOLOGIES EXPO
19ª FIERA INTERNAZIONALE DEL RECUPERO DI MATERIA ED ENERGIA E DELLO SVILUPPO SOSTENIBILE

PLASTICHE NELL'AMBIENTE MARINO

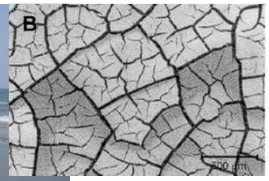


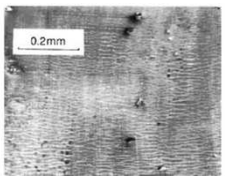
Da 0.5 milioni tonn/anno a oltre 280 negli ultimi 60 anni

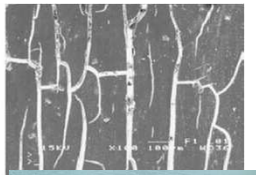
Circa il 10% di questi materiali finisce in mare

La degradazione in mare è molto lenta (anche centinaia di anni) per la temperatura e l'ossigeno

I quantitativi in mare sono enormi e ubiquitari, dai poli agli abissi







PLOS ONE

RESEARCH ARTICLE

Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea

Marcus Eriksen[1*], Laurent C. M. Lebreton[2], Henry S. Carson[3,4], Martin Thiel[5,6,7], Charles J. Moore[8], Jose C. Borerro[9], Francois Galgani[10], Peter G. Ryan[11], Julia Reisser[12]

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Life

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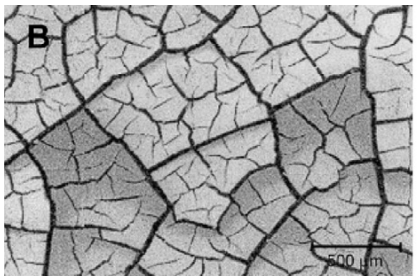
ORIGINE DELLE MICROPLASTICHE
(frammenti < 5mm)

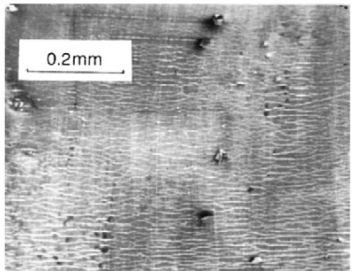
(a) Produzione diretta

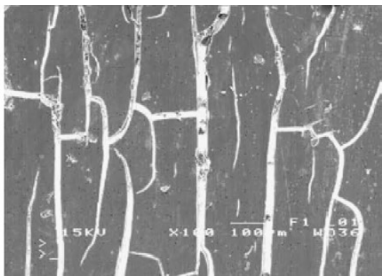
Microparticelle plastiche usate come esfolianti in formulazioni cosmetiche

Abrasivi industriali, paste abrasive (sferule acriliche e poliesteri)

(b) Degradazione delle meso- e macroplastiche







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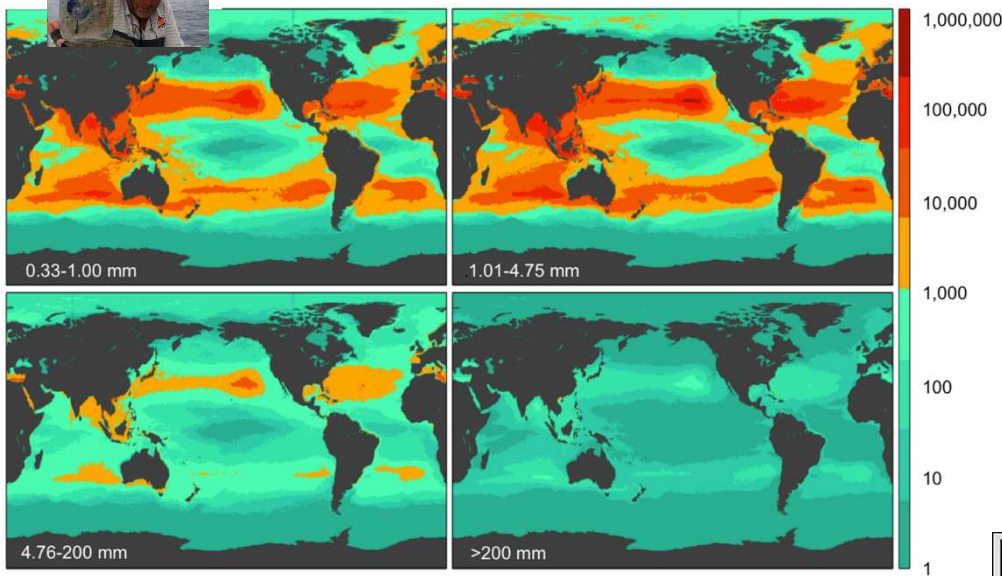
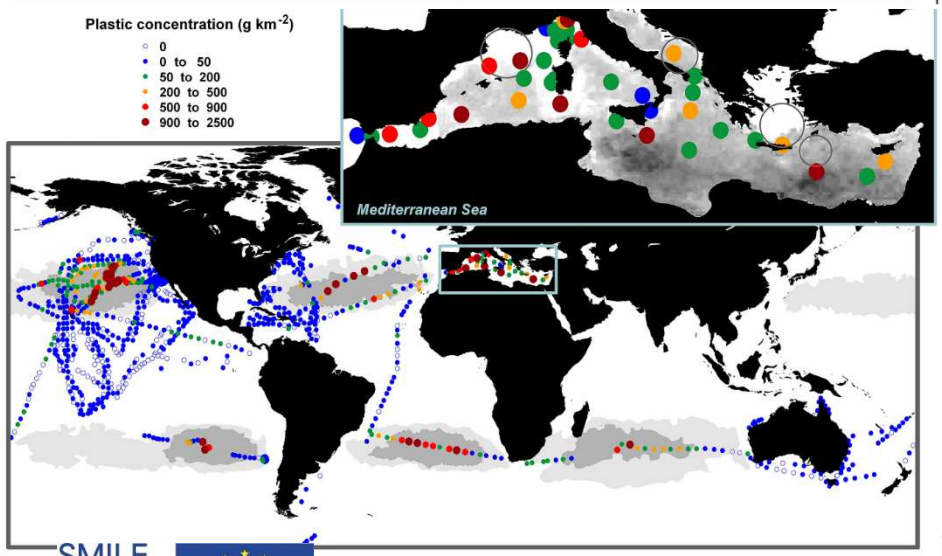
MISURAZIONE DELLE PLASTICHE NELL'AMBIENTE MARINO

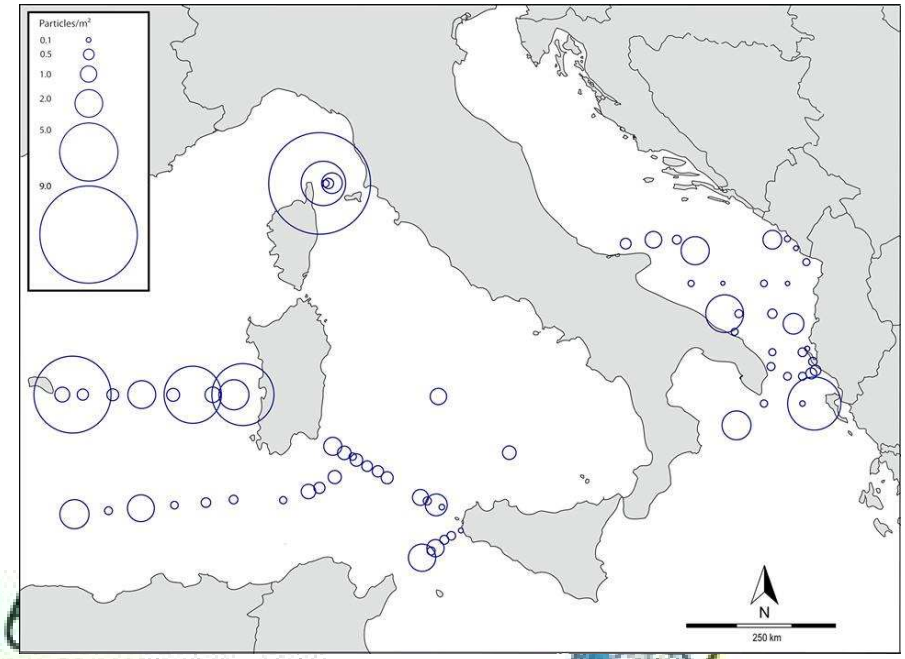


Stime di densità di macro e microplastiche negli oceani del mondo (Eriksen et al, 2014) valutano un minimo di **5.25 miliardi particelle** fluttuanti per gli oceani che pesano **270.000 tonnellate**: 1000 particelle /m² (Law et al., 2014) nel North Pacific Subtropical gyre

Densità media calcolata da Cozar in **Mediterraneo** è pari a **240.000 particelle/km²**

Densità media calcolata in Mediterraneo da ISMAR **1.700.000 particelle/Km²** con punta di 8.400.000 particelle/km² a nord della Corsica.





