



PLASTIC DAY

Marine litter, effetti, mitigazioni e soluzioni sostenibili

8 marzo 2016

ore 10.30-16.30

Complesso didattico di Pian dei Mantellini, 44 - Siena

I ricercatori del Dipartimento di Scienze Fisiche, della Terra e dell' Ambiente, in collaborazione con Novamont ed attori pubblici regionali e nazionali, stakeholders ed esponenti del mondo della ricerca e dell'Accademia, discuteranno alcune delle tematiche emergenti legate alla presenza e agli effetti del *marine litter* nell'ambiente Mediterraneo, le possibili azioni di mitigazione e dell'uso sostenibile di nuovi polimeri.



UNIVERSITÀ
DI SIENA
1240

Perché a Siena... e perché oggi?



A top-down view of a clear glass petri dish containing a white, gelatinous substance. Scattered throughout the substance are numerous small, multi-colored fragments of plastic, including white, black, blue, green, and brown pieces of various shapes and sizes. The dish is set against a light blue background.

The emerging issue of

MICROPLASTICS

Microplastics publications

Analyze search results

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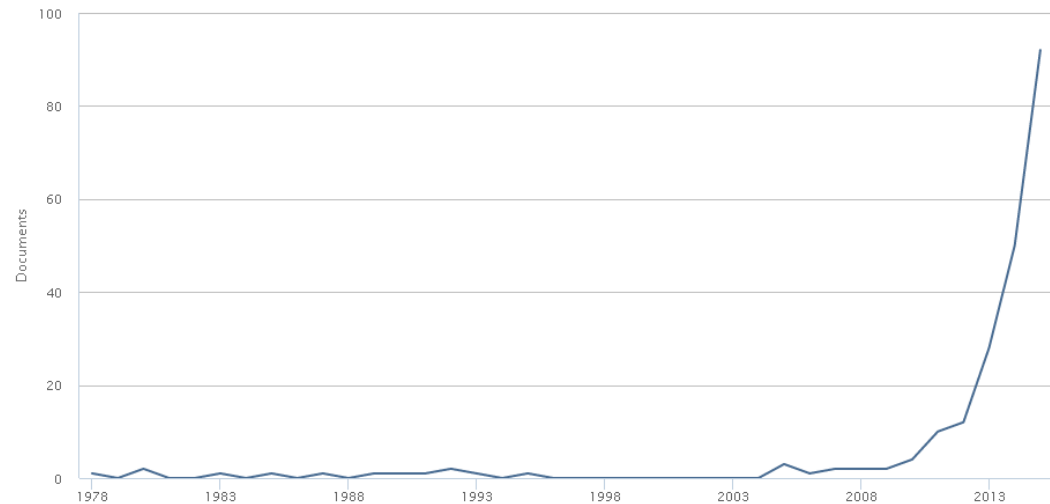
TITLE-ABS-KEY (microplastics) [Back to your search results](#)

219 document results Choose date range to analyze: 1978 to 2015 [Analyze](#)

Year | Source | Author | Affiliation | Country/Territory | Document type | Subject area

Year ▾	Documents
2015	92
2014	50
2013	28
2012	12
2011	10
2010	4
2009	2
2008	2
2007	2
2006	1
2005	3
2004	0
2003	0
2002	0
2001	0
2000	0
1999	0

Documents by year



Microplastics and affiliation

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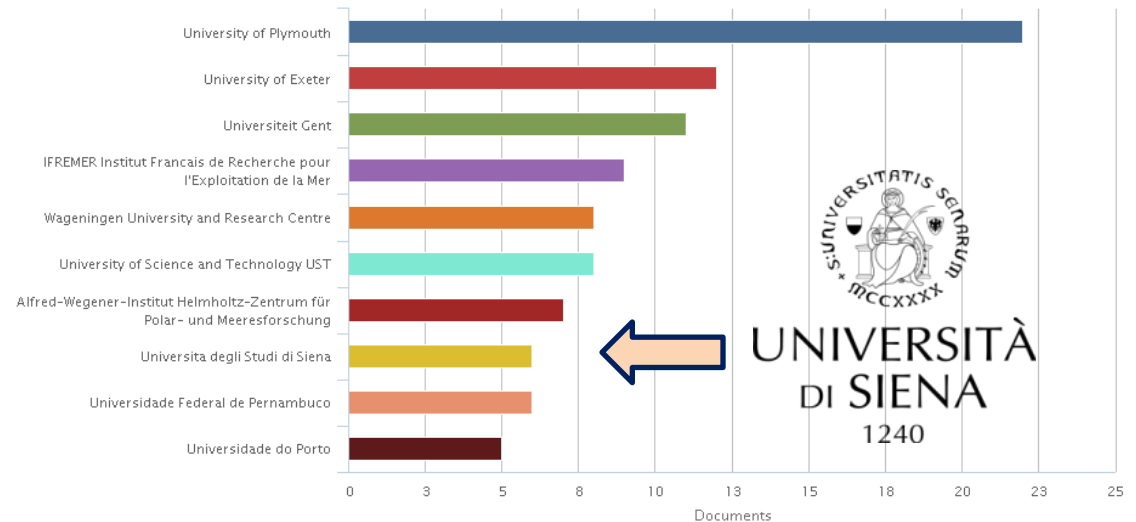
219 document results Choose date range to analyze: 1978 to 2015 [Analyze](#)

Year Source Author **Affiliation** Country/Territory Document type Subject area

Affiliation	Documents
<input checked="" type="checkbox"/> University of Plymouth	22
<input checked="" type="checkbox"/> University of Exeter	12
<input checked="" type="checkbox"/> Universiteit Gent	11
<input checked="" type="checkbox"/> IFREMER Institut Francais de ...	9
<input checked="" type="checkbox"/> Wageningen University and R...	8
<input checked="" type="checkbox"/> University of Science and Tech...	8
<input checked="" type="checkbox"/> Alfred-Wegener-Institut Helmh...	7
<input checked="" type="checkbox"/> Universita degli Studi di Siena	6
<input checked="" type="checkbox"/> Universidade Federal de Pern...	6
<input checked="" type="checkbox"/> Universidade do Porto	5
<input type="checkbox"/> Universitat Osnabruck	5
<input type="checkbox"/> Universitat Bayreuth	5
<input type="checkbox"/> 5 Gyres Institute	4
<input type="checkbox"/> Universite de Geneve	4
<input type="checkbox"/> Plymouth Marine Laboratory	4

Documents by affiliation

Compare the document counts for up to 15 affiliations



Perché oggi?





DIPARTIMENTO DI SCIENZE FISICHE,
DELLA TERRA E DELL'AMBIENTE



NOVAMONT

www.unisi.it/plastic-day

PROGRAMMA

9.30 - 10.30

Registrazione dei partecipanti

10.30

**Saluto di benvenuto del Prorettore
dell'Università di Siena**

10.40

Inizio dei lavori - 1° parte

13.00

Colazione di lavoro

14.00

Inizio dei lavori - 2° parte

15.30

Tavola rotonda e conclusioni

16.30

Chiusura dei lavori

PROGRAMMA DEGLI INTERVENTI

M.C. Fossi (Università di Siena) ▶

**Impatto del *marine litter* sulla biodiversità del
Mediterraneo**

G.A. de Lucia (IAMC-CNR) ▶ **Interazione tra
litter e tartarughe marine nelle acque della
Sardegna**

T. Romeo (ISPRA) ▶ **Impatto delle plastiche
sulle risorse ittiche**

F. Serena (ARPAT) ▶ **La pesca come strumento
di valutazione del *marine litter***

C. Lapucci (LaMMA) ▶ **Modelli e osservazioni
satellitari per capire la distribuzione della
plastica in mare**

S. Aliani (ISMAR-CNR) ▶ **Plastica e circolazione
globale nel Mar Mediterraneo**

F. Degli Innocenti (Novamont) ▶ **Sviluppo di
materiali biodegradabili per la riduzione degli
impatti dei rifiuti plastici nel settore ittico**

Rappresentante del Ministero dell'Ambiente e
della Tutela del Territorio e del Mare ▶ ***Marine
Litter* : Governance e Strategia Marina**





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Tavola rotonda

“Ricerca, Produzione Sostenibile, Sensibilizzazione, Governance”

Moderatore Claudio Leonzio

Regione Toscana – Gilda Ruberti

ARPAT – Fabrizio Serena

WWF Italia – Eva Alessi

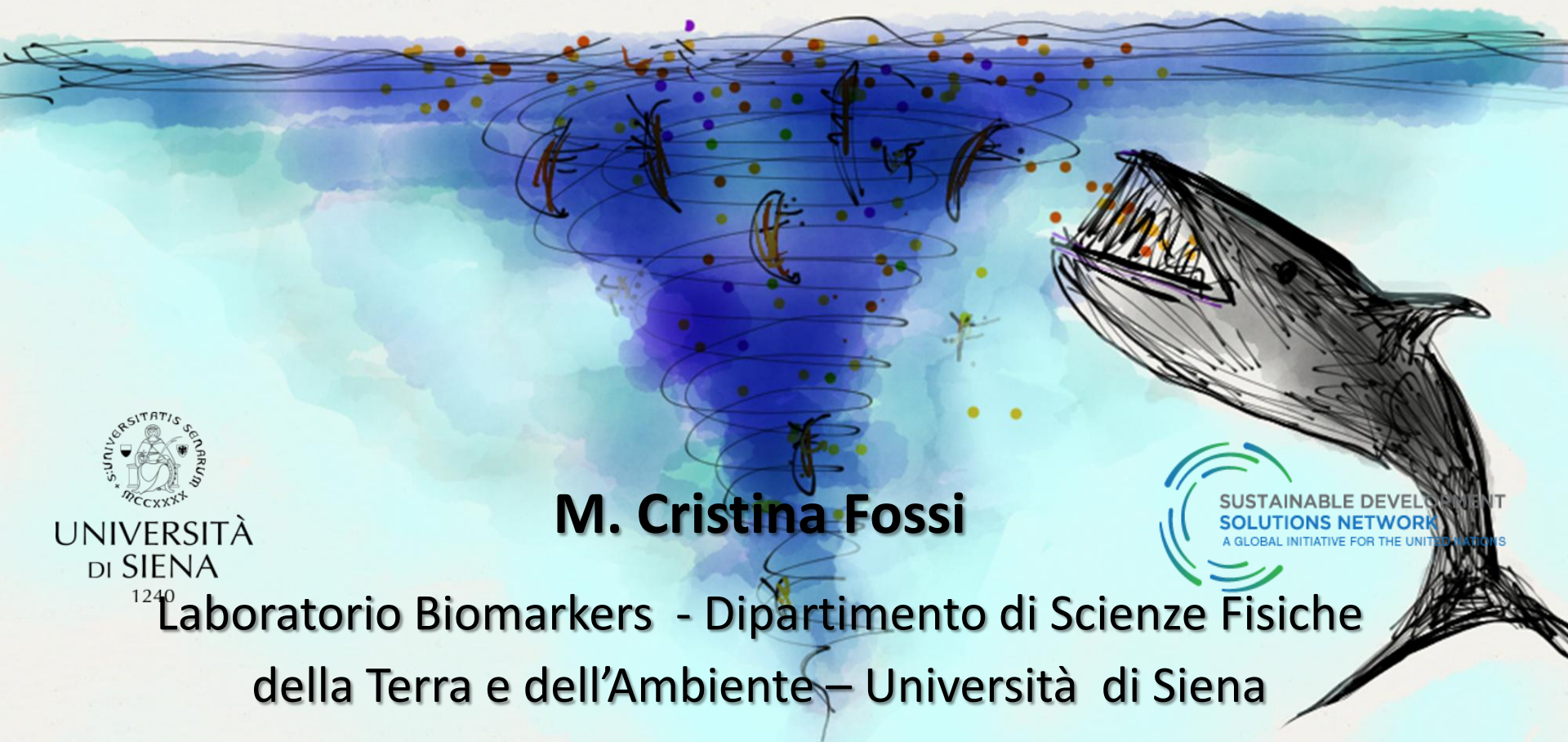
Legambiente – Stefania Di Vito

Mare Vivo – Maria Rapini

Novamont – Francesco Dell’Innocenti

COREPLA

Impatto del *Marine Litter* sulla biodiversità del Mediterraneo



M. Cristina Fossi



Laboratorio Biomarkers - Dipartimento di Scienze Fisiche
della Terra e dell'Ambiente – Università di Siena



