Mediterranean e-course on marine litter monitoring & mitigation

17 & 19 January 2023, 10.00 – 14.00 CET

PLASTIC BUSTERS CAP

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Photo©Thomais Vlachogianni

MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA

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Mediterranean e-course on marine litter monitoring & mitigation

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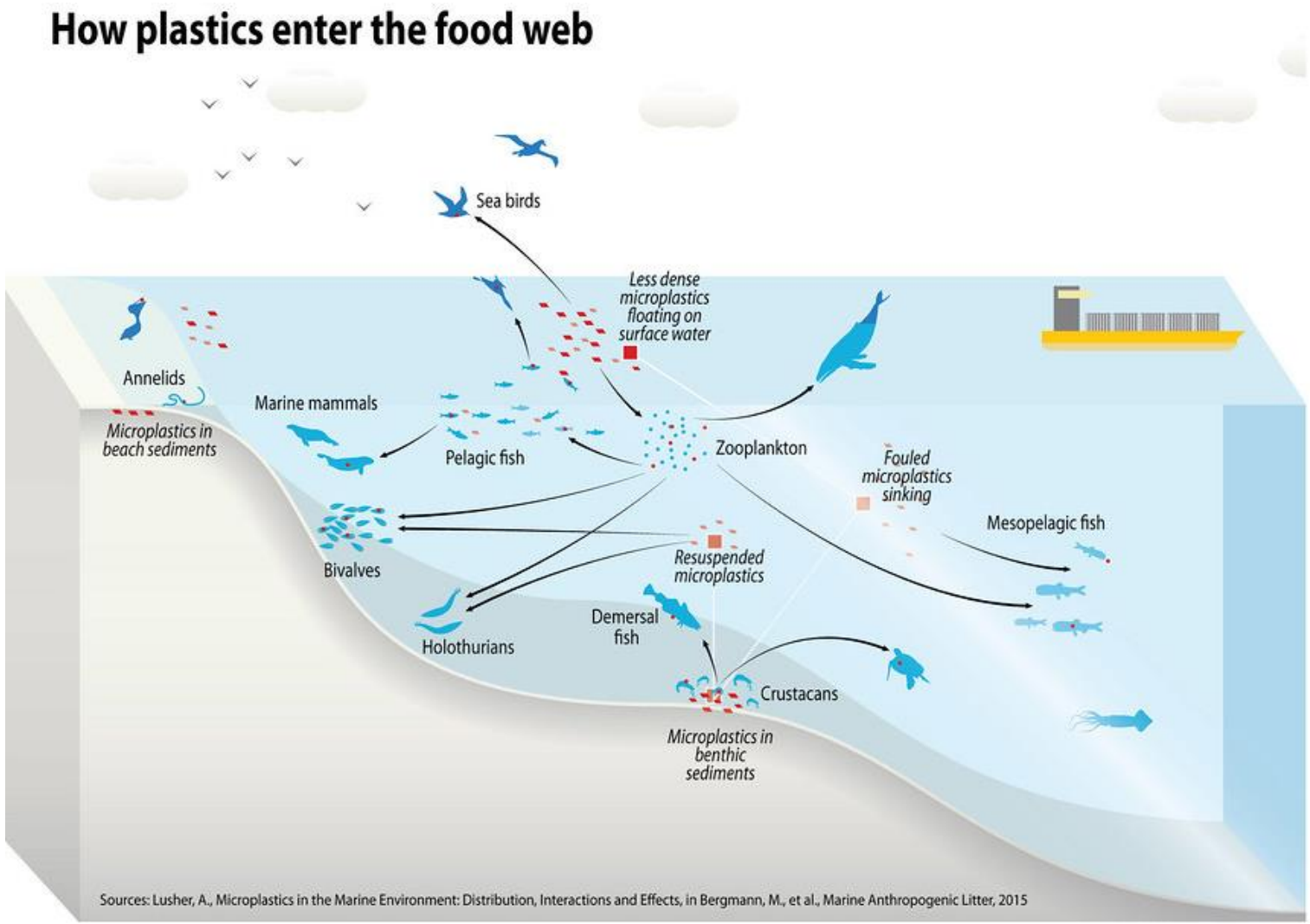
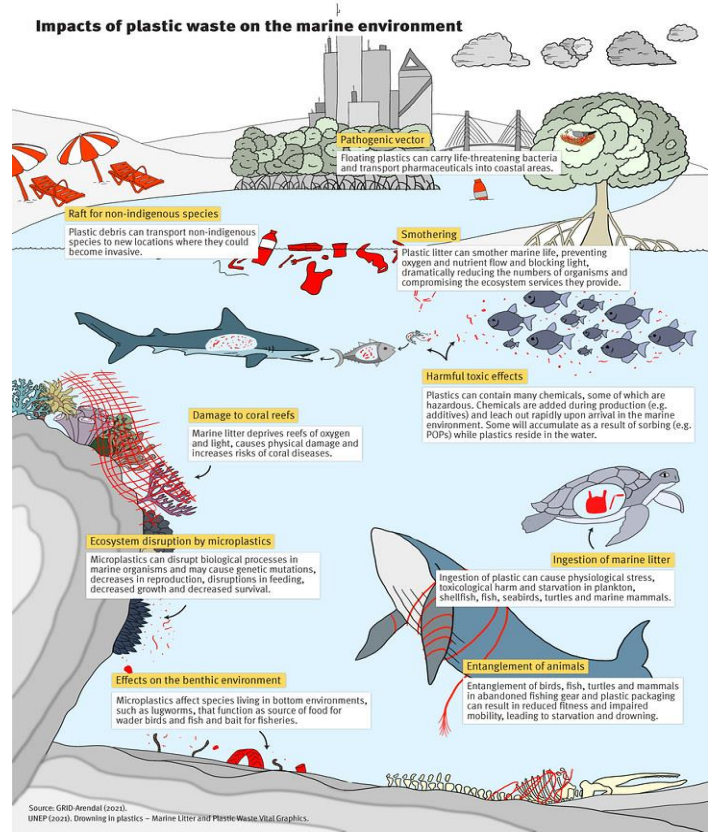
EFFECTS OF MARINE LITTER ON BIOTA ?

MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA: STATE OF ART





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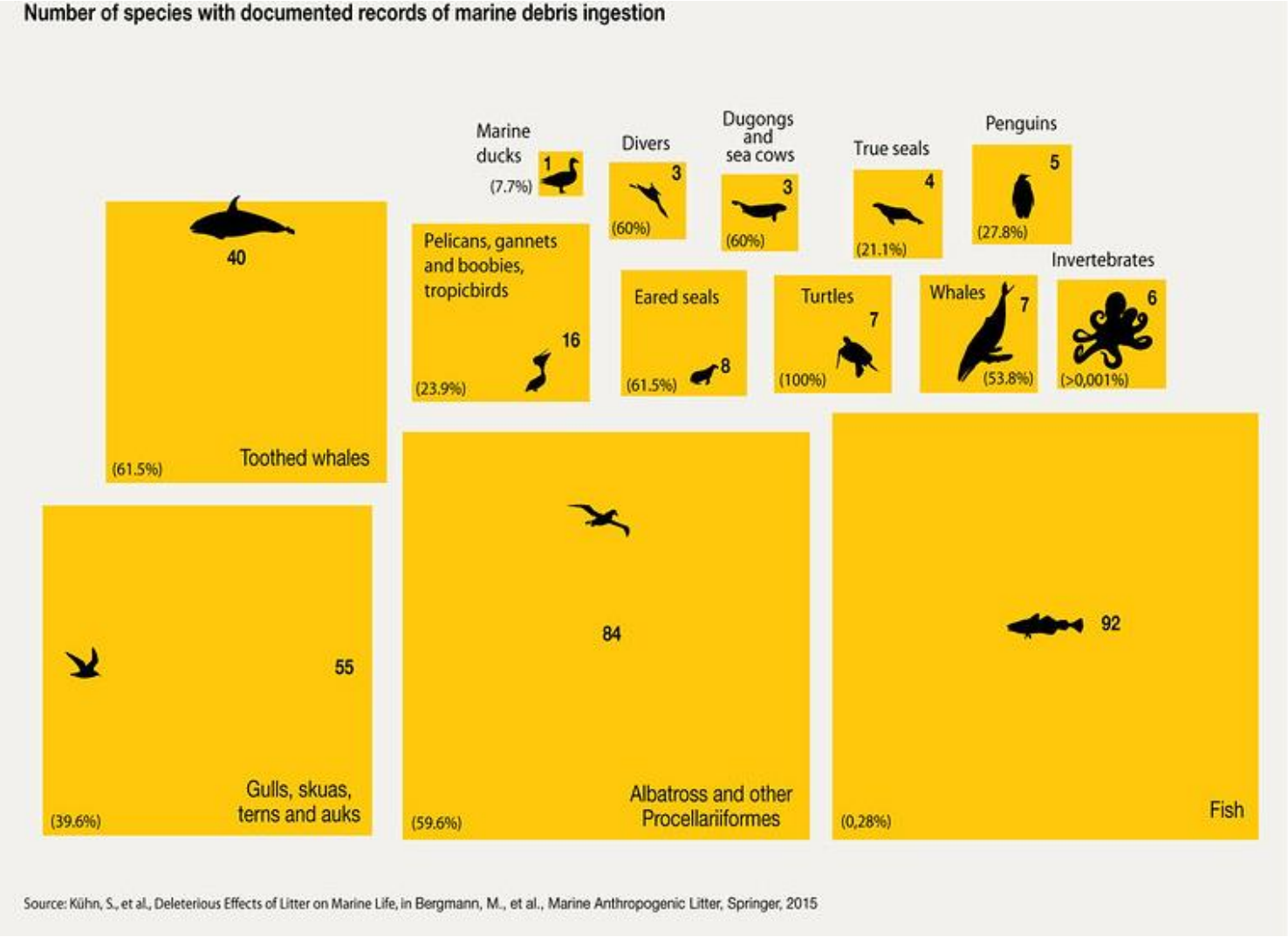

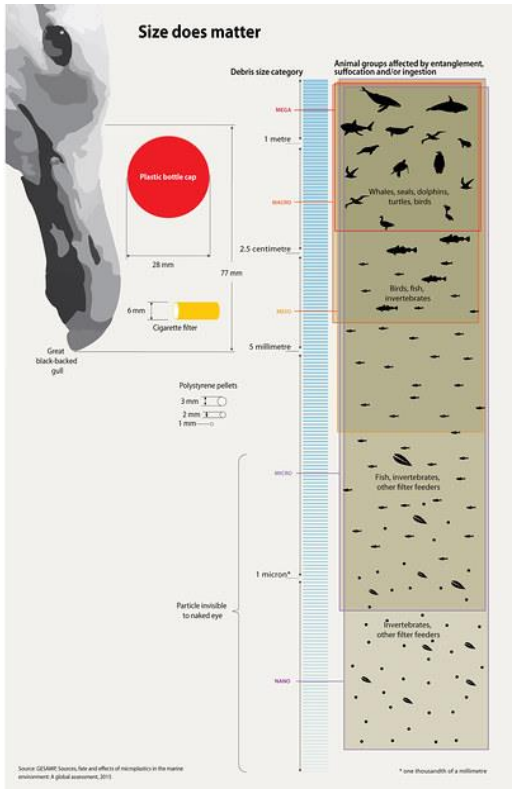

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MARINE LITTER IMPACT: WHAT HAPPENS IN THE MEDITERRANEAN SEA?