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TIPICI EFFETTI DELLE PLASTICHE IN MARE









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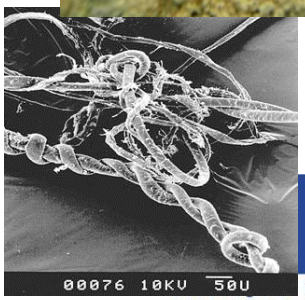
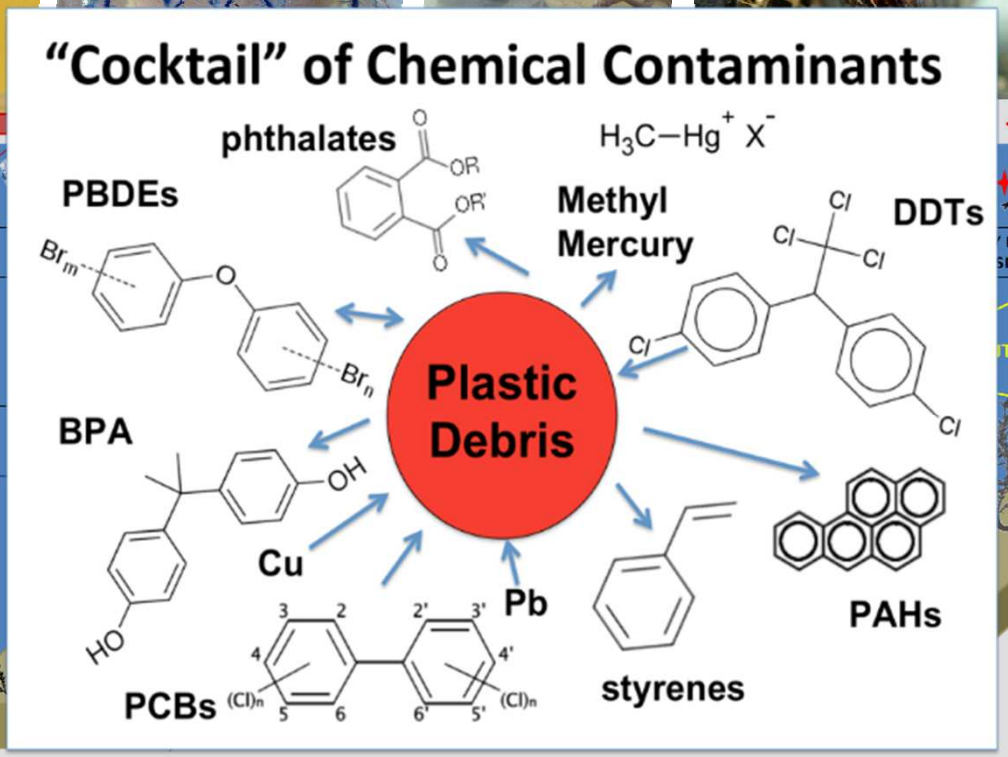
NUOVI RISCHI ECOTOSSICOLOGICI DELLE MICROPLASTICHE

Accumulate nel biota, inducono pseudosazietà, danni fisici e meccanici

..ma possono anche "accumulare" inquinanti e trasferirli nella rete trofica





Life for MarIne Litter and Environmental prevention of sea pollution in coastal areas

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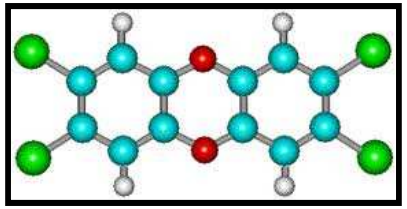
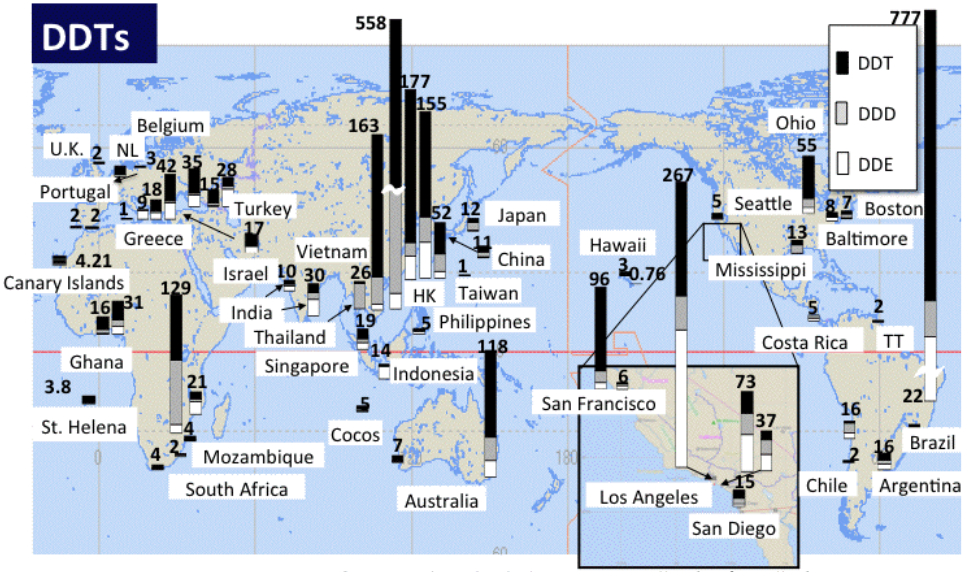
Contaminanti adsorbiti sulle plastiche

Concentration of PCBs* in beached plastic resin pellet (ng/g-pellet)

*sum of concentrations of CB#66, 101, 110, 149, 118, 105, 153, 138, 128, 187, 180, 170, 206
Measured by Polaris Q (Thermo Fisher Scientific)





Concentration of DDTs in beached plastic resin pellet (ng/g-pellet)

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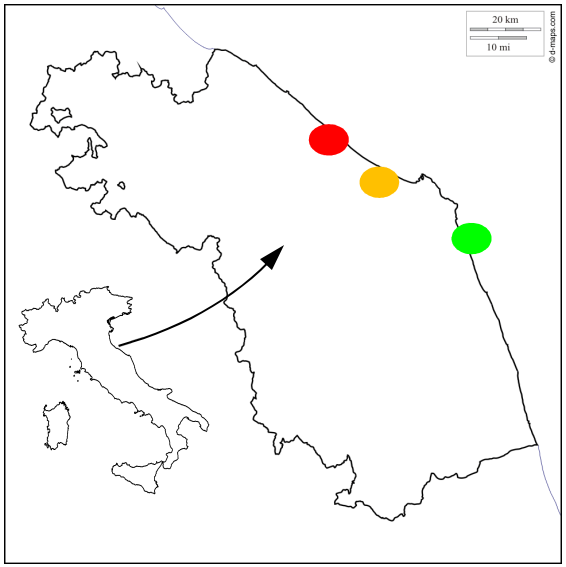
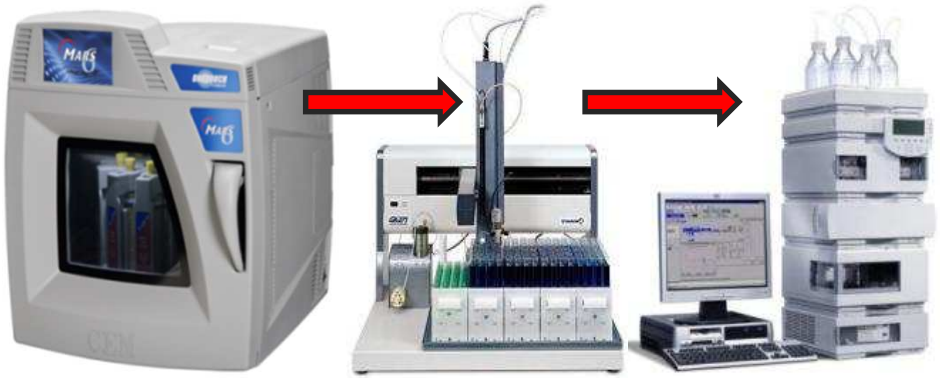
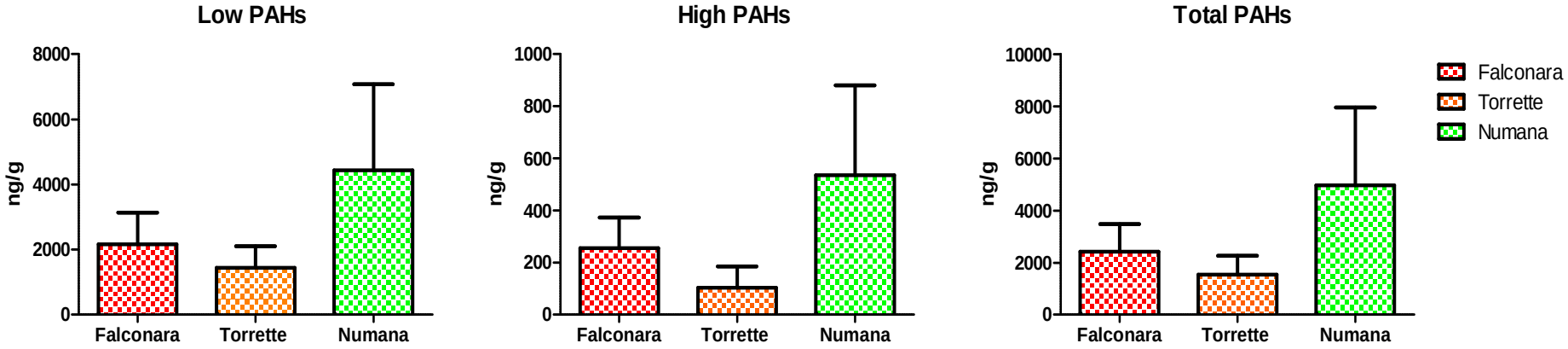
IPA sulle microplastiche nelle spiagge Adriatiche



Estrazione ed analisi di 18 IPA sulle microplastiche





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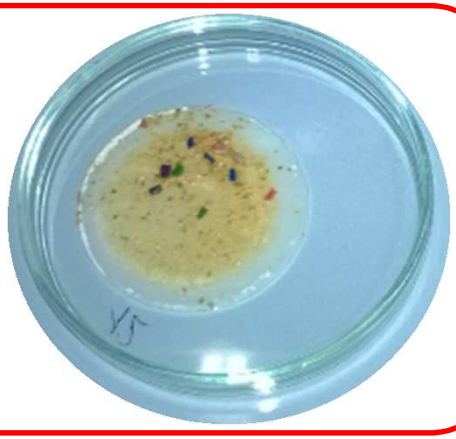
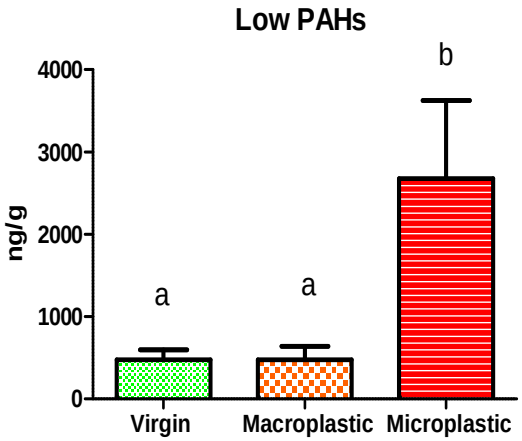
Concentrazioni di IPA su plastiche vergini, macroplastiche spiaggiate e microplastiche