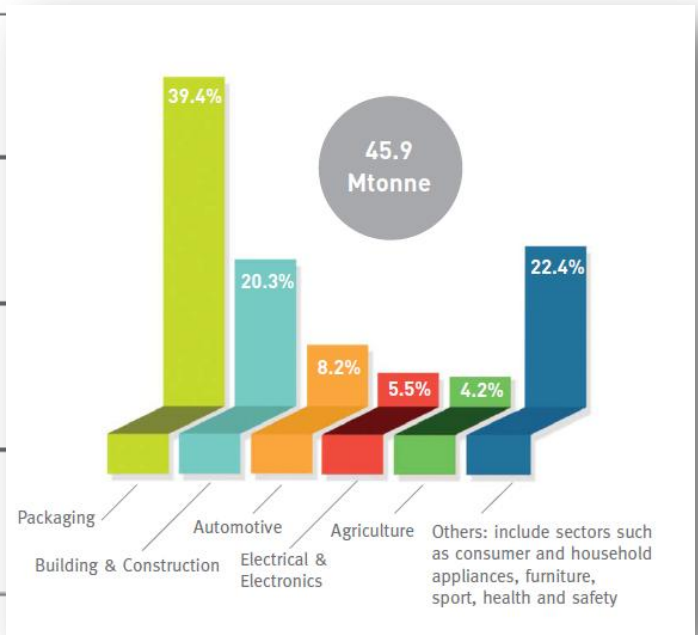
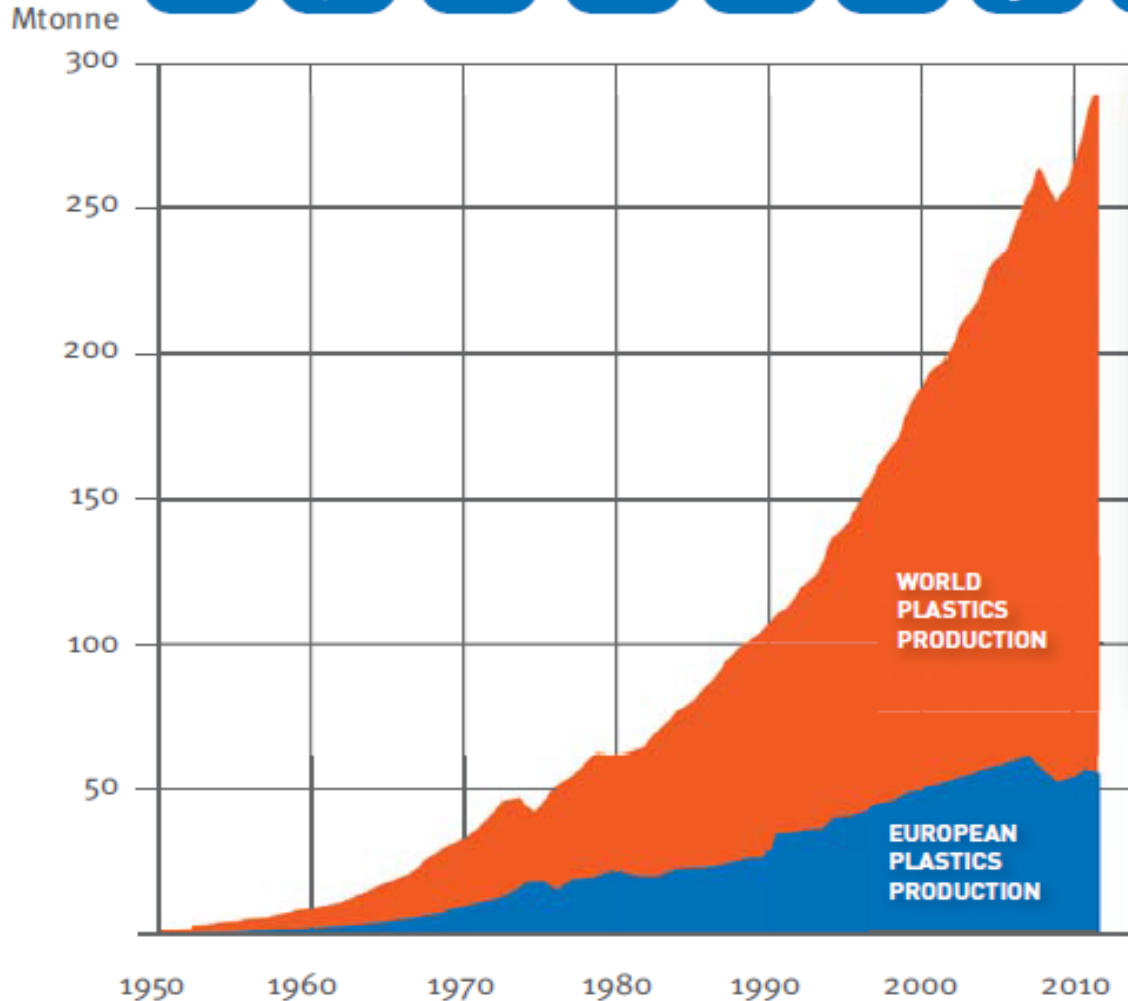
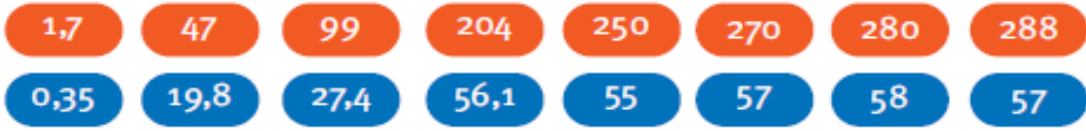
RESEARCH ARTICLE

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. Lebreton², Henry S. Carson^{3,4}, Martin Thiel^{5,6,7},
Charles J. Moore⁸, Jose C. Borerro⁹, Francois Galgani¹⁰, Peter G. Ryan¹¹,
Julia Reisser¹²

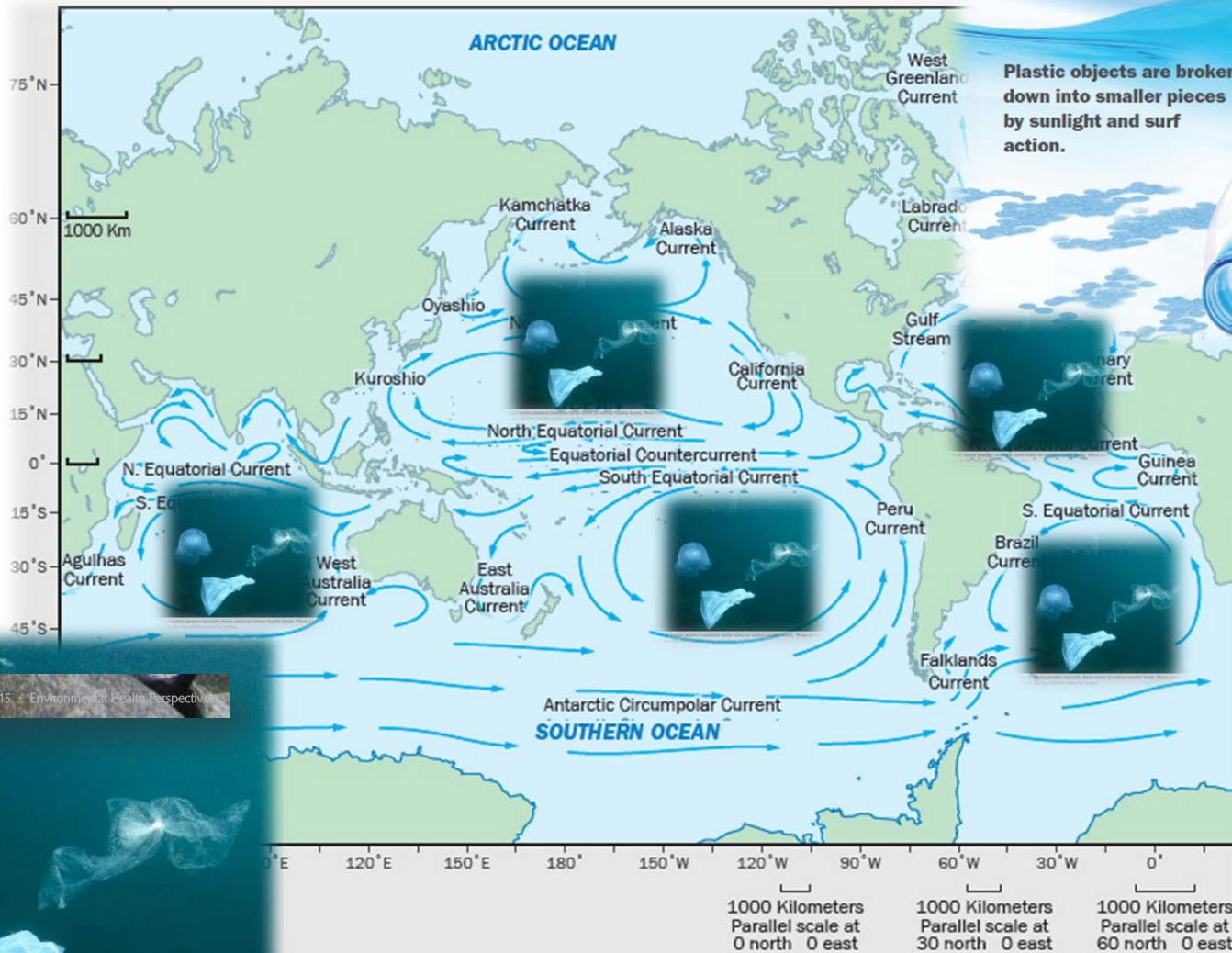
World plastics production grows

1950 1976 1989 2002 2009 2010 2011 2012



Plastics – the Facts 2013
 An analysis of European latest plastics production, demand and waste data
 PlasticsEurope

Plastic debris into five ocean gyres



Plastic objects are broken down into smaller pieces by sunlight and surf action.

VOLUME 123 | NUMBER 2 | February 2015 • Environmental Health Perspectives



Carry plastic debris into the five major ocean gyres. Thousands of tons of plastic debris are estimated to bob in these gyres, but more than half of all plastic debris enters the world's oceans each year.

Different marine plastics resemble foods eaten at various trophic levels. These plastic bags look like the jellyfish eaten by turtles.
© Norbert Wu/Minden Pictures/Corbis

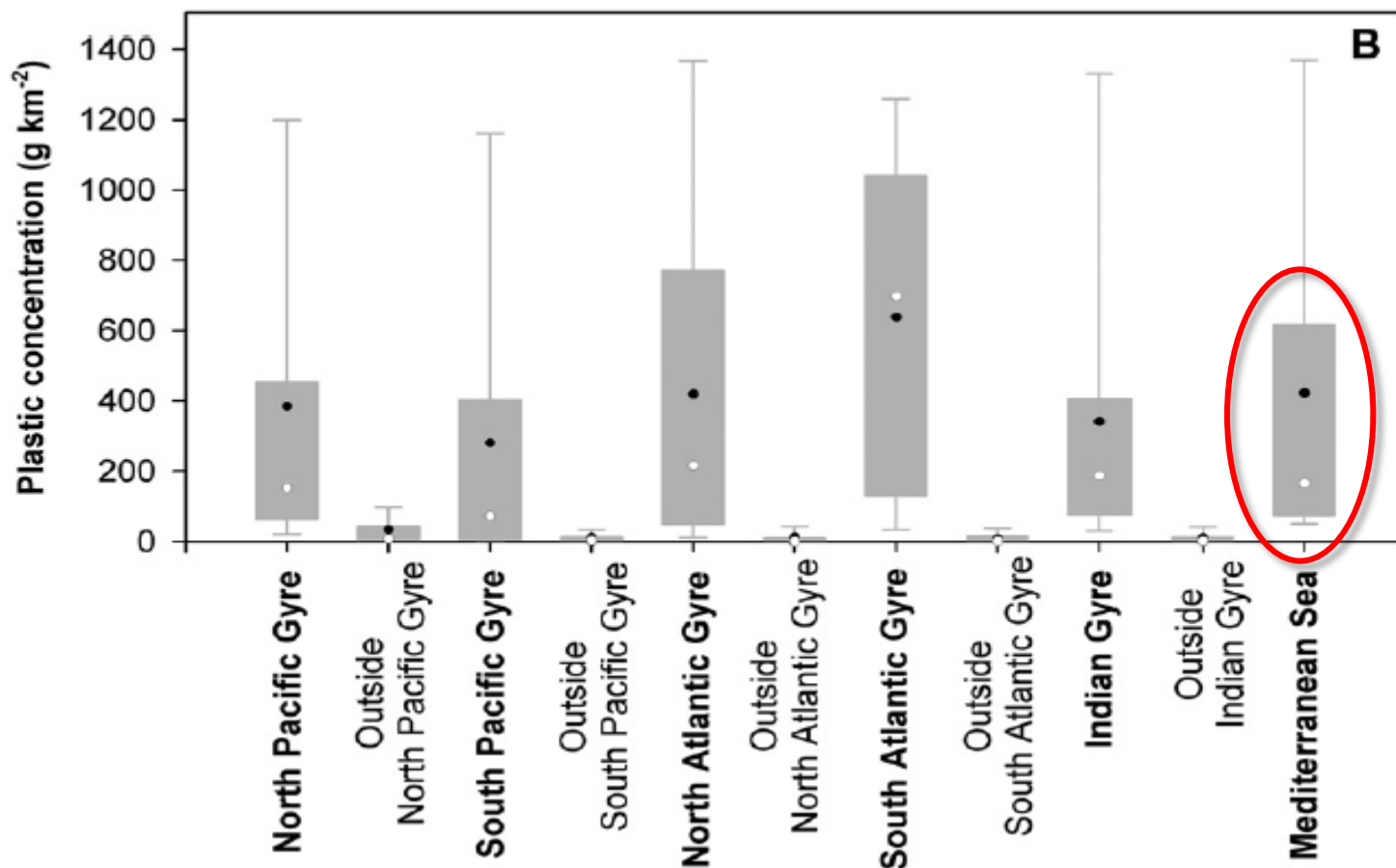
© Jane Whitney



RESEARCH ARTICLE

Plastic Accumulation in the Mediterranean Sea

Andrés Cózar^{1*}, Marina Sanz-Martín^{2,3}, Elisa Martí¹, J. Ignacio González-Gordillo¹, Bárbara Ubeda¹, José Á. Gálvez¹, Xabier Irigoien⁴, Carlos M. Duarte^{2,4}