7 plastic items in the stomach

145 plastic items in the stomach

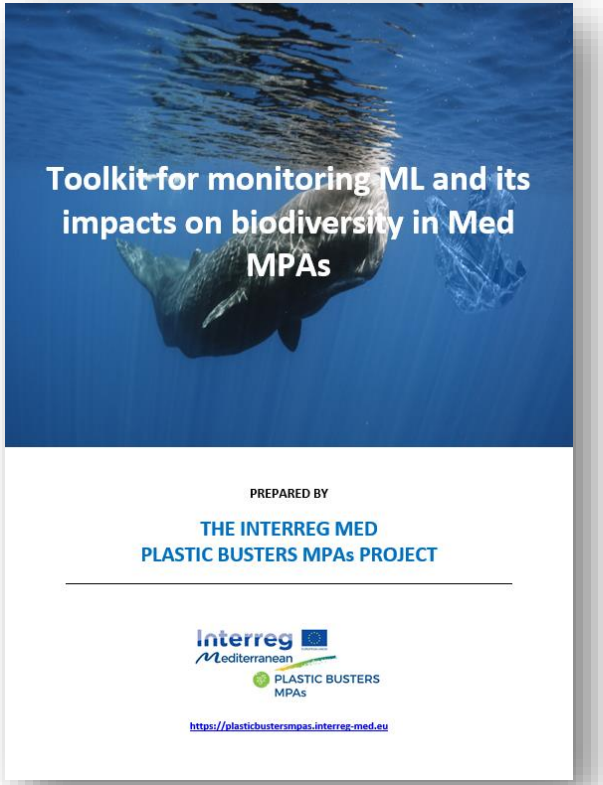
22 Kg of plastic in the stomach

More than 130 marine species affected
by marine litter in the Mediterranean basin


Environmental Pollution

Bioindicators for monitoring marine litter ingestion and its impacts on Mediterranean biodiversity