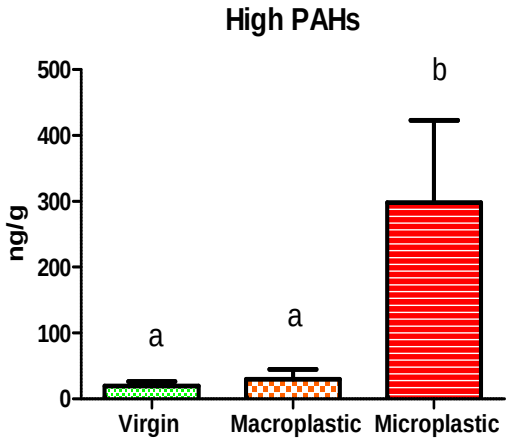
Virgin plastics

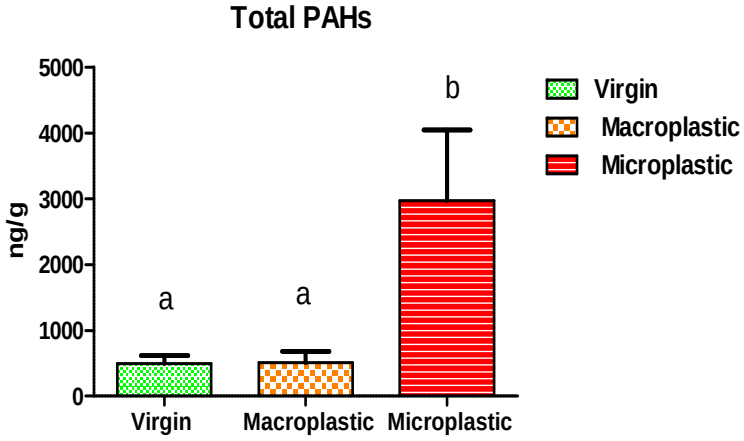
Macroplastics

Microplastics









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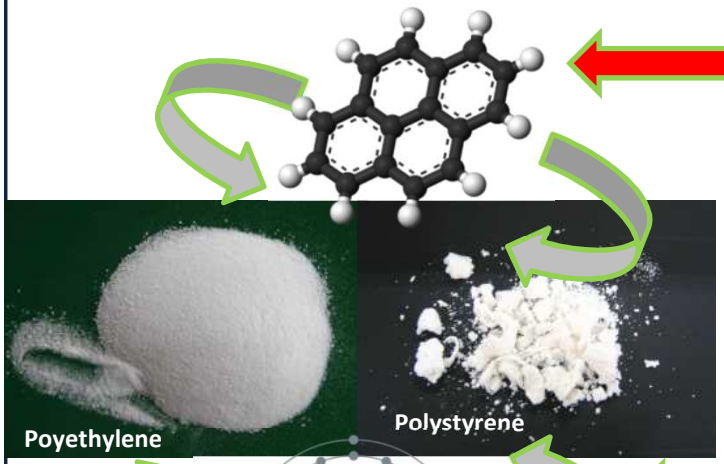
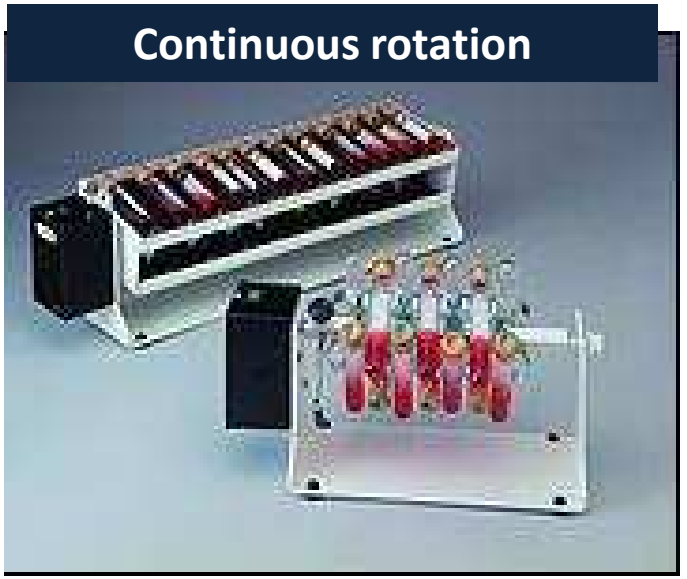
VALUTAZIONE SPERIMENTALE DELLE CINETICHE DI ADSORBIMENTO DI INQUINANTI CHIMICI SULLE MICROPLASTICHE

- **2 polimeri, polietilene e polistirene**
- **2 periodi a breve termine (3 e 6 giorni)**
- **3 dosi di pirene**
- **2 dosi di cadmio**



Pirene:
- **Low 0.5 µg/L**
- **Medium 5 µg/L**
- **High 50 µg/L**



Cadmio:
- **Low 5 µg/L**
- **Medium 15µg/L**

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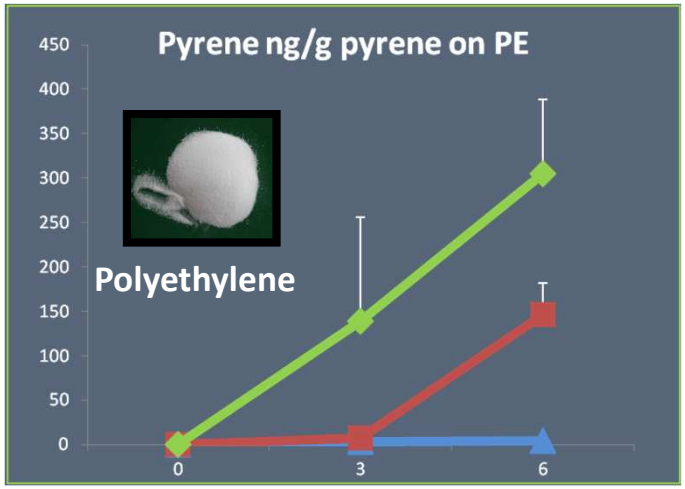
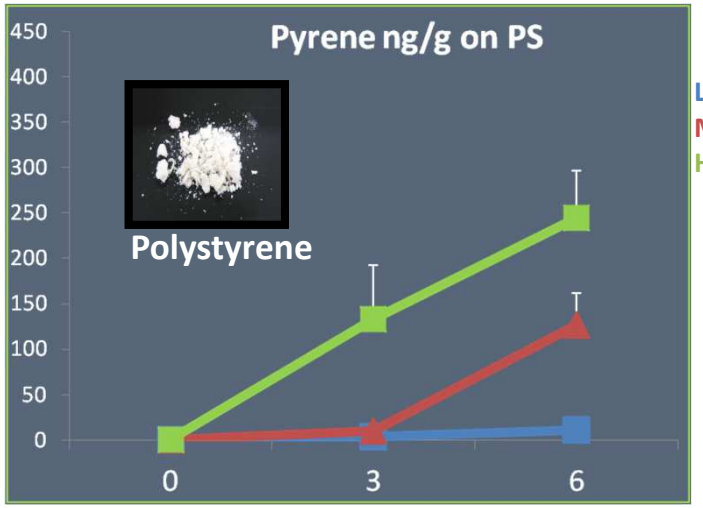
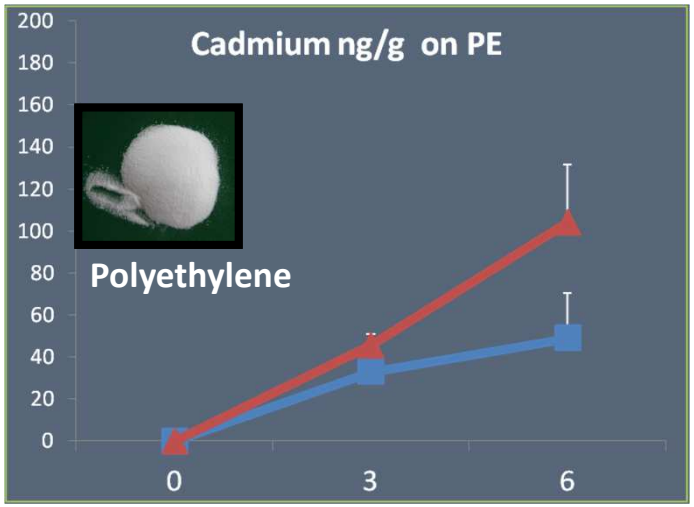
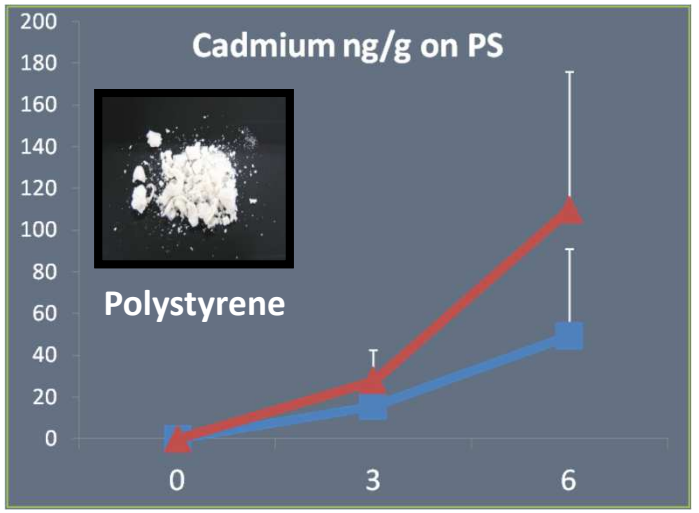
ADSORBIMENTO DI PIRENE E CADMIO





Low pIrene [0.5 µg/L]
Medium pIrene [5 µg/L]
High pIrene [50 µg/L]





Low Cadmio[5 µg/L]
Medium Cadmio [15 µg/L]

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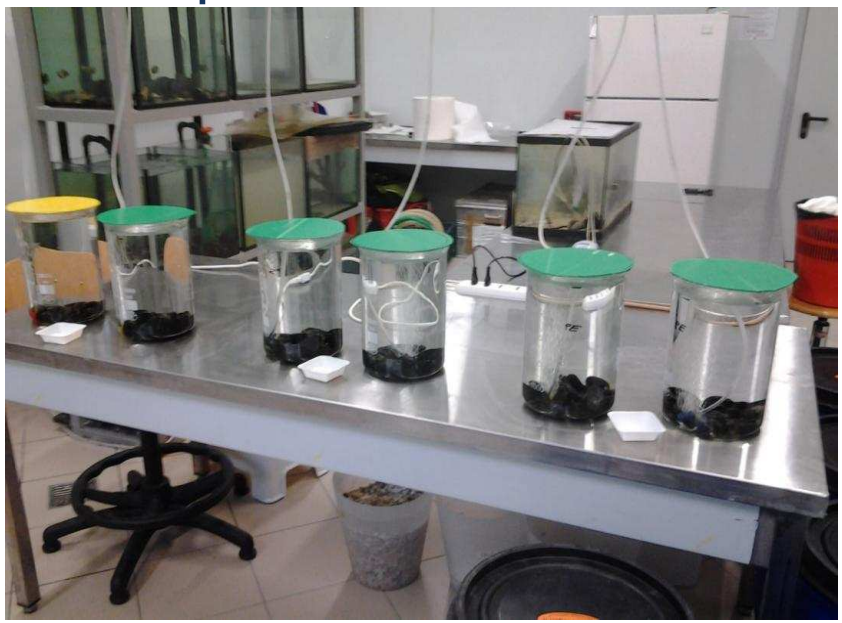
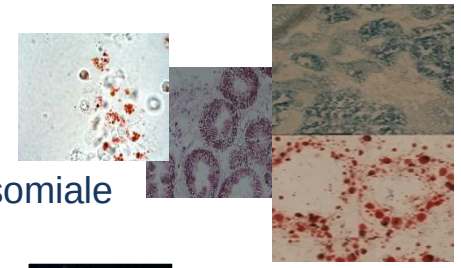
ESPOSIZIONE DI MITILI ALLE MICROPLASTICHE