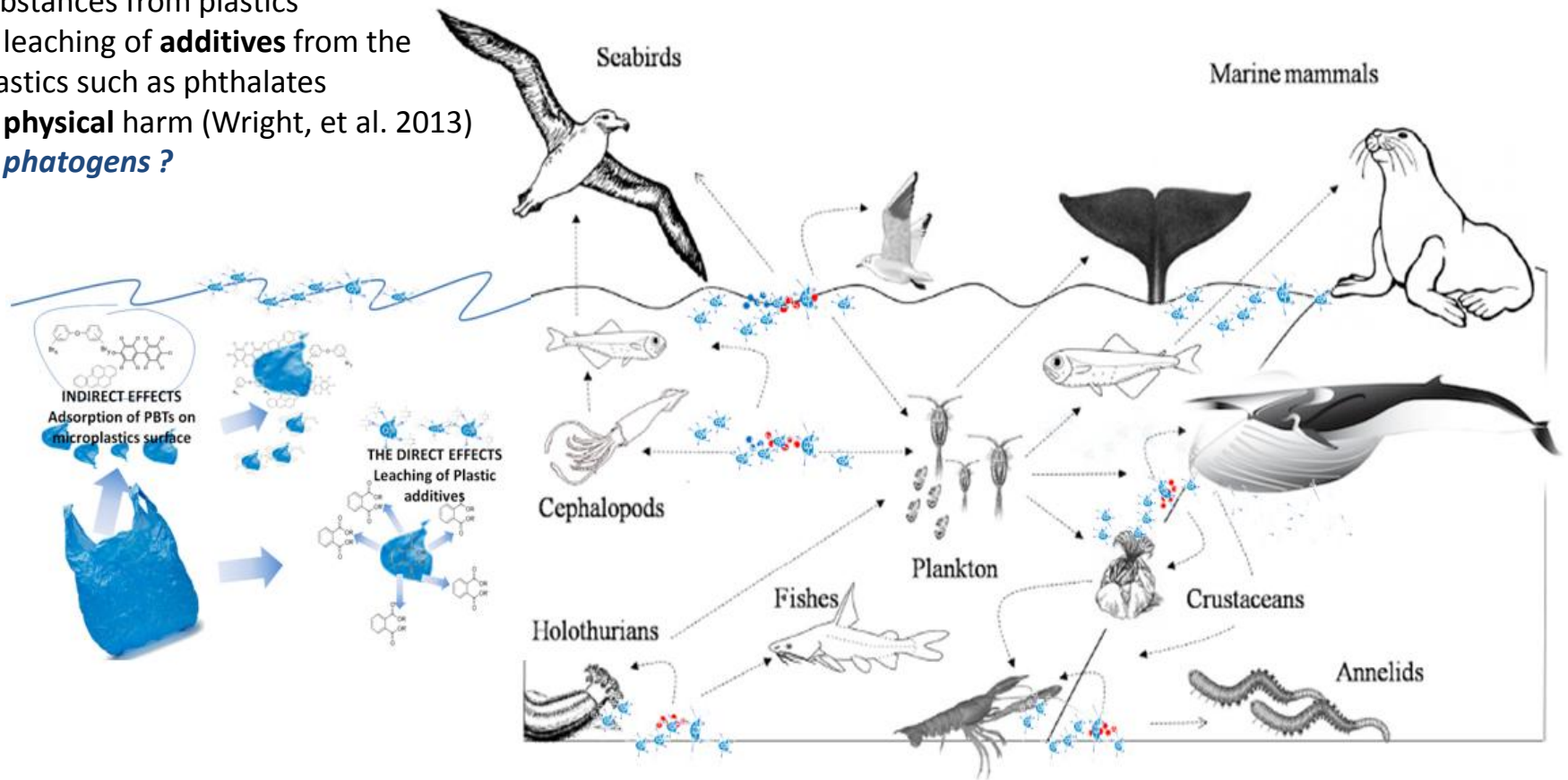
Can Microplastics Affect



Mediterranean Biodiversity?

Impact of Microplastics on marine organisms

- 1- transport of persistent, bioaccumulating and toxic (PBT) substances from plastics
- 2- leaching of **additives** from the plastics such as phthalates
- 3- **physical** harm (Wright, et al. 2013)
- 4- *phatogens ?*



Marine Litter: a Global Challenge

The main legal and institutional frameworks affecting the Mediterranean on this topic are:

- (1) Local Agendas 21;
- (2) national legislation on waste management and environmental protection;
- (3) the Barcelona Convention and its Protocols;
- (4) the Mediterranean Strategy for Sustainable Development (MSSD);
- (5) MEDPOL of UNEP;
- (6) the EU Environmental Strategy for the Mediterranean and Horizon 2020;
- (7) the EU Marine Strategy Directive;
- (8) the EU Thematic strategy on the Prevention and Recycling of Waste;
- (9) the IMO MARPOL 73/78 Convention – Annex V;
- (10) the GPA and the Regional Seas Program;
- (11) the Basel Convention



GAP

There is a general lack of available data on marine wildlife affected by marine litter in the Mediterranean.

*UNEP/MAP Barcelona Convention
RAP on Marine litter in Mediterranean
(Istanbul 2013)*



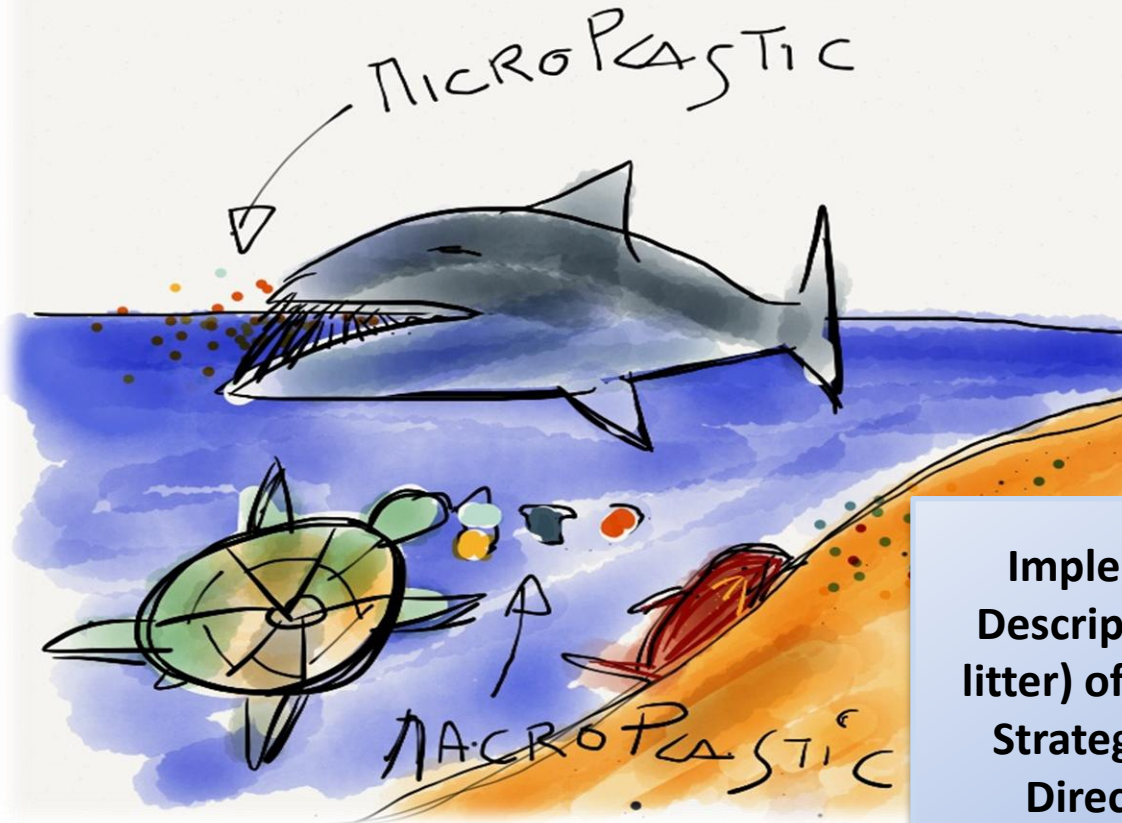
PLASTIC-BUSTERS SDSN Project 2013

Evaluate the **presence and effects of marine debris**, particularly **microplastics**, in Mediterranean environment using **marine organisms as sentinel species**

Mitigate and reduce the impact of marine litter in the Mediterranean Sea

Harmonize monitoring and mitigation activities in the entire basin

Implementation of Descriptor 10 (marine litter) of the EU Marine Strategy Framework Directive (MSFD)



SDSN – University of Siena

About us

MED Solutions is the Regional hub for the Mediterranean of the Sustainable Development Solutions Network (SDSN), directed by Professor Jeffrey Sachs (Columbia University), Special Advisor to United Nations Secretary-General Ban Ki-moon on the Millennium Development Goals. MED Solutions is coordinated by the University of Siena.

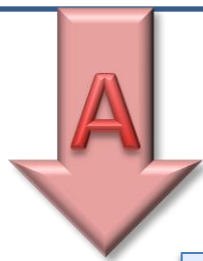
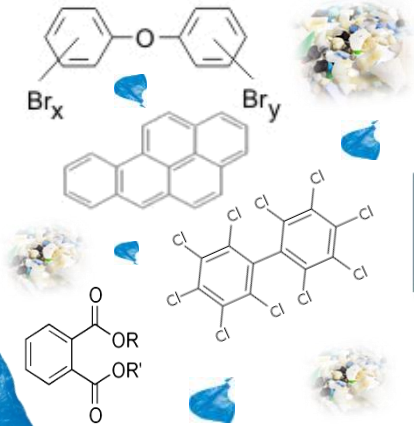


MED Solutions

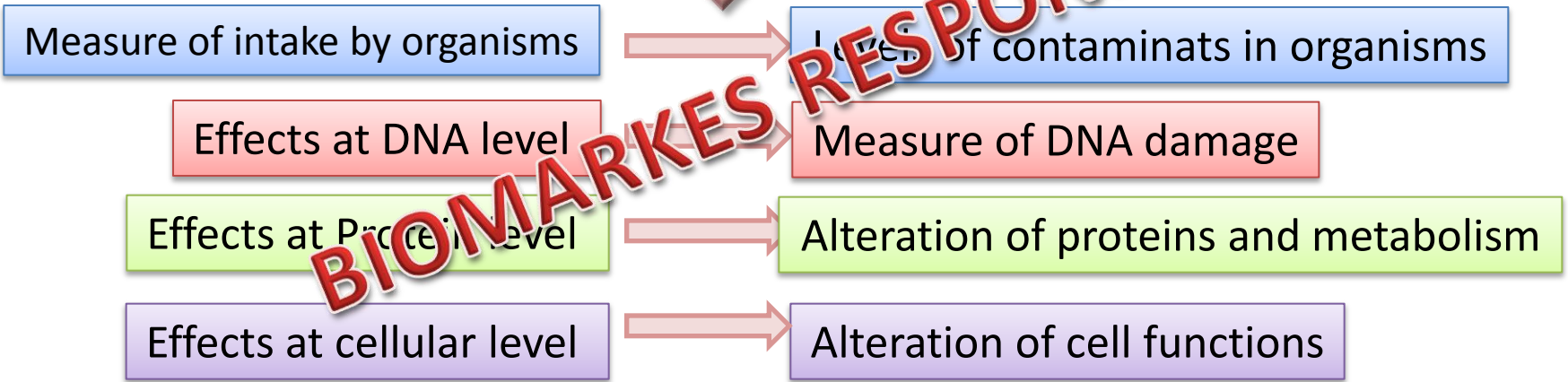
Microplastics effects on organisms?

In the environment:

- Persistent Organic Pollutants
- Phthalates
- Bisphenol A...



BIOMARKERS RESPONSES





Balaenoptera physalus

The idea ...2011



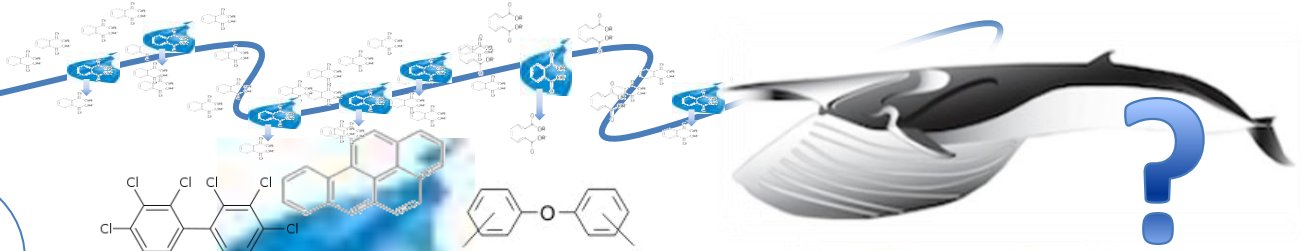
300 liters of water daily



70,000 liters of water
with each mouthful

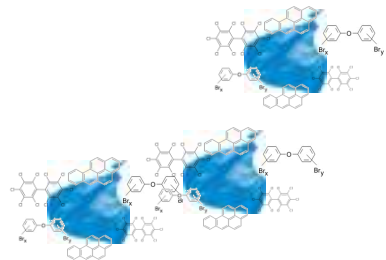
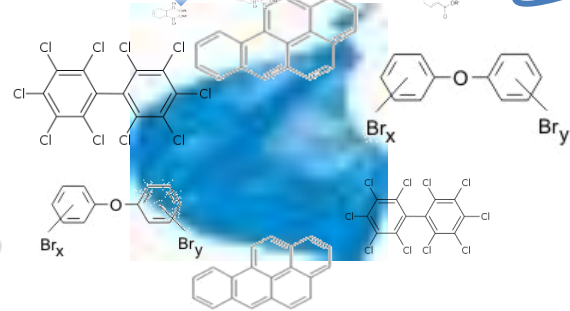