PLASTIC BUSTERS MPAs: SIMULTANEUS MONITORING



MONITORING MACRO- AND MICROLITTER IN THE ENVIRONMENT

MONITORING MACRO- AND MICROLITTER IN BIOTA

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CAPITALIZATION STRATEGY

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DeFishGear

Interreg Mediterranean

MEDSEALITTER

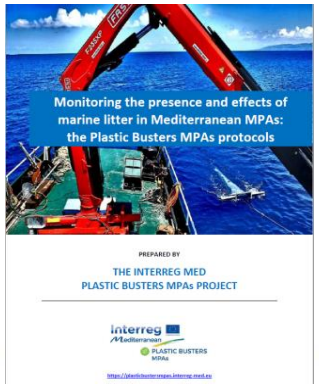
PLASTIC BUSTERS MPAs

UNEP

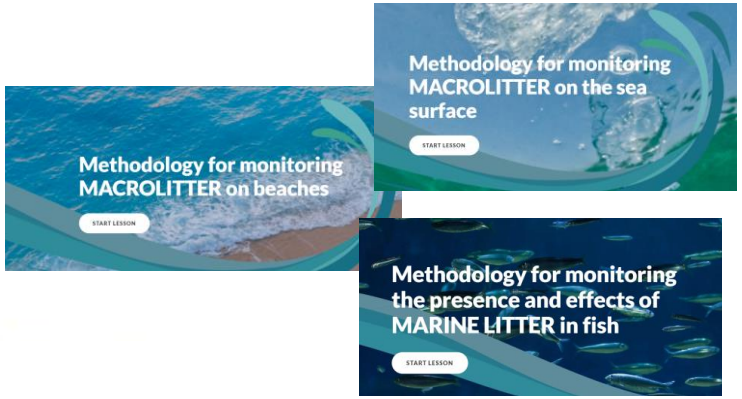
INDICIT II

INDICATOR • IMPACT • TAXA

COMMON



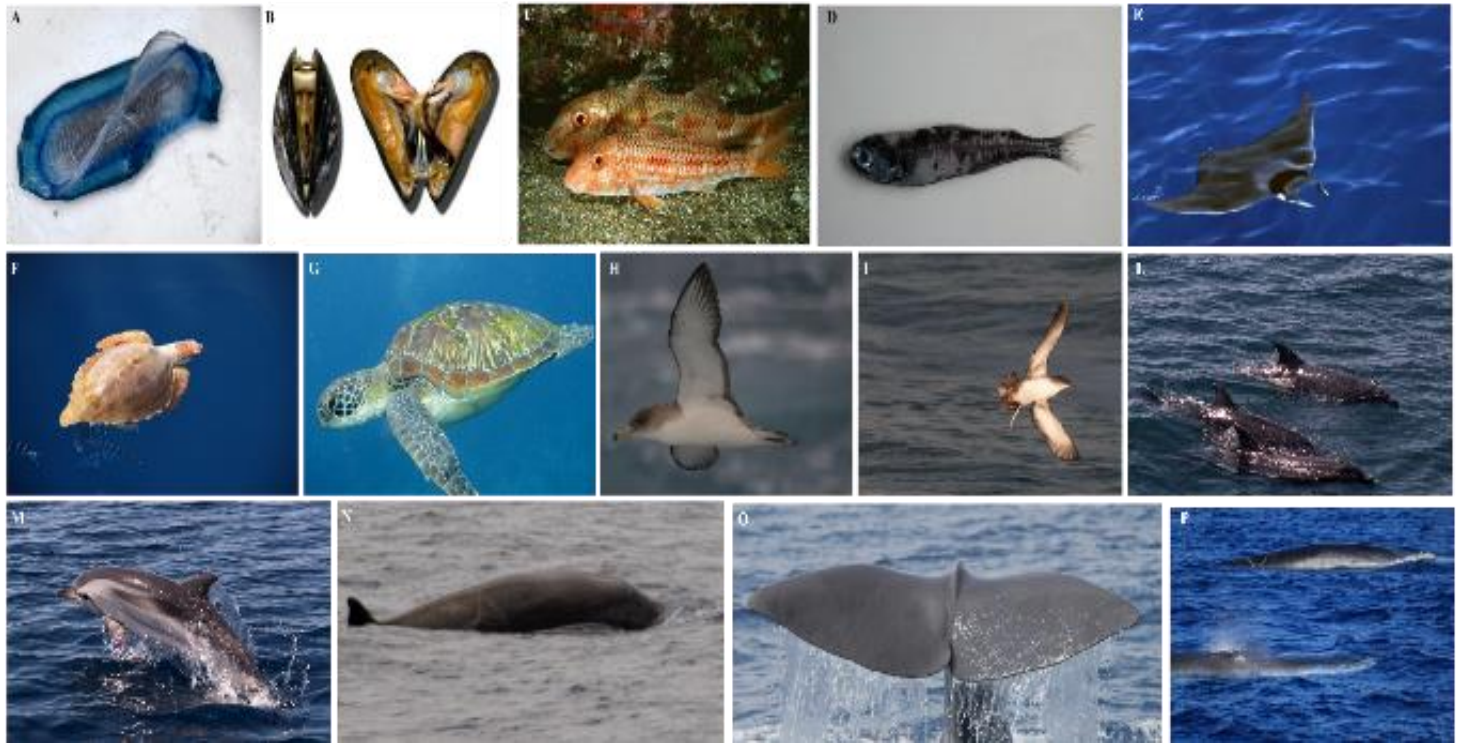
Protocol for *Marine litter* monitoring



E-learning modules

Resource Pack

MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA: THE NOVELTY



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BIOINDICATORS SELECTION IN RELATION TO HABITAT & HOME RANGE

Basin Scale

	SEA SURFACE	COASTAL WATERS	OPEN WATERS	SEAFLOOR	COAST LINE AND BEACH SEDIMENT
BASIN SCALE *(Mediterranean Sea)*	*Calonect… diomedea, Puffinu… yelkouan*	*Calonectris diomedea, Puffinus yelkouan*	*Balaenoptera physalus;* *Cetorhinus maximus* *Xiphias gladius;* *Thunnus thynnus* *Xiphias gladius;* *Thunnus thynnus* *Caretta caretta* *Physeter macrocephalus*		
MEDIUM-SCALE *(Mediterranean UN Environment/MAP sub-regions)*			*Thu…us alalunga* *Coryphaen…inpurus* *Caretta caret…* *Thunnus alalunga*		
SMALL-SCALE *(FAO GSA)*		*Boops boops* *Trachinotus ovatus*	*Maurolicus muelleri* *Engraulis encrasicolus* *Sardina pilchardus* Myctophids	*Mullus ba…tus* *Nephrops norvegicus,* *Galeus melastomus,* *Merluccius merluccius,* *Solea spp.* *Galeus melastomus,* *Scyliorhinus canicula*	
LOCAL SCALE				Holoturians	*Mytilus galloprovincialis* *Arenicola marina* Decapods *(e.g. Carcinus sp.)*

BIOINDICATOR SELECTION STRATEGY

Ecological and biological selection criteria

Habitat and home range selection criteria