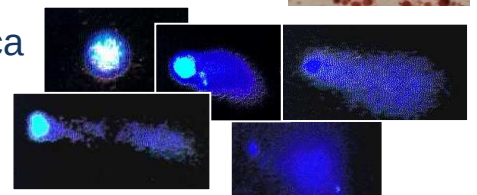
Microparticelle di PE e PS, vergini o pre-trattate con pirene

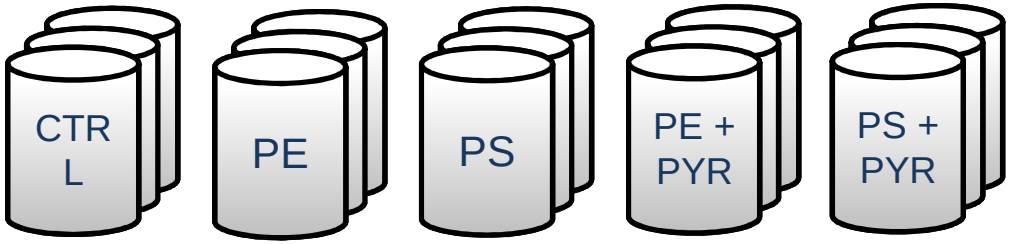


- Biodisponibilità e accumulo di pirene
- MPs: localizzazione istologica
- Biomarker cellulari, biochimici e molecolari

Alterazioni lisosomiali
Risposte immunitarie
Effetti neurotossici
Proliferazione perossisomiale
Difese antiossidanti
Perossidazione lipidica
Effetti genotossici
Integrità del DNA
Profilo espressione genica







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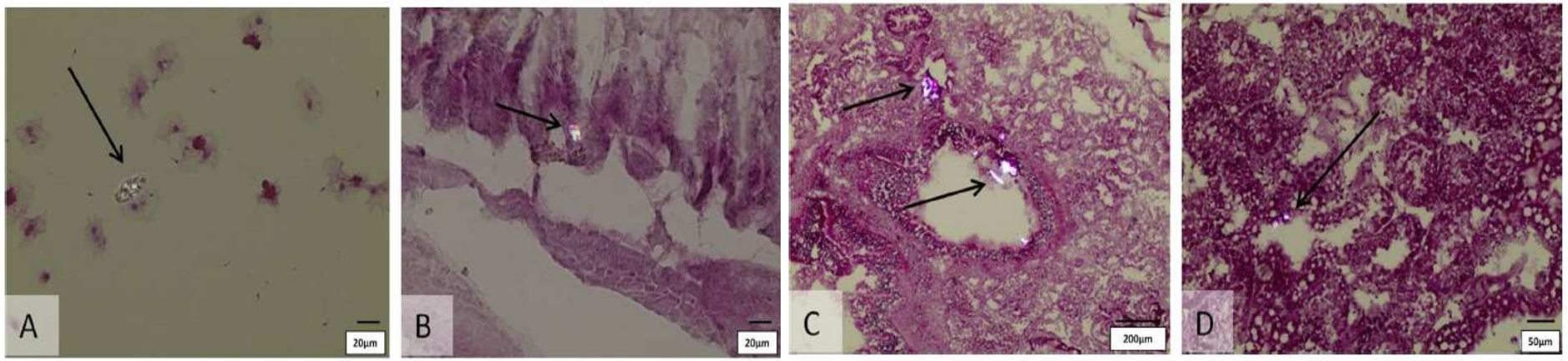
Environmental Pollution 198 (2015) 211–222
Contents lists available at ScienceDirect
Environmental Pollution
journal homepage: www.elsevier.com/locate/envpol

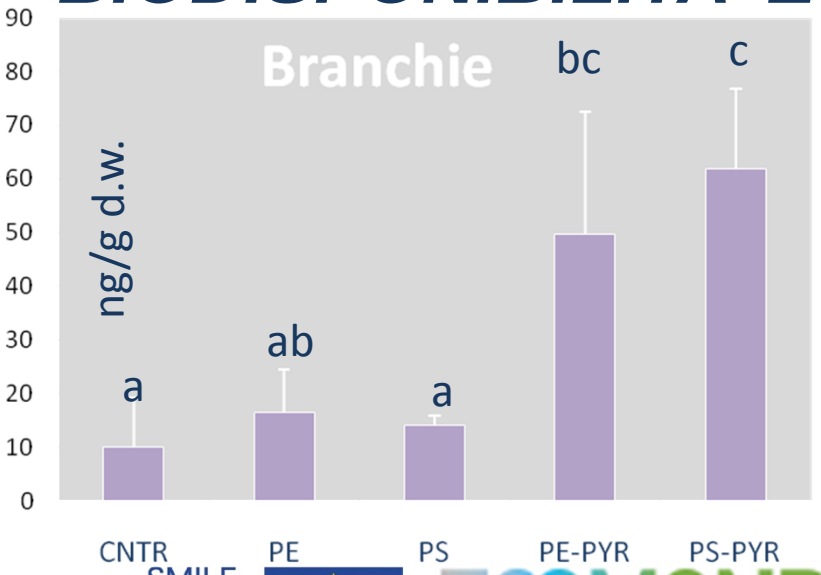
Pollutants bioavailability and toxicological risk from microplastics to marine mussels

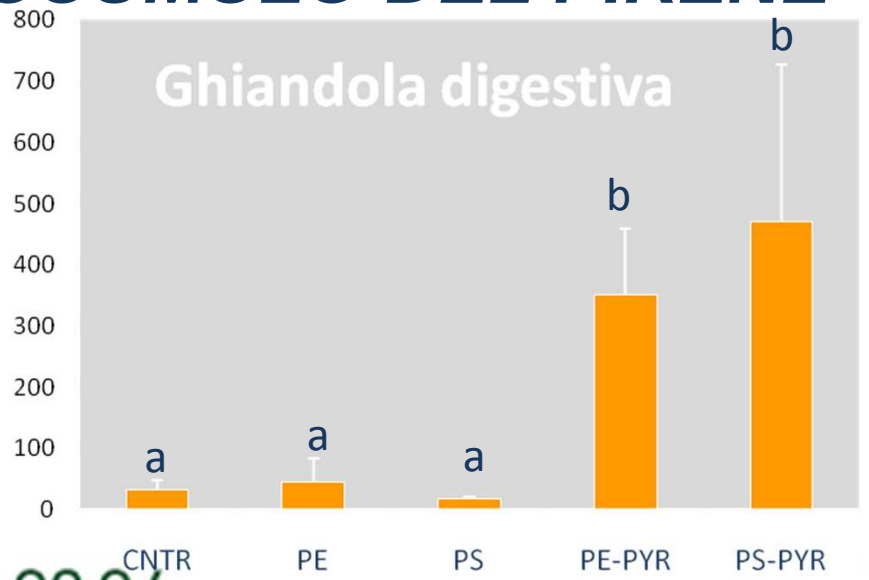
Carlo Giacomo Avio [a], Stefania Gorbi [a], Massimo Milan [b], Maura Benedetti [a], Daniele Fattorini [a], Giuseppe d'Errico [a], Marianna Pauletto [b], Luca Bargelloni [b], Francesco Regoli [a,*]

UPTAKE & COMPARTIMENTALIZZAZIONE DELLE MPs



BIODISPONIBILITA' E ACCUMULO DEL PIRENE





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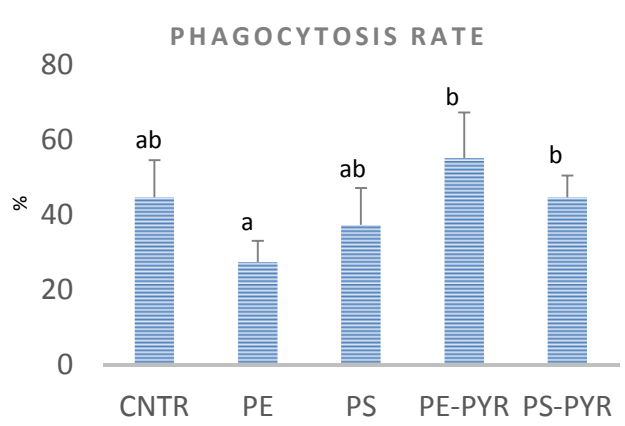