Microplastics and contaminants



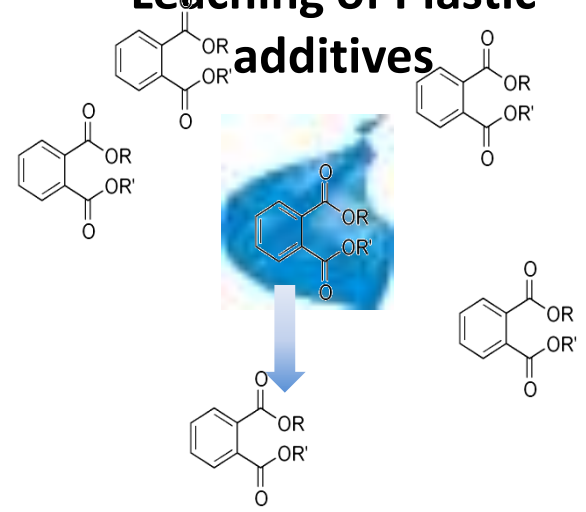
THE INDIRECT EFFECTS

Adsorption of PBTs on microplastics surface

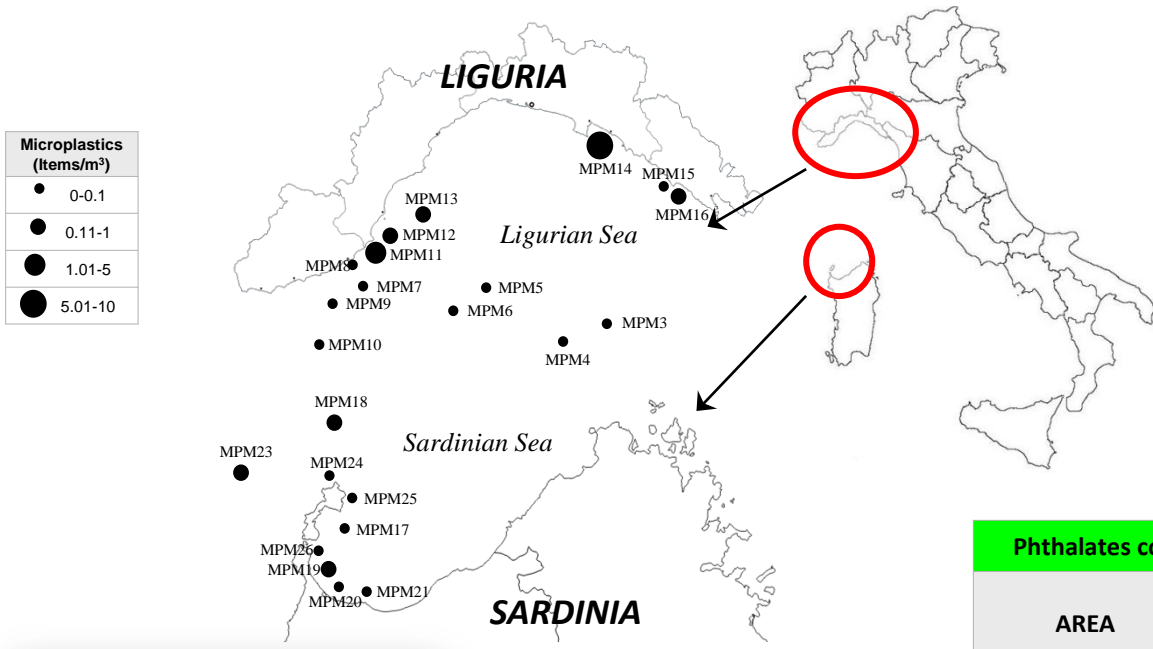


THE DIRECT EFFECTS

Leaching of Plastic additives



First data: Microplastics threat in the Pelagos Sanctuary



Microplastic particles in superficial neustonic/planktonic samples (items/m³) collected in the Pelagos Sanctuary (Ligurian Sea and Sardinian Sea) and mean DEHP and MEHP concentrations (ng/g).

Microplastics (Items/m ³)
● 0-0.1
● 0.11-1
● 1.01-5
● 5.01-10

Phthalates concentration in superficial neustonic/planktonic samples						
AREA	DEHP (ng/g)			MEHP (ng/g)		
	n	mean	s.d.	n	mean	s.d.
Ligurian Sea	14	18.38	44.39	14	61.93	124.26
Sardinian Sea	9	23.42	32.46	9	40.30	41.55

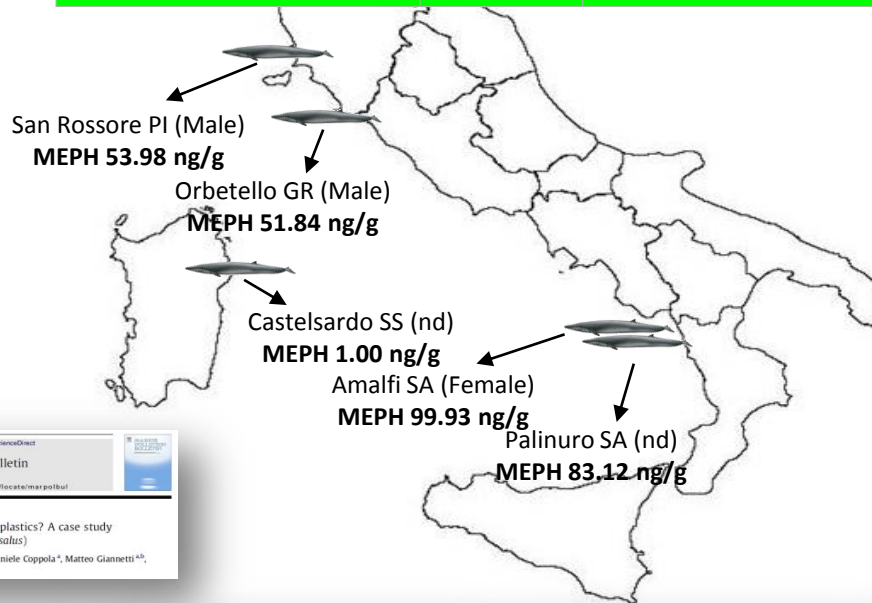
Contents lists available at ScienceDirect
Marine Pollution Bulletin
journal homepage: www.elsevier.com/locate/marpolbul

Are baleen whales exposed to the threat of microplastics? A case study of the Mediterranean fin whale (*Balaenoptera physalus*)
Marta Cristina Fossi^{a,*}, Cristina Panti^b, Cristiana Guerranti^c, Daniele Coppola^a, Matteo Giannetti^{a,b}, Letizia Marsili^d, Roberta Minutoli^e

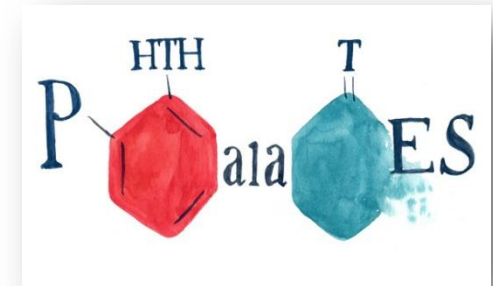


First data: Plastic additives in Fin whales

MEHP concentration in stranded fin whales		
SPECIES	TISSUE	Mean MEHP (ng/g)
<i>Balaenoptera physalus</i>	Blubber	57.97



DEHP concentrations (ng/g) in blubber samples of five stranded fin whales collected along the Italian coasts during the period July 2007 – June 2011 in five different locations.

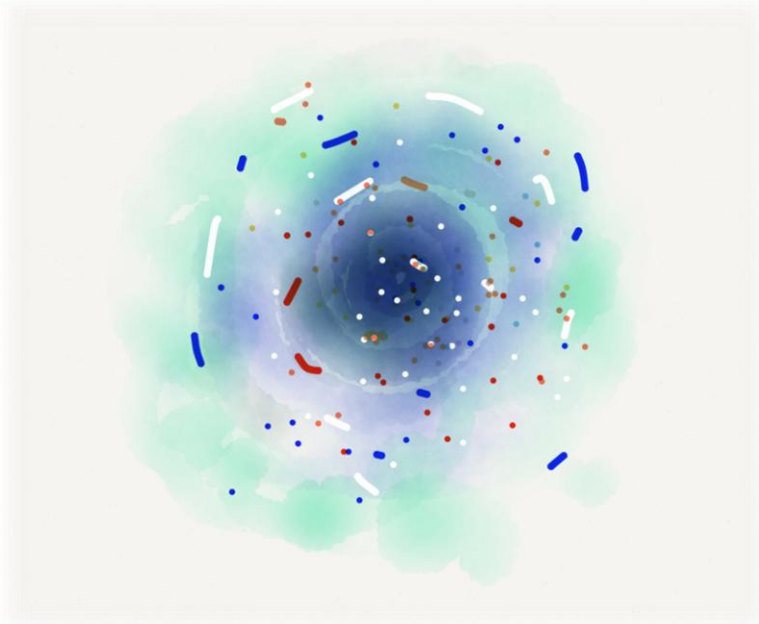


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Are baleen whales exposed to the threat of microplastics? A case study of the Mediterranean fin whale (*Balaenoptera physalus*)
Maria Cristina Fossi ^{a,*}, Cristina Panti ^b, Cristiana Guerranti ^c, Daniele Coppola ^d, Matteo Gianetti ^{a,b}, Letizia Marsili ^e, Roberta Minutoli ^c

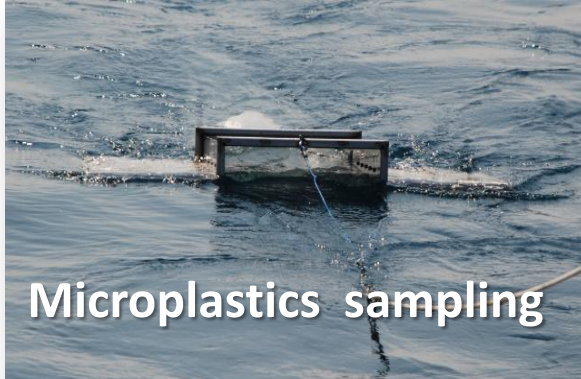


Current data

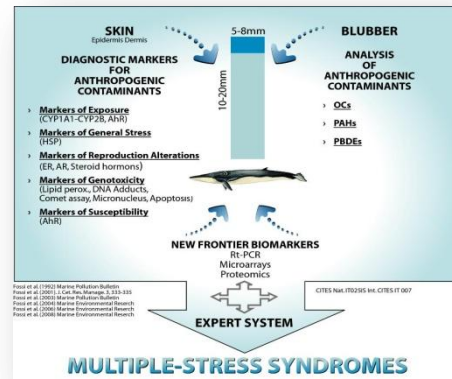


Current study examined the interaction between **free-ranging fin whales** (*Balaenoptera physalus*) and **microplastics** by comparing populations living in two semi-enclosed basins, the Mediterranean Sea and the Sea of Cortez (Gulf of California, Mexico).