BLUE: biondicator for macrolitter

RED: bioindicator for microplastics

Local Scale

HARMONIZED MARINE LITTER DIAGNOSIS IN MEDITERRANEAN BIODIVERSITY

NOT ONLY SEA TURTLES

46 Species

Taxa	N° species	N° specimens
Invertebrates	9	551
Elasmobranch	1	1
Fish	23	1244
Reptiles	2	190
Birds	3	83
Pinnipeds	1	12
Cetaceans	7	120
Total	46	2201

2201 Specimens in PB MPAs

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MARINE LITTER INGESTION: MEDITERRANEAN SEA

The Marine Strategy Framework Directive defines Criteria 3 of Descriptor 10:

D10.C3 as "*The **amount of litter and micro-litter ingested** by marine animals is at a **level** that **does not adversely affect** the **health of the species** concerned*"

D10.C4 as "*the **number of individuals** of each species which are **adversely affected due to litter**, such as by entanglement, other **types of injury or mortality, or health effects**.*"

The Integrated Monitoring and Assessment Guidance defines the indicator for Ecological Objective 10 on marine litter (EO10) (known as Candidate Indicator 24) as "***Trends in the amount of litter ingested by or entangling marine organisms,** focusing on selected **mammals, marine birds, and marine turtles**".*

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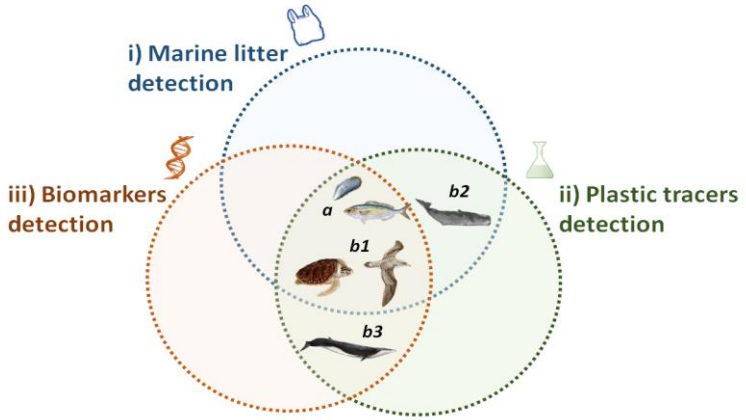
MARINE LITTER INGESTION: MEDITERRANEAN SEA

The Marine Strategy Framework Directive defines Criteria 3 of Descriptor 10:
D10.C3 as "*The **amount of litter and micro-litter ingested** by marine animals is at a **level** that **does not adversely affect** the **health of the species** concerned*"

DOES ML ADVERSELY AFFECT THE HEALTH OF THE SPECIES ?

The quantification of marine litter ingestion is not enough… we need to investigate ecotoxicological effects !