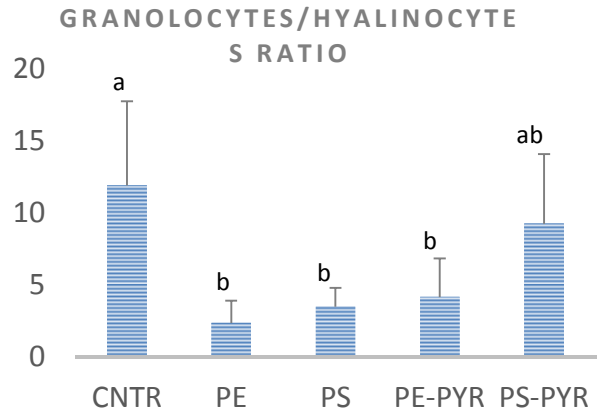

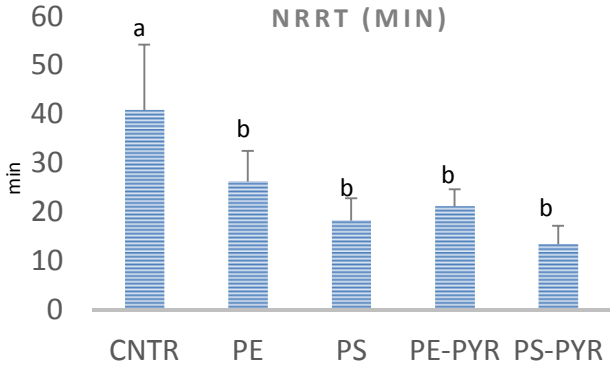

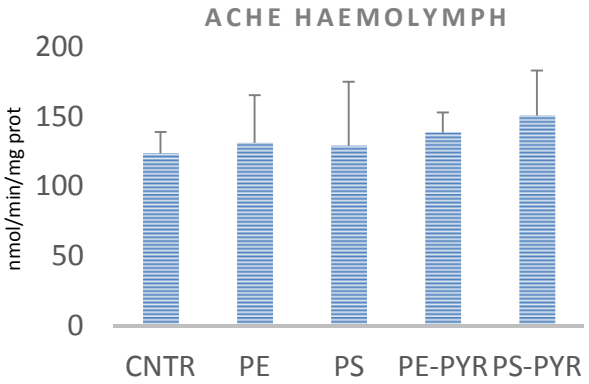

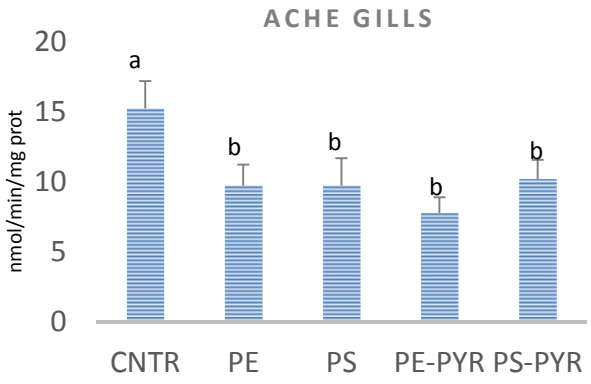

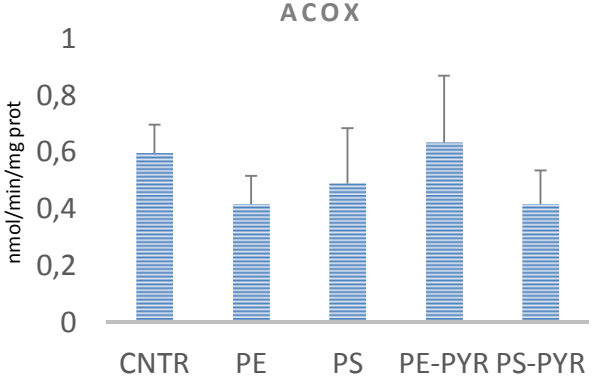

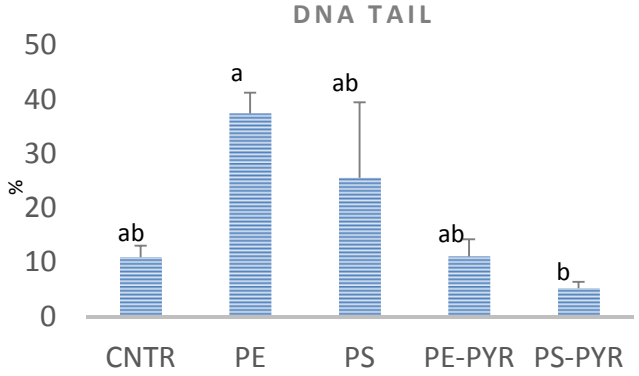

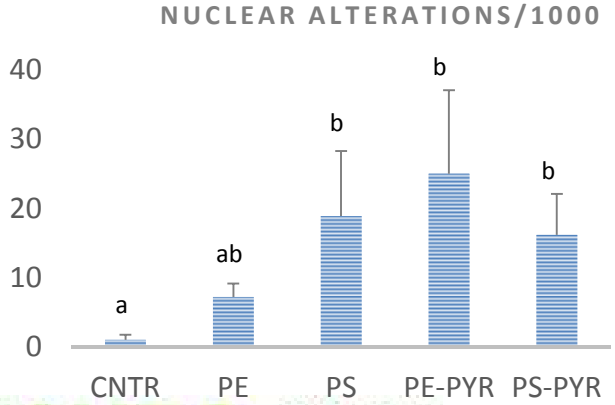

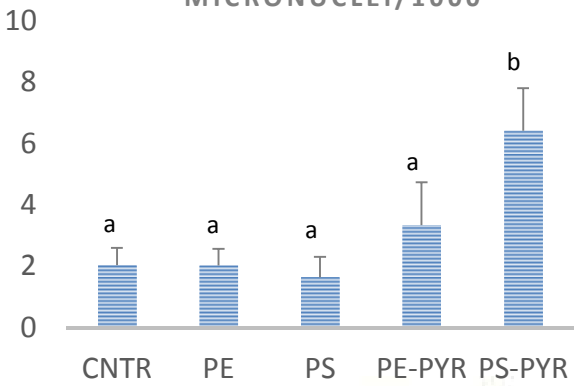

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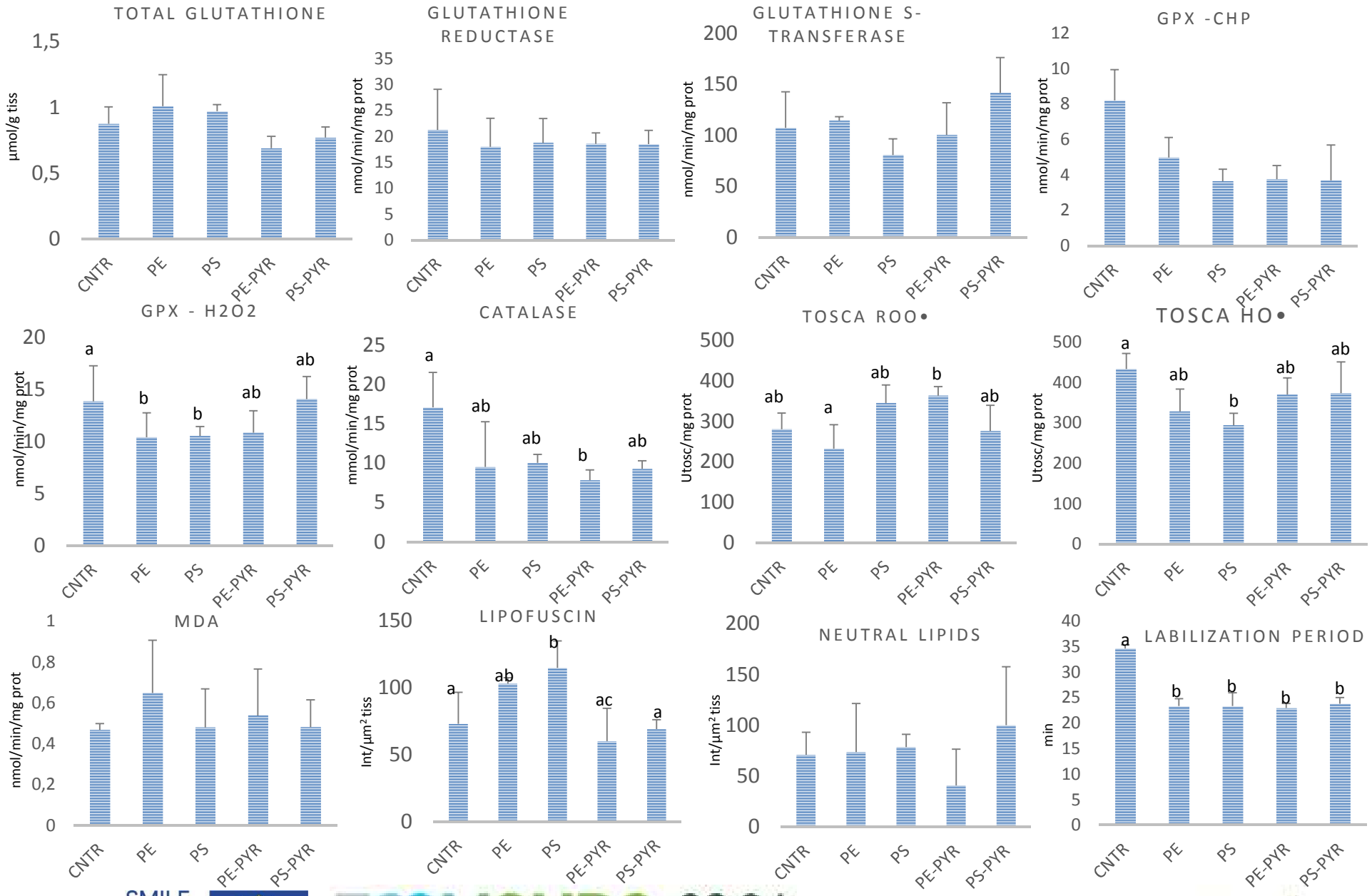