Experimental work



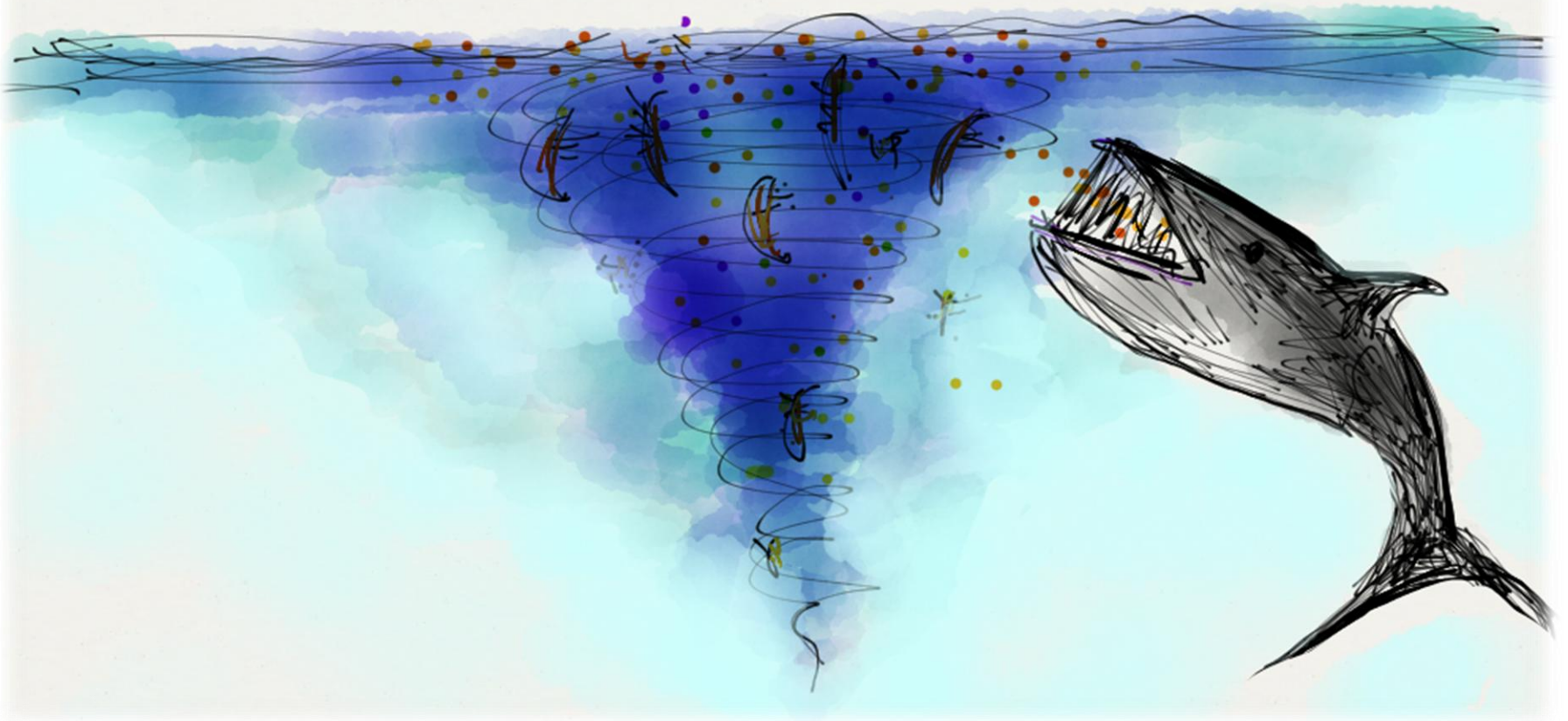
Pelagos Sanctuary



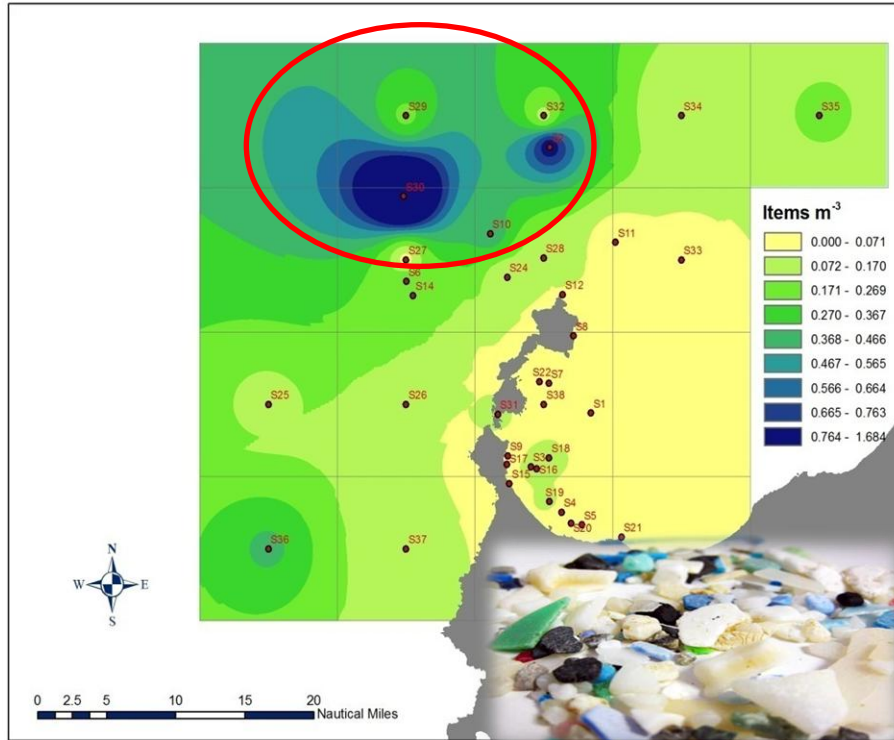
Sea of Cortez



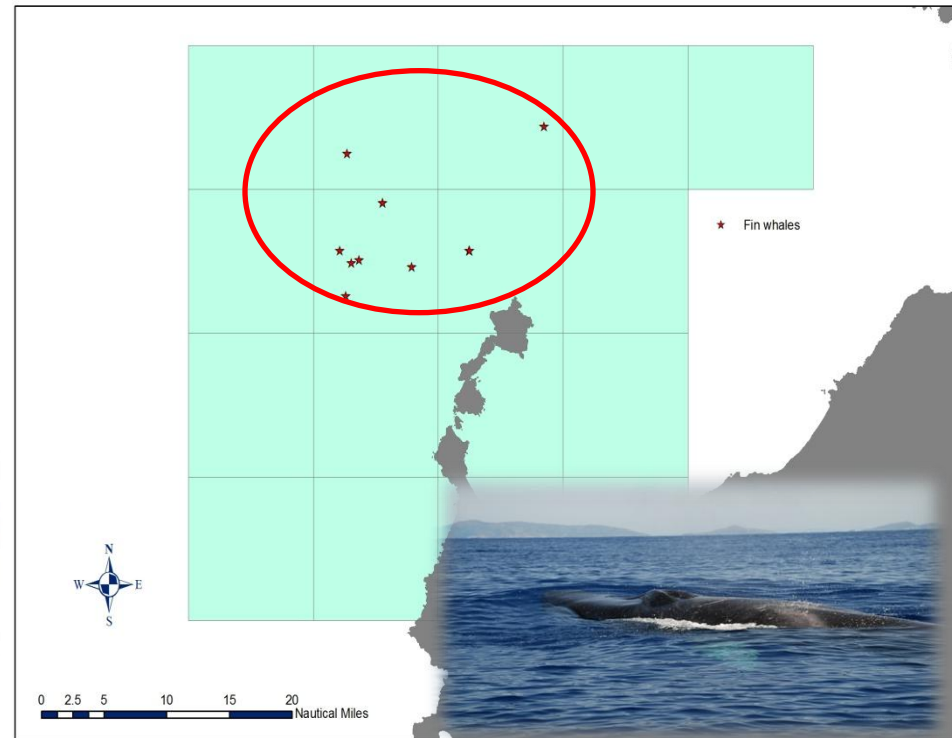
***Do fin whales feed in areas affected
by microplastics?***



Microplastic density (items/m³) in the Pelagos Sanctuary

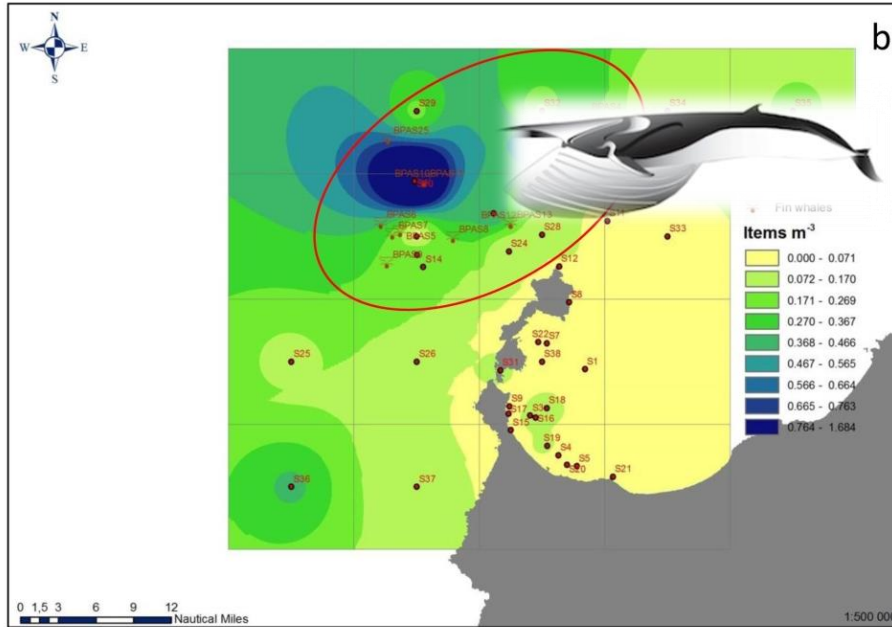


Mediterranean fin whale sampling site/feeding grounds

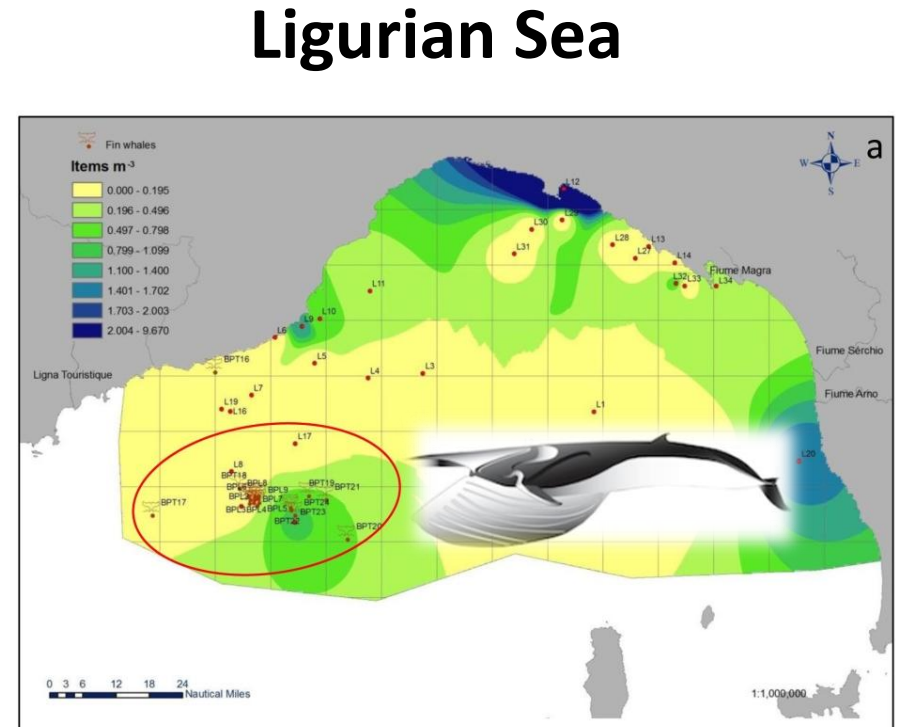


Microplastic density (items/m³) in the Pelagos Sanctuary and Mediterranean fin whale sampling site/feeding grounds

Ligurian Sea: microplastic samples L1-L36 (expressed as items/m³), fin whale sampling points (BPL-BPT);
Sardinian Sea: microplastic samples S1-S34 (items/m³); fin whale sampling points (BPA).
The red circle represents where high-microplastic-density areas and fin whales sampling sites overlap.



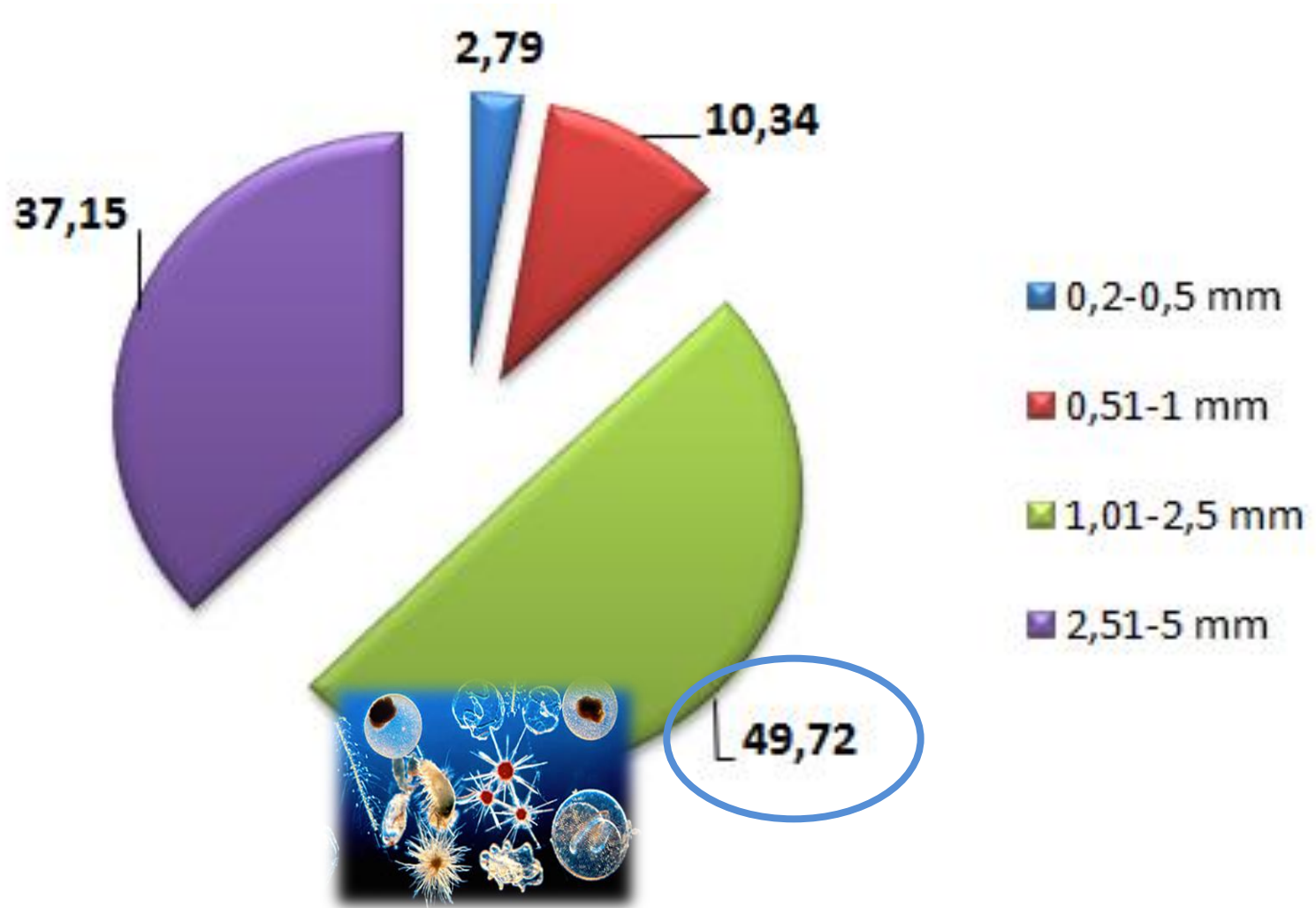
Sardinian Sea



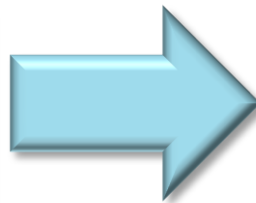
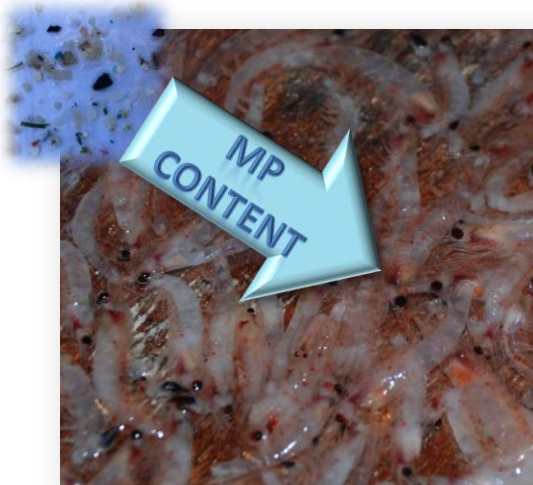
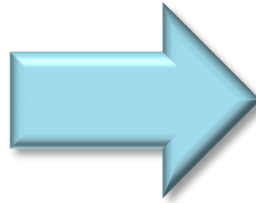
Ligurian Sea



Percentage of microplastics size distribution (ranging from 0,2 to 5 mm) in the Pelagos Sanctuary sampling sites