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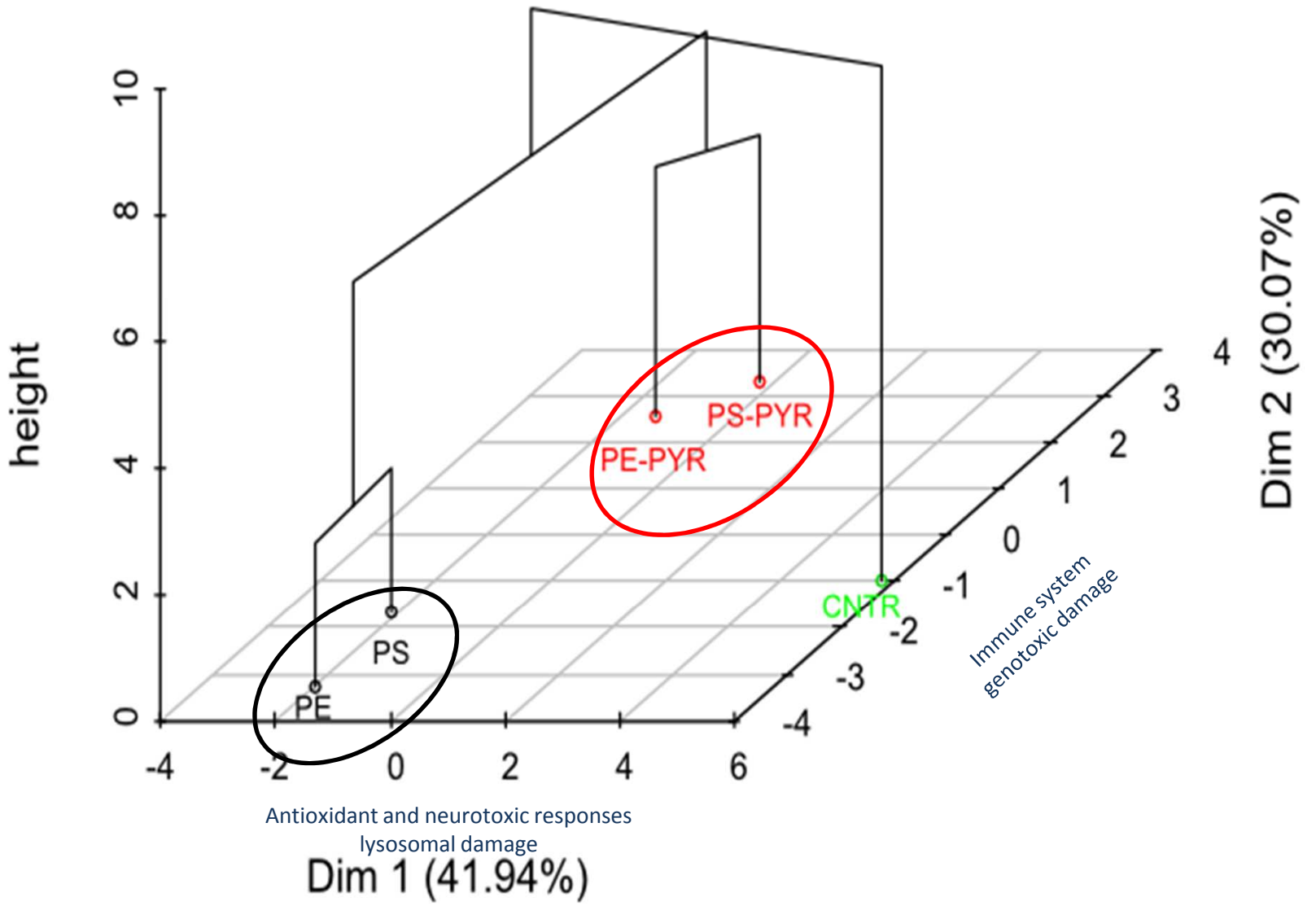
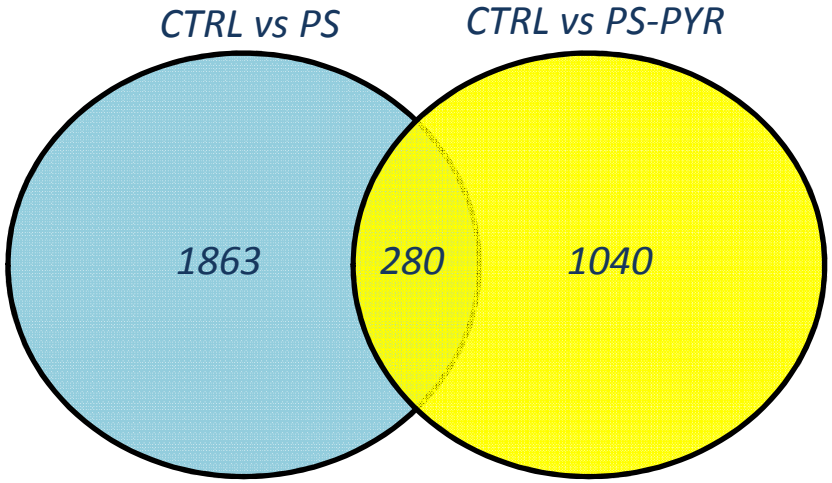
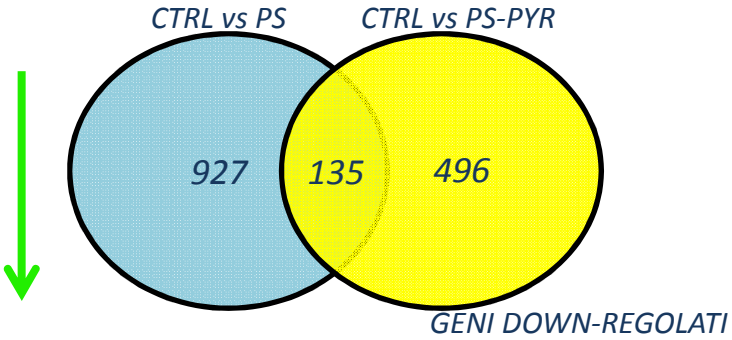
Hierarchical clustering analysis



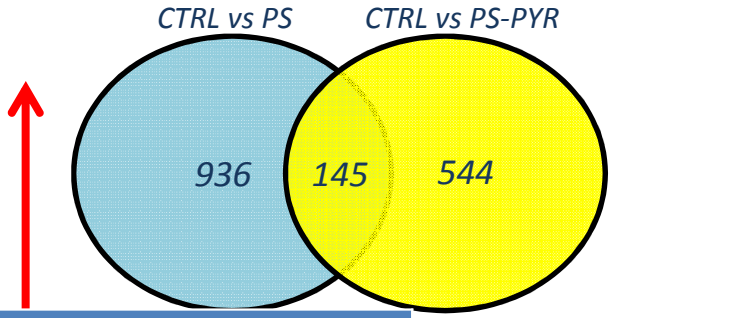
Risultati trascrittomica



TOTALE DI GENI DIFFERENZIALMENTE ESPRESSI



GENI DOWN-REGOLATI



GENI UP-REGOLATI

CNTR vs PS		CNTR vs PS-PYR	
KEGG	N° DEGs	KEGG	N° DEGs
LYSOSOME	16	LYSOSOME	15
MEMBRANE PROTECTION	9	MEMBRANE PROTECTION	6
ENDOSOME	6	ENDOSOME	3
APOPTOSE	7	APOPTOSE	8
PATHWAYS NOD-like receptor	4	PATHWAYS NOD-like receptor	7
REGOLATION OF PROGRAMMED CELL DEATH	5	REGOLATION OF PROGRAMMED CELL DEATH	8
RESPONSE TO BACTERIUM	5	RESPONSE TO BACTERIUM	3
CYCLE TCA	8	CYCLE TCA	3
ARACHINOID ACID METABOLISM	5	ARACHINOID ACID METABOLISM	3

SVILUPPO DI UNA NUOVA PROCEDURA DI ESTRAZIONE DELLE MPs DAI TESSUTI DI ORGANISMI MARINI

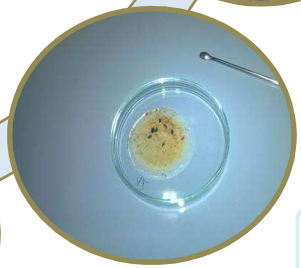
1. Preparazione e spike con MPs

2. Essiccamento

3. Triturazione

4. Separazione su gradiente di densità e filtrazione sotto vuoto

5. Digestione parziale in H_2O_2



6. Visual sorting

7. Caratterizzazione dei polimeri in FT-IR

MPs extraction from gastrointestinal samples

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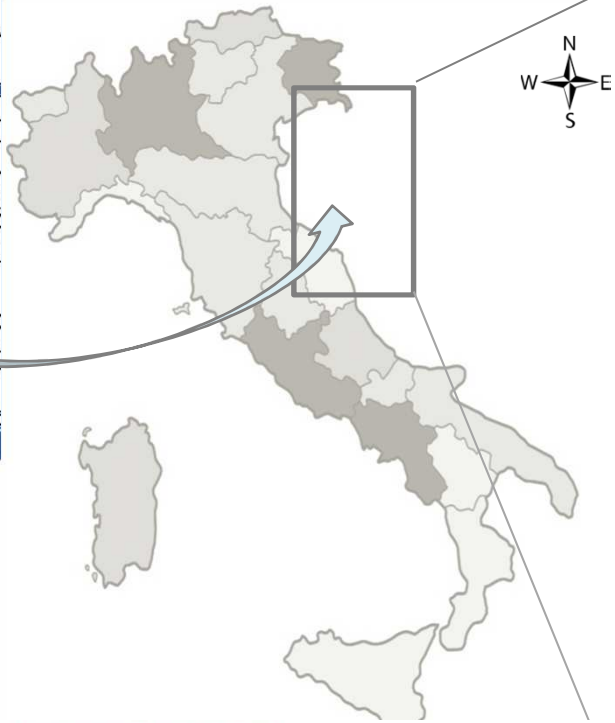
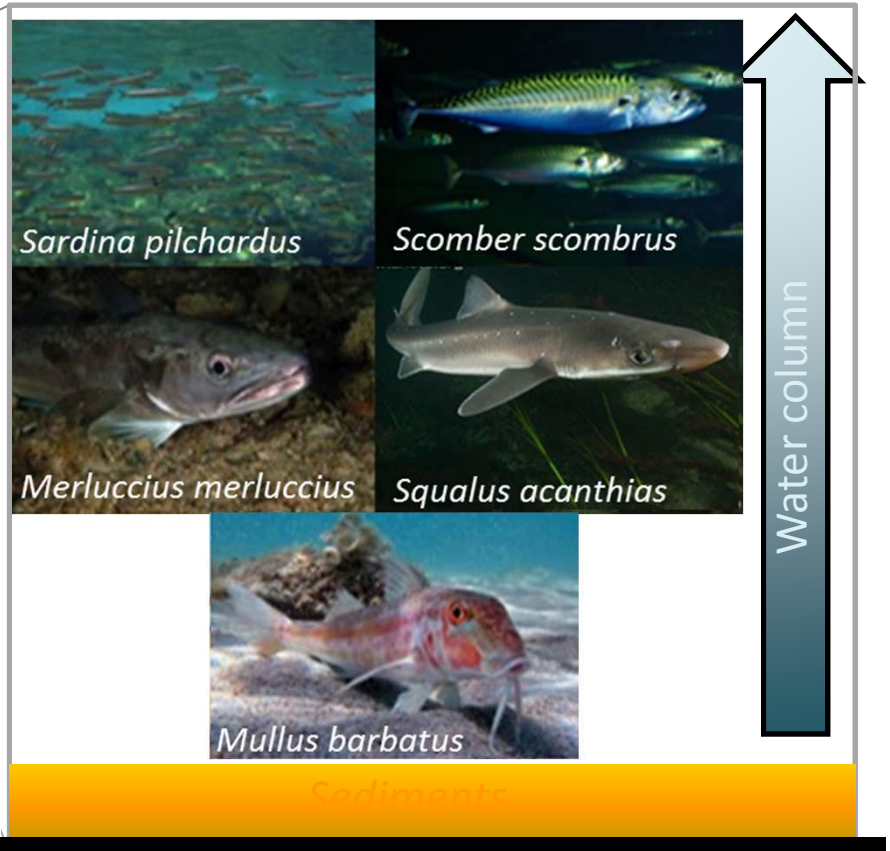
PRESENZA DI MICROPLASTICHE NEI PESCI ADRIATICI





Marine Environmental Research xxx (2015) 1–9

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journal homepage: www.elsevier.com/locate/marenvrev

Experimental development of a new protocol for extraction and characterization of microplastics in fish tissues: First observations in commercial species from Adriatic Sea

Carlo Giacomo Avio, Stefania Gorbi, Francesco Regoli*

Dipartimento di Scienze della Vita e dell'Ambiente (DiSVA), Università Politecnica delle Marche, Ancona, Italy

Species	Number of stomach examinated	Stomach with microplastics (%)	Number of microplastics in fish + (means ±SD)
S. pilchardus	99	19	1.78 ± 0.7
S. acanthias	9	44	1.25 ± 0.5
M. merluccius	3	100	1.33 ± 0.57
M. barbatus	11	64	1.57 ± 0.78
C. lucernus	3	67	1 ± 0

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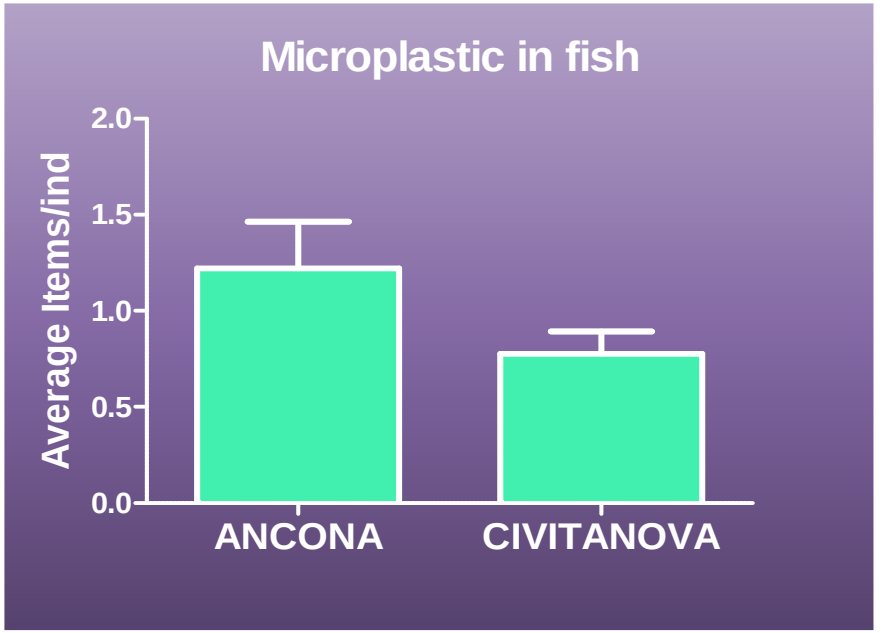
MICROPLASTICHE IN SPECIE COMMERCIALI DA SITI DIVERSI



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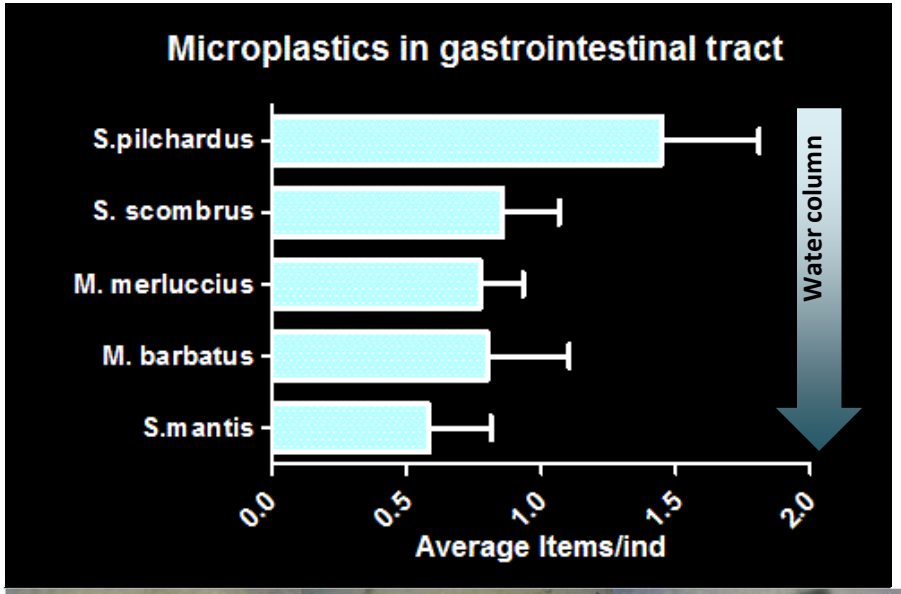

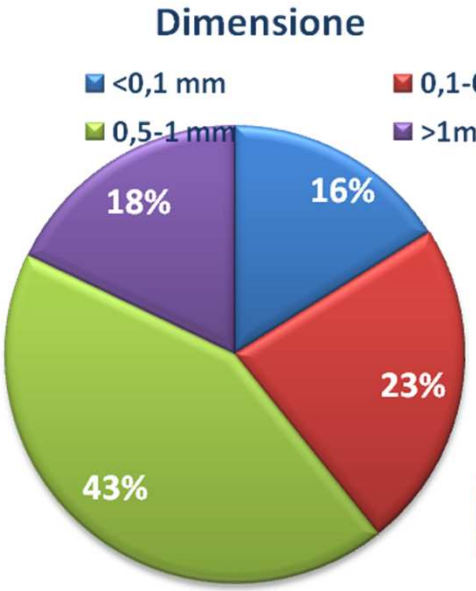

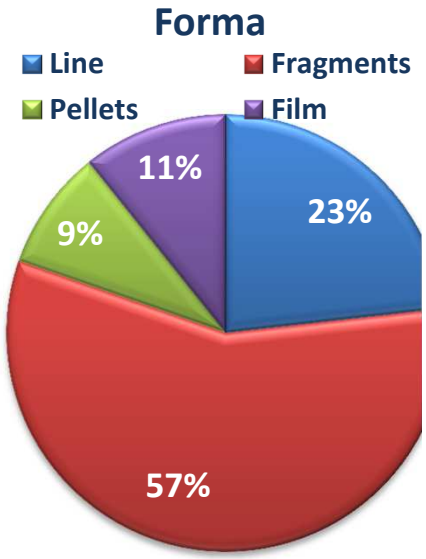

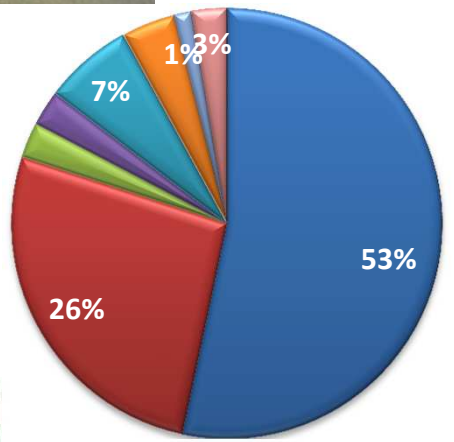

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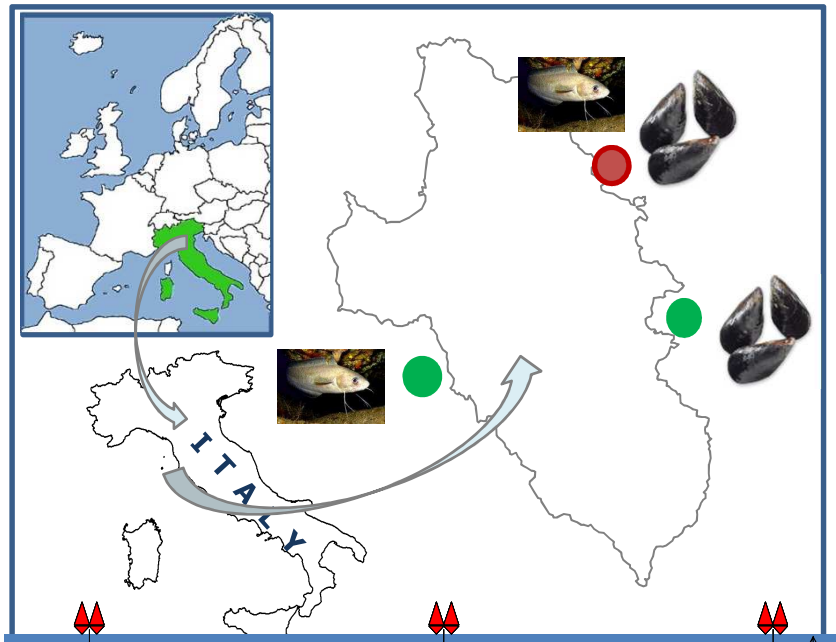
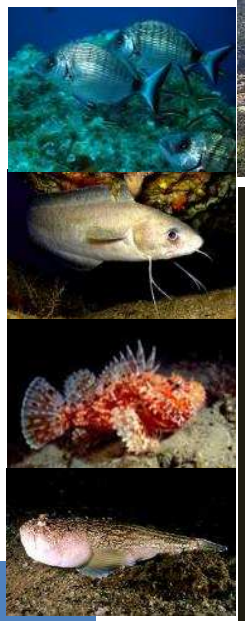
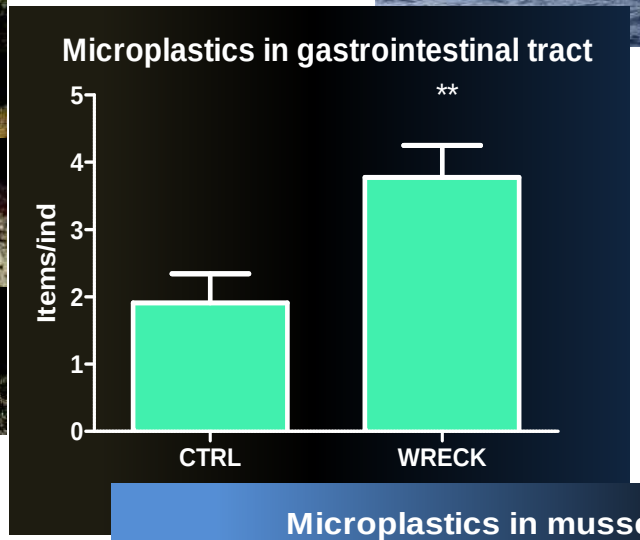
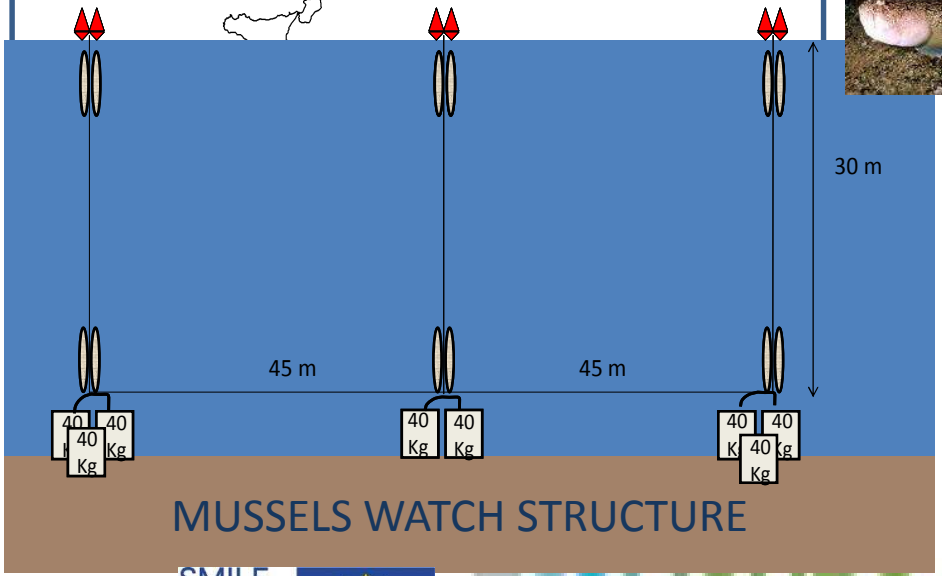
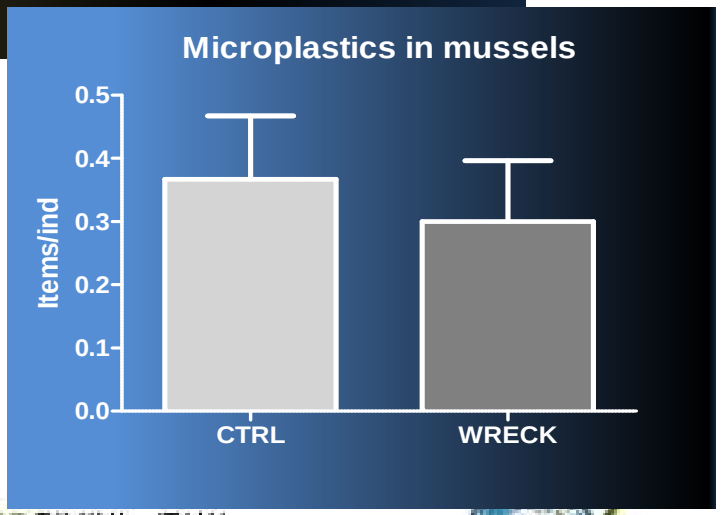
IL CASO STUDIO DELLA COSTA CONCORDIA