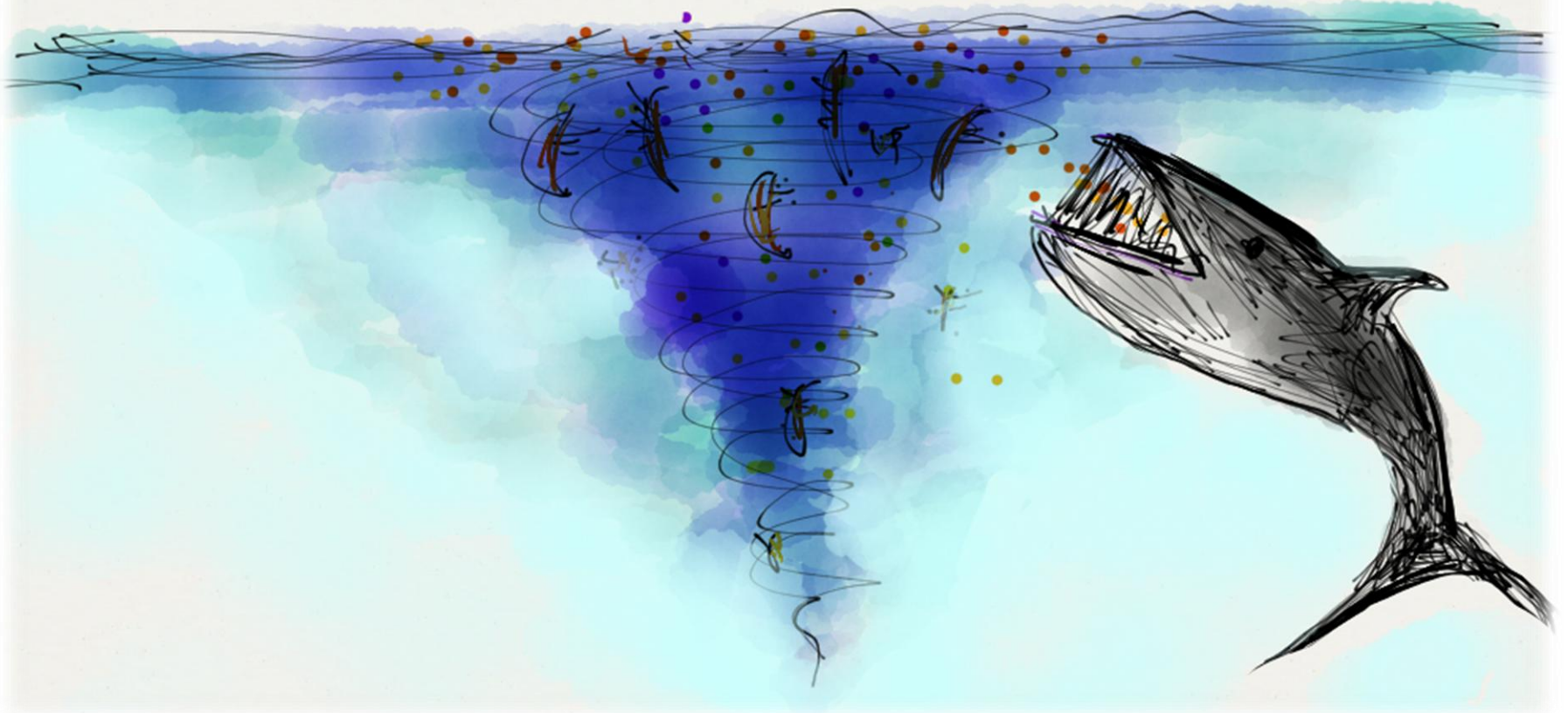
Potential MPs intake routes



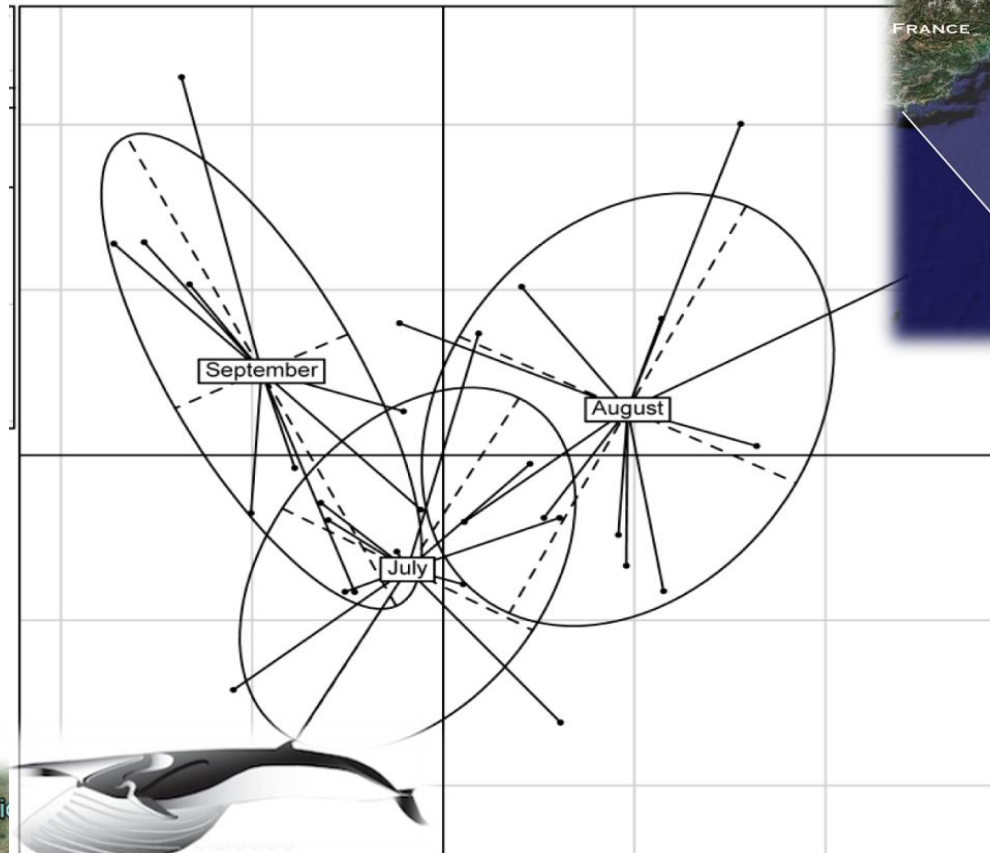
MEPH ranging from 8.87 ng/g to 21.79 ng/g in *M. norvegica*

In addition to direct intake, fin whales may also indirectly ingest microplastics through the consumption of large quantities of euphausiids and small schooling fish contaminated with microplastics

Does the sampling period affect the toxicological responses?



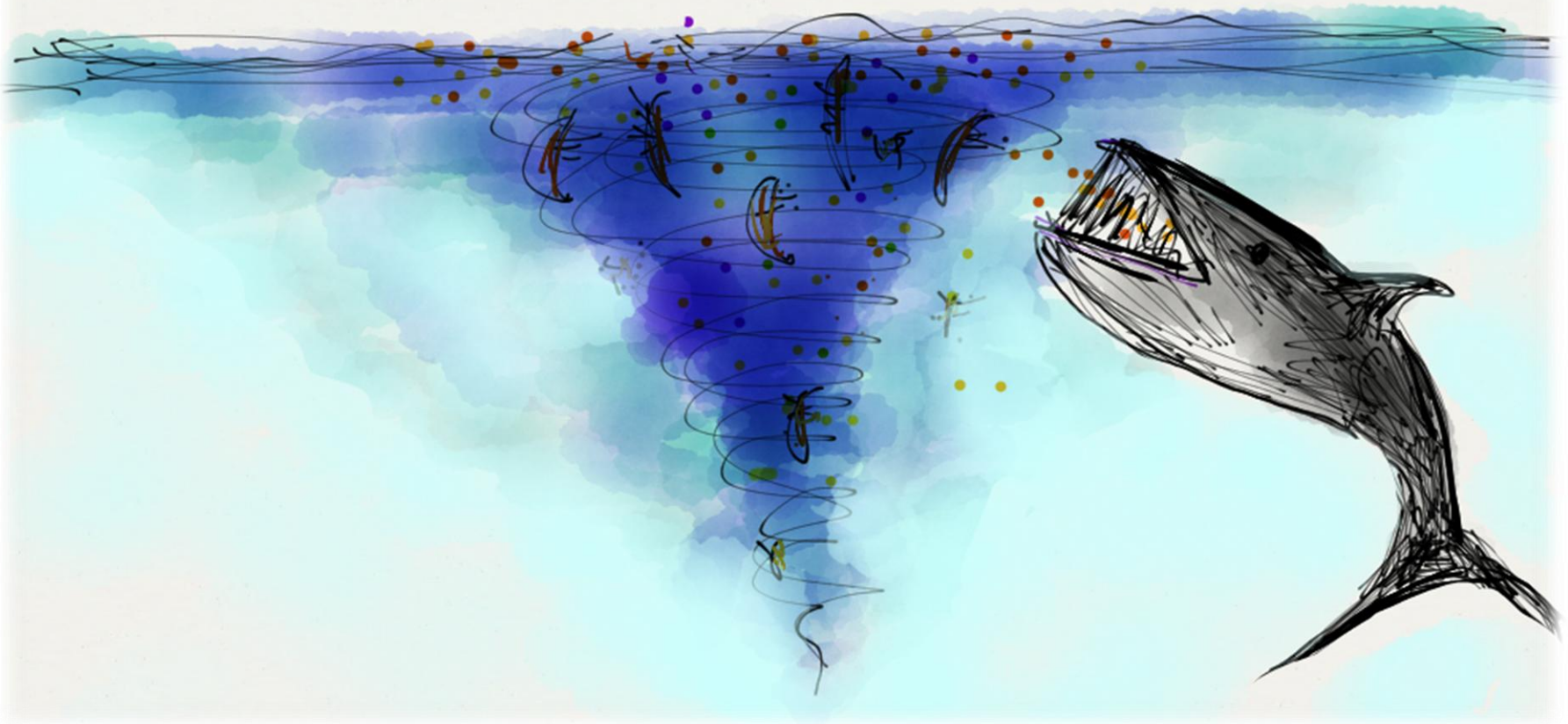
Discriminant analysis on the PCA factors applied to the three sampling periods (July, August and September) of Mediterranean fin whales, biomarkers (CYP1A, CYP2B, LPO) and contaminants (HCB, DDT, PCB, OCs and MEHP)



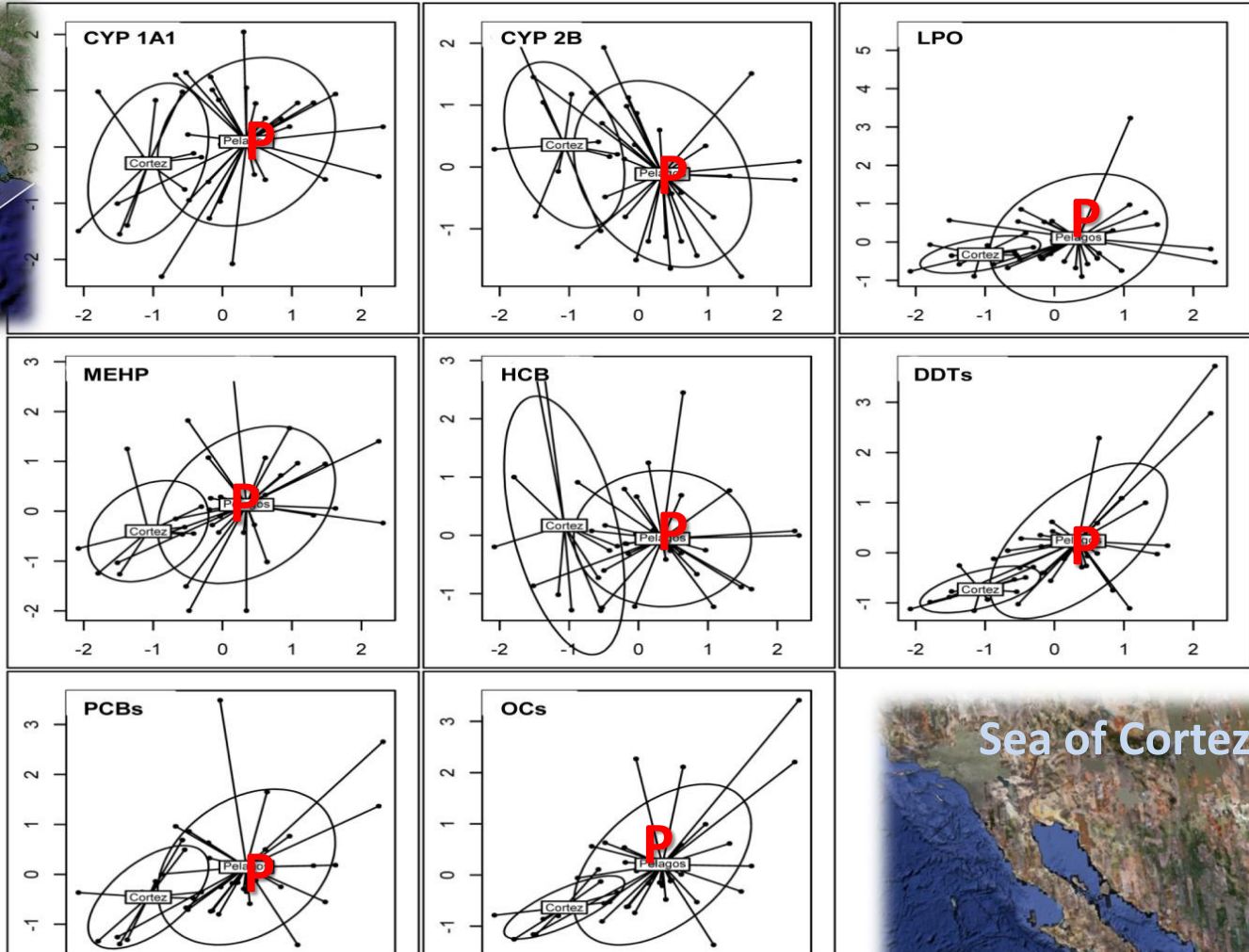
Toxicological analyses demonstrated that these three sampling/foraging periods differed significantly (Monte Carlo test: $RV = 0.125$, $p = 0.005$).



***Is the toxicological pressure different
for Mediterranean and Mexican
fin whales?***



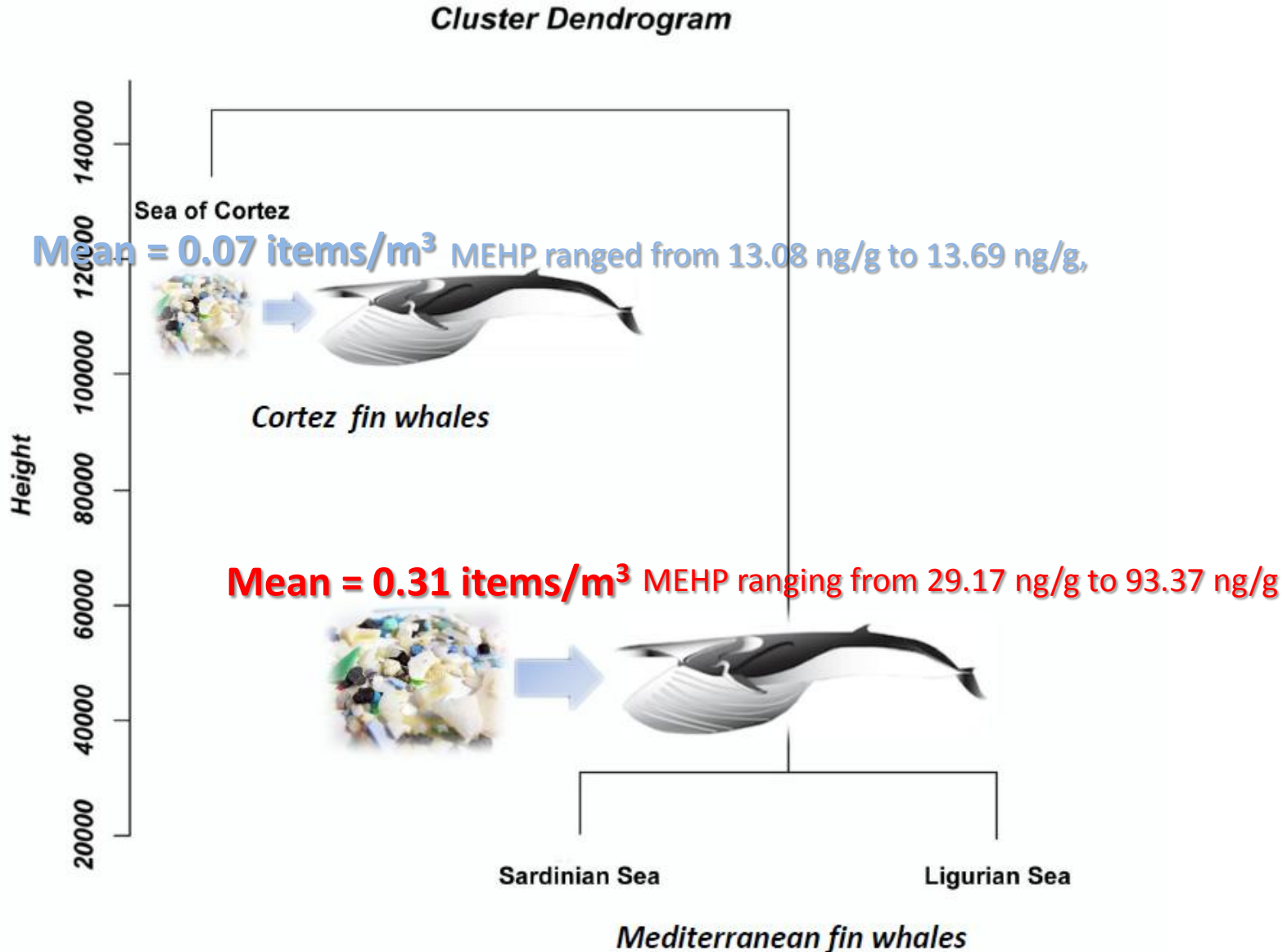
Discriminant analysis on the PCA factors applied to the variables: basin (the Mediterranean Sea and the Sea of Cortez), biomarkers (CYP1A, CYP2B, LPO) and contaminants (HCB, DDT, PCB, OCs and MEHP)



Monte Carlo simulation resulted in the detection of a significant difference between the two basins (RV = 0.052, $p = 0.011$).



Cluster dendrogram: phthalates, Ocs and biomarkers responses in skin biopsies of fin whales collected in the Pelagos Sanctuary and Sea of Cortez

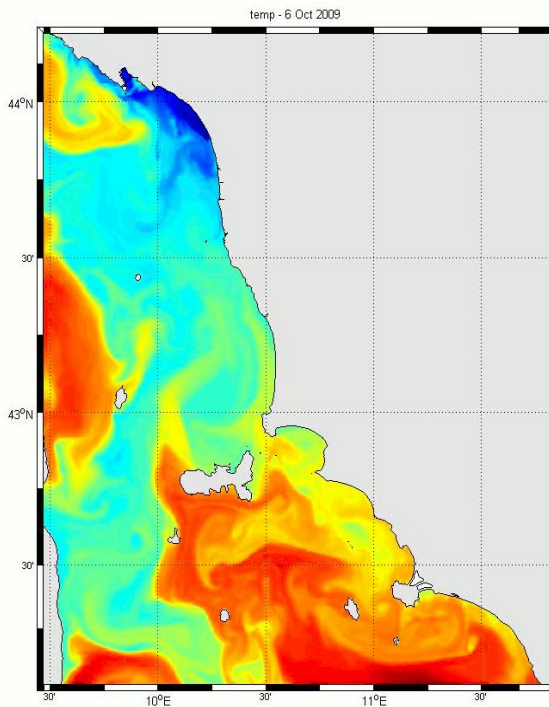


New results: PlasticPelagos

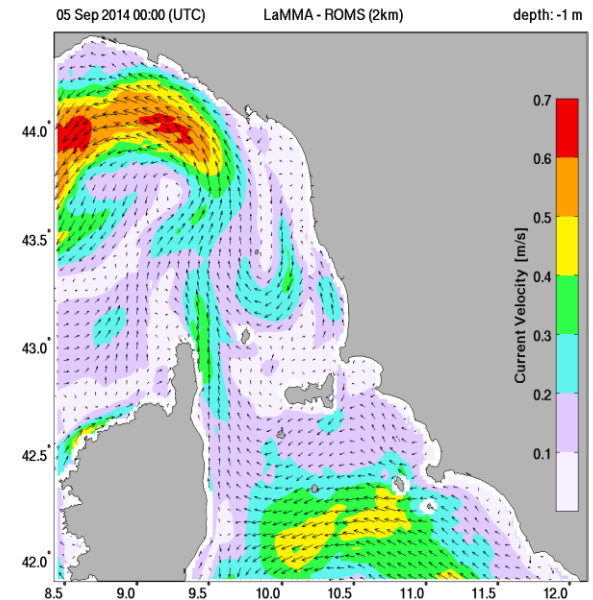
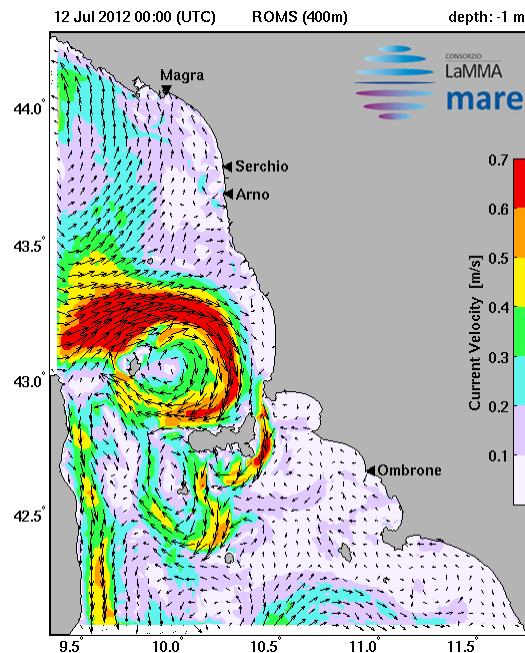




ROMS model (Regional Ocean Modeling System) (Temperature, Salinity, Corrents)



Temperatura



<http://www.lamma.rete.toscana.it/mare/modelli/correnti>

ASTREA IN THE PELAGOS SANCTUARY



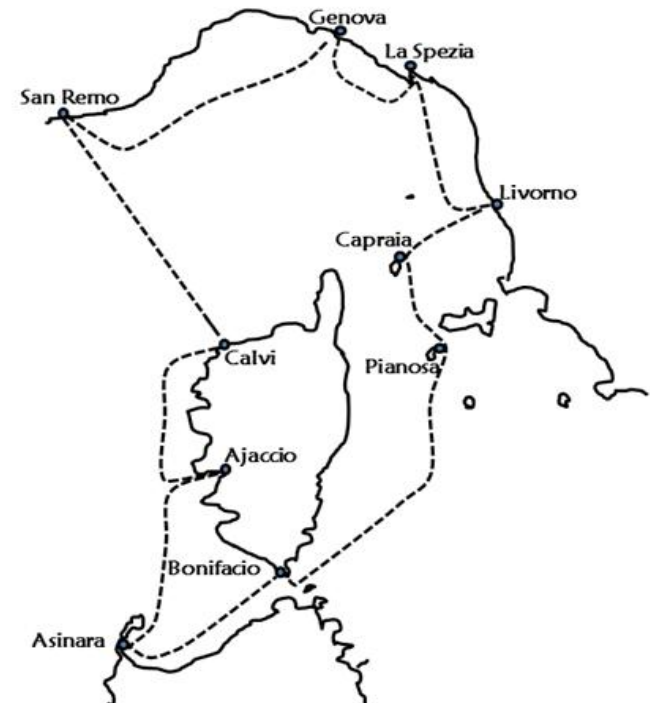
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ISPRA
Istituto Superiore per la Protezione
e la Ricerca Ambientale