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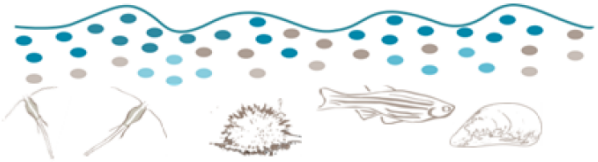
RESULTS €7.5 MILLION CALL ON MICROPLASTICS PUBLISHED

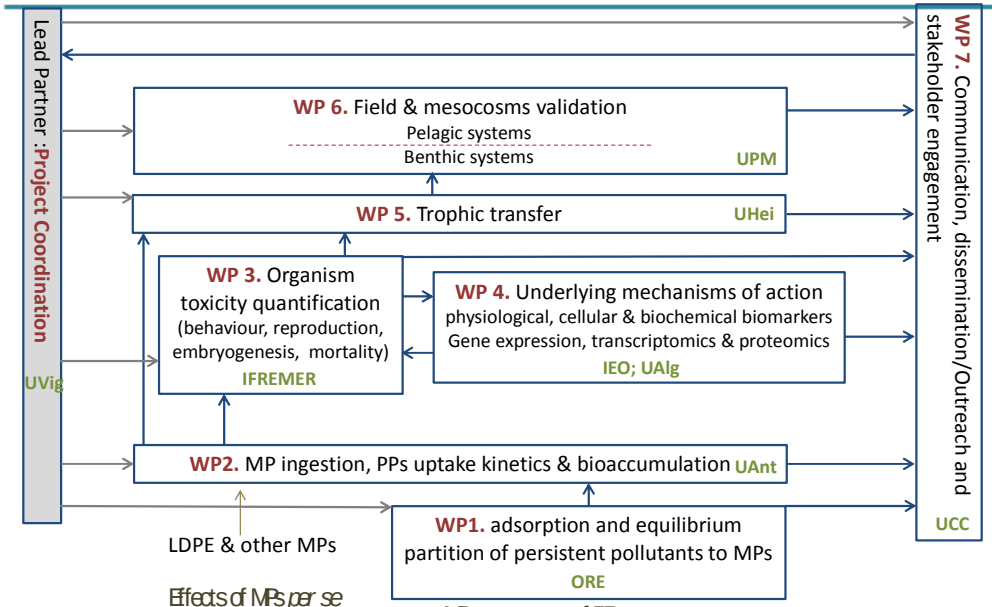
JPI OCEANS

Four research projects investigating the impact of plastic particles on the marine environment are selected for funding from ten member countries of the JPI Oceans.

EPHEMARE



ECOTOXICOLOGICAL EFFECTS OF MICROPLASTICS IN MARINE ECOSYSTEMS



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EPHEMARE

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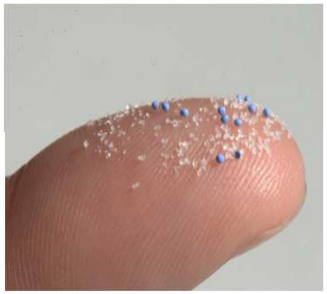
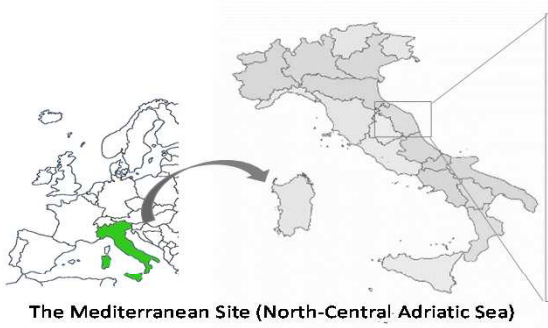
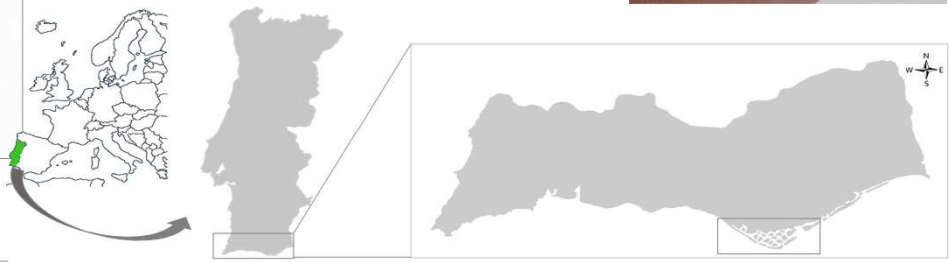
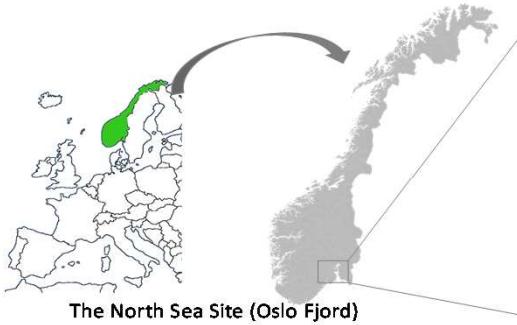




The Mediterranean Site (North-Central Adriatic Sea)



The North East Atlantic Site (Southern Portugal)



The North Sea Site (Oslo Fjord)

The Scheldt Estuary

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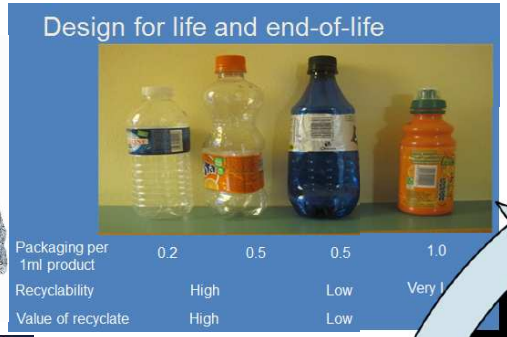
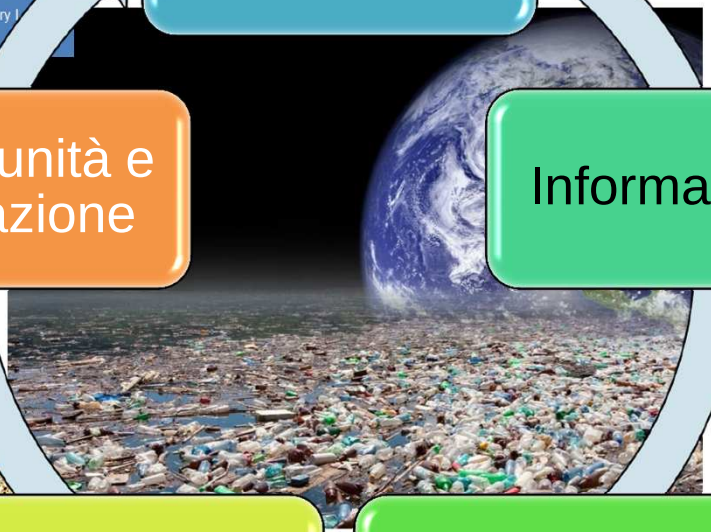
Dalla scala globale a quella nazionale e locale, interazione tra ricerca, politica e società



Ricerca
Conoscenza

JPI OCEANS

Opportunità e innovazione



Informazione

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DELLO SVILUPPO SOSTENIBILE

GRAZIE PER L'ATTENZIONE

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