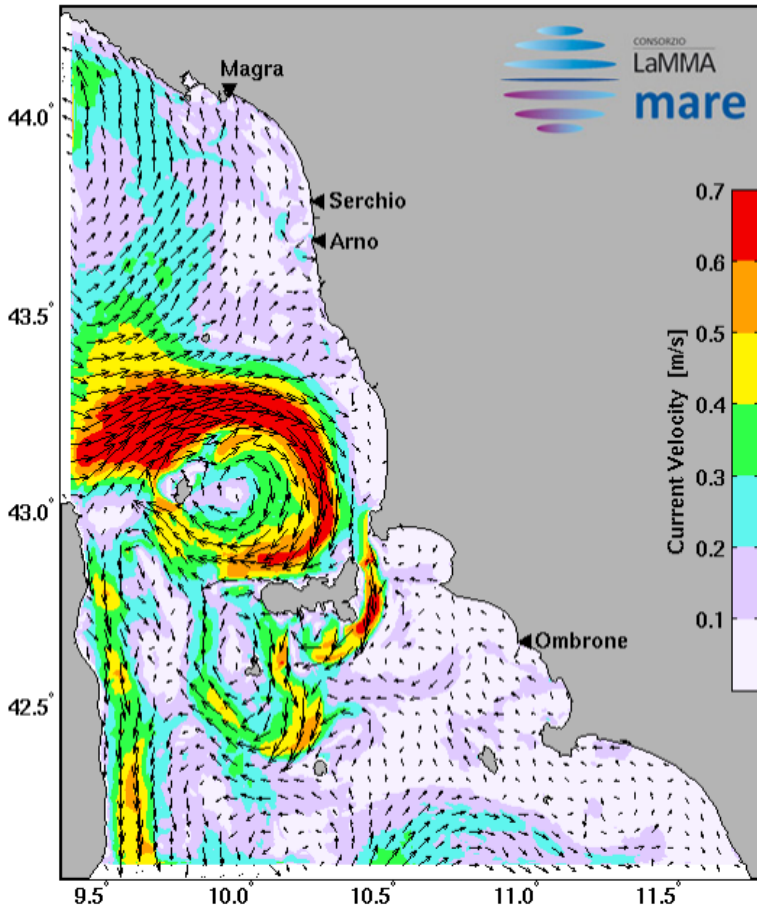
CONSORZIO
LaMMA



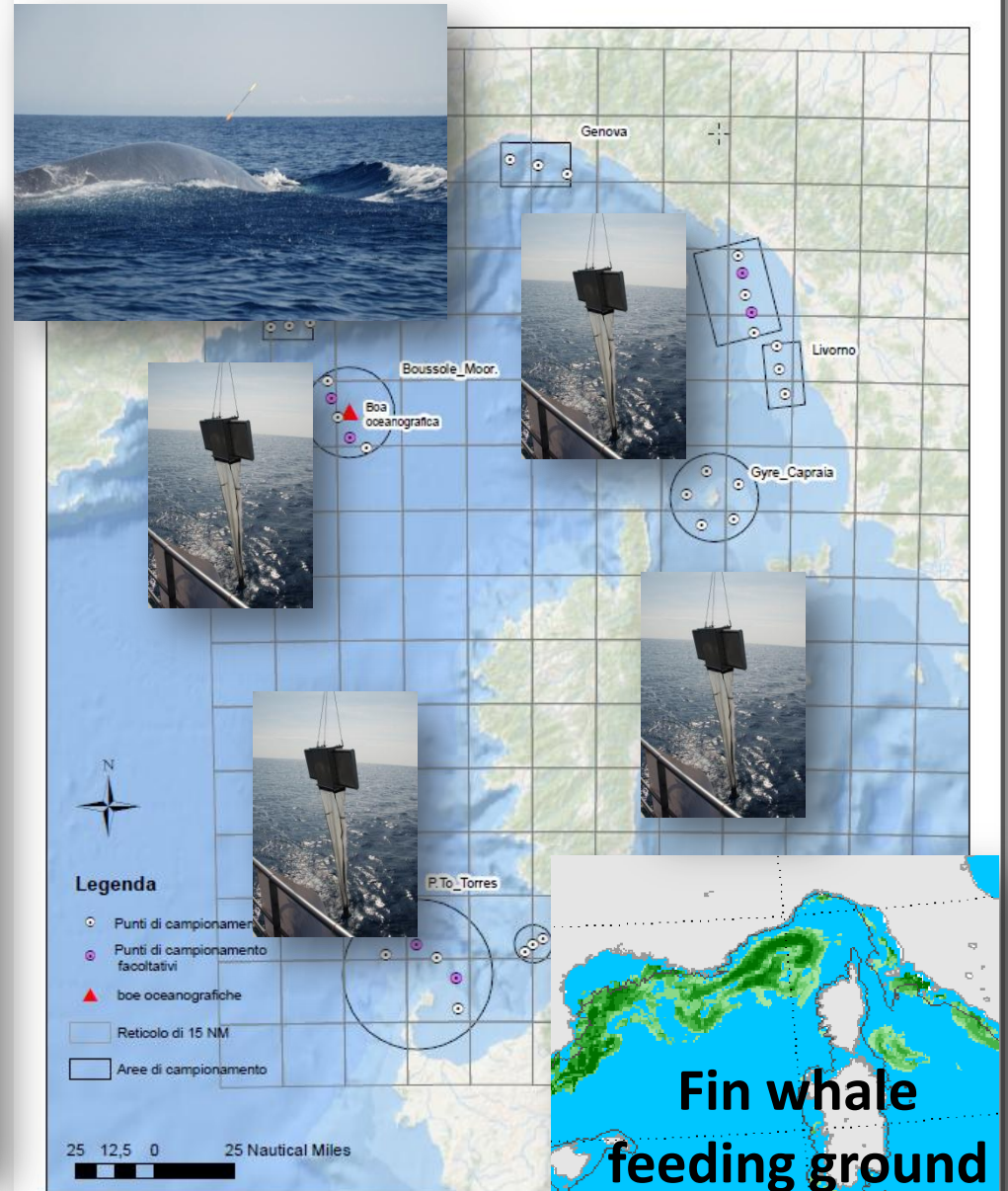
8-18 September
900 miles in Pelagos Sanctuary
Detection of presence and
effects of Microplastics

Gyres and sampling sites

12 Jul 2012 00:00 (UTC) ROMS (400m) depth: -1 m



Punti di campionamento campagna ASTREA



Marine organisms as sentinel species: macro-plastic

Case study: the Mediterranean **Loggerhead turtle** (*Caretta caretta*)

Aim: exploring the toxicological effects of **macro-plastics**

Further implication: indicators of macro-plastics in the marine environment in the implementation of the **Descriptor 10** of MSFD

Macro-plastic





Presence of plastic debris in loggerhead turtle stranded along the Tuscany coasts of the Pelagos Sanctuary for Mediterranean Marine Mammals (Italy)

Tommaso Campani^a, Matteo Baini^{a,*}, Matteo Giannetti^{a,d}, Fabrizio Cancelli^b, Cecilia Mancusi^c, Fabrizio Serena^c, Letizia Marsili^a, Silvia Casini^a, Maria Cristina Fossi^a



found 483 pieces of marine litter with a total mass of 62.37g



22 loggerhead turtles out of 31 animals had ingested marine debris (71%)

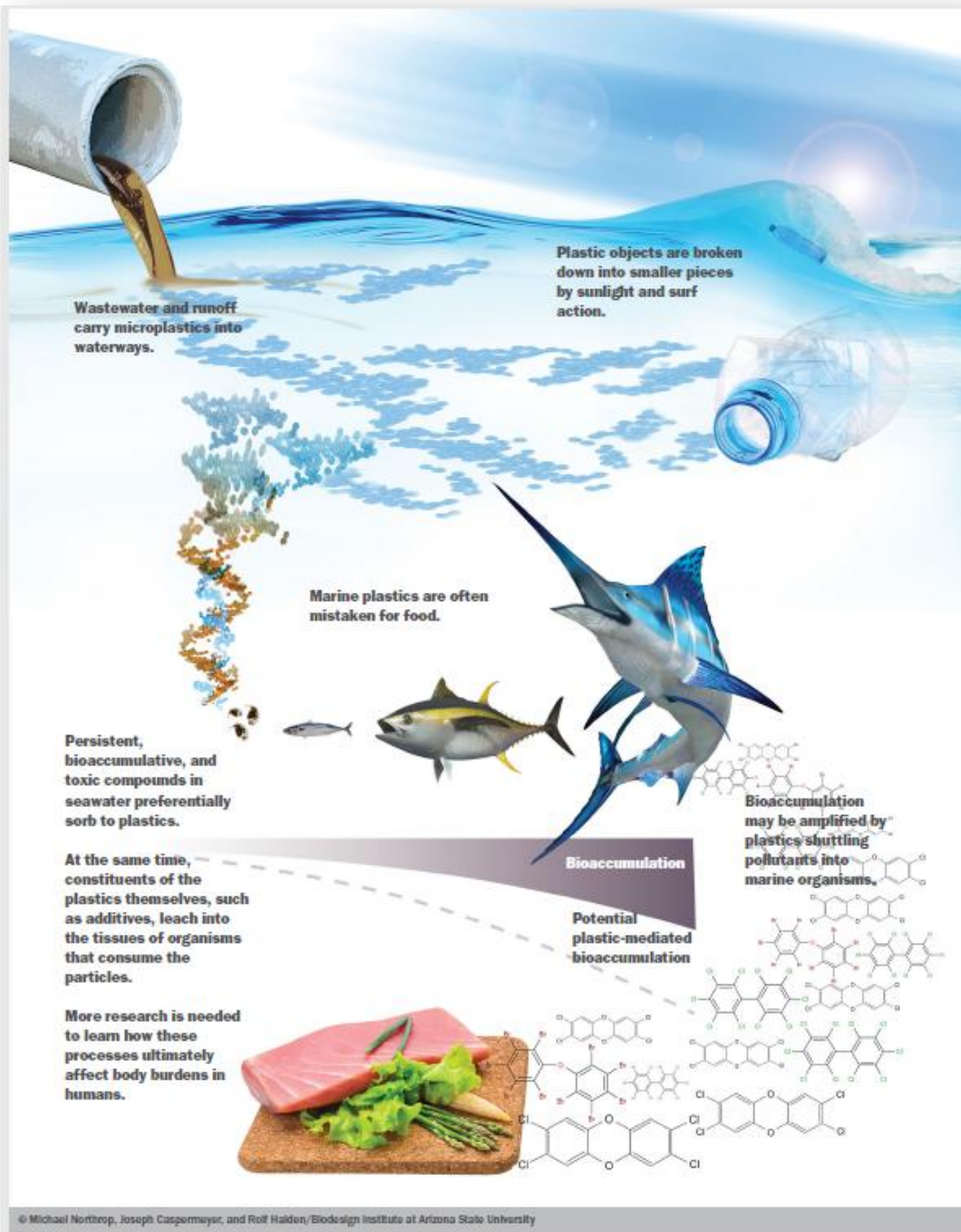
Caretta caretta

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	(ENDANGERED)	CRITICALLY ENDANGERED
LC	DD	LC	NT	VU	EN	CR

Marine Plastic and Human impact?



New Link in the Food Chain?



Marine Plastic Pollution and Seafood Safety

Mediterranean Sea?



Microplastic impact in Top predator fish

Plastic debris in stomach of top predator fish

Table I. Mean values and range of fish length and weight for each predator (SWO = swordfish; BFT = bluefin tuna; ALB = albacore). The number of stomach containing plastics is also reported.



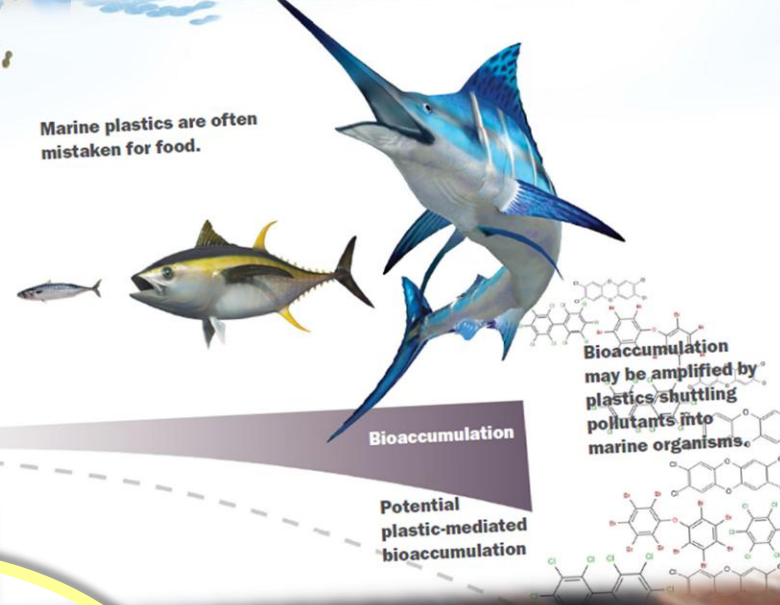
<i>Species</i>	<i>Number of stomachs examined</i>	<i>Mean fish length ± SD</i>	<i>Length range</i>	<i>Mean fish weight ± SD</i>	<i>Weight range</i>	<i>Number of stomachs with debris</i>
		(cm)	(cm)	(kg)	(kg)	
SWO	56	145.4 ± 25.4	63 - 206	41.2 ± 19.8	2.5 - 109	7
BFT	34	156.4 ± 22.1	123 - 201	58.7 ± 32.2	23 - 151	11
ALB	31	71.2 ± 8.2	64 - 83			4
Total	121					22



Thunnus albacares



Marine plastics are often mistaken for food.



7 Plastic debris





Plastic have no border!



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Lead promoter: University of Siena (SDSN - MED Solutions) (IT)

**UNEP/MAP along with its network MEDPOL designated monitoring laboratories
MIO-ECSDE, Mediterranean Information Office for Environment, Culture and Sustainable
Development (GR)**

IFREMER, Institut Français de Recherche Pour L'Exploitation de la Mer (FR)

SOCIB, Balearic Islands Coastal Ocean Observing and Forecasting System (ES)

**ISPRA, Institute for Environmental Protection and Research, Laboratory of Ichthyology and
Marine ecology (IT)**

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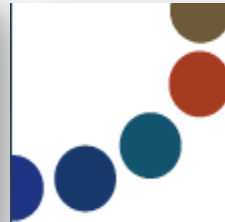
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UNITED NATIONS ENVIRONMENT PROGRAMME
MEDITERRANEAN ACTION PLAN
for the Barcelona Convention



PROJECT SCOPE



The overall goal of the project is to contribute to the de-pollution of the Mediterranean sea through the promotion of the implementation of the Regional Plan on Marine Litter Management in the Mediterranean (Barcelona Convention - IG.21/9).

The main objectives and activities focus on:

- a) addressing the marine litter related **knowledge gaps via monitoring, assessment and mitigation;**
- b) developing and implementing **concrete actions to prevent, reduce identify convergence areas and remove marine litter;**
- c) actions to enhance the **awareness of stakeholders** and catalyze change in their perceptions and attitudes towards waste.



PLASTIC-BUSTERS FOR A MEDITERRANEAN FREE FROM LITTER

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PLASTIC-BUSTERS for a Mediterranean free from litter

17 / 02 / 2016

The overall goal of the project is to effectively tackle the issue of marine litter in the Mediterranean. The project directly supports the implementation of the UNEP/MAP Regional Plan on Marine Litter Management in the Mediterranean, linking and contributing also to the global Honolulu Strategy framework for prevention and management of Marine Debris. The project is also in line with the recommendations of the UfM Ministerial Meeting on Environment and Climate Change (May 2014) and the UfM Ministerial on Blue Economy (November 2015).



Marine litter has become a major pollution problem affecting all of the world seas. Increased levels of marine litter originate largely from land based activities (~80%). This includes, in particular, inadequate urban solid waste management (collection, transportation, treatment and final disposal) negative impacts on human health, marine wildlife, marine ecological systems, beach quality, and navigational safety as well as fishing and maritime industries.

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G7 countries outline measures against marine litter



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The G7 countries are developing an action plan to combat marine litter. Practical measures to reduce waste from land- and sea-based sources will be set out at a meeting in Berlin. This meeting will also focus on removing the existing waste in our oceans. During the G7 summit in Elmau at the start of June 2015, the G7 heads of state and

government decided on a G7 action plan to combat marine litter and expressly committed themselves to concrete measures. Today in Berlin, State Secretary Jochen Flasbarth opened a workshop following up on the decisions taken in Elmau. He highlighted to workshop participants that "marine litter is the most visible sign of economic practices and a way of life that are not sustainable".

Today, there are an estimated 100 to 142 million tonnes of waste in our oceans. Most of this waste is packaging material and waste from fishing and shipping, 75 percent of this waste consists of plastics. Currently up to 10 million tonnes of waste are added to this each year.

State Secretary Flasbarth commented: "Marine litter has been a pressing matter on the agenda for marine conservation for a long time now, both nationally and internationally. There is also a common understanding among the G7 heads of state and government regarding the urgency of this issue and important fields of action and approaches. We are striving for a package of concrete implementation measures with which we can save our oceans from further pollution from vast quantities of waste, in particular plastic waste. What we need is a clear roadmap."



G7 GERMANY
2015 | Schloss Elmau

Thank you for your attention!



Siena



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