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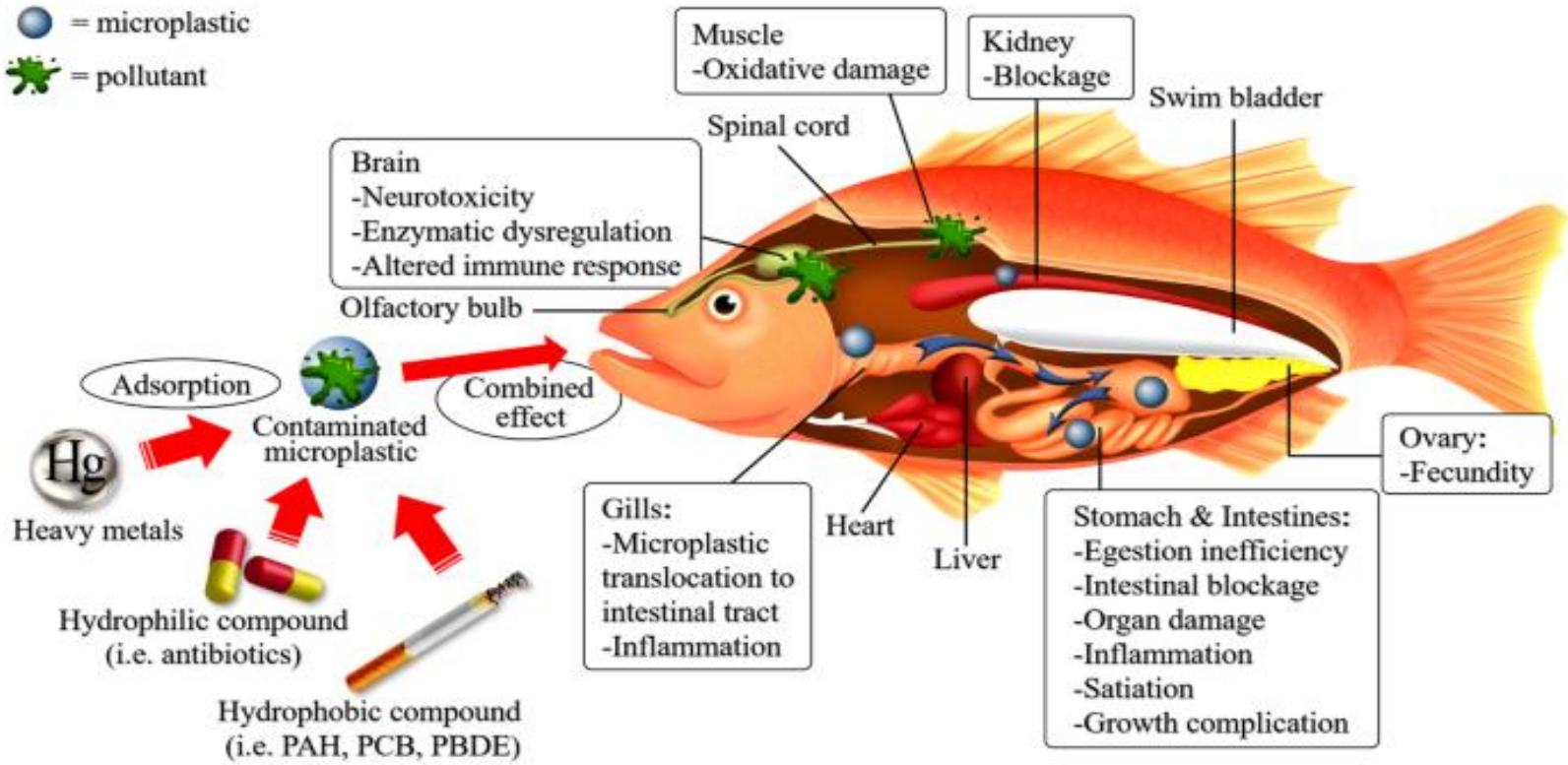
PLASTICS AND MICROPLASTICS AS VECTORS OF CHEMICAL POLLUTANTS



Review | Open Access | Published: 22 January 2021

Marine microplastics as vectors of major ocean pollutants and its hazards to the marine ecosystem and humans

Tan Suet May Amelia, Wan Mohd Afiq Wan Mohd Khalik, Meng Chuan Ong, Yi Ta Shao, Hui-Juan Pan & Kesaven Bhubalan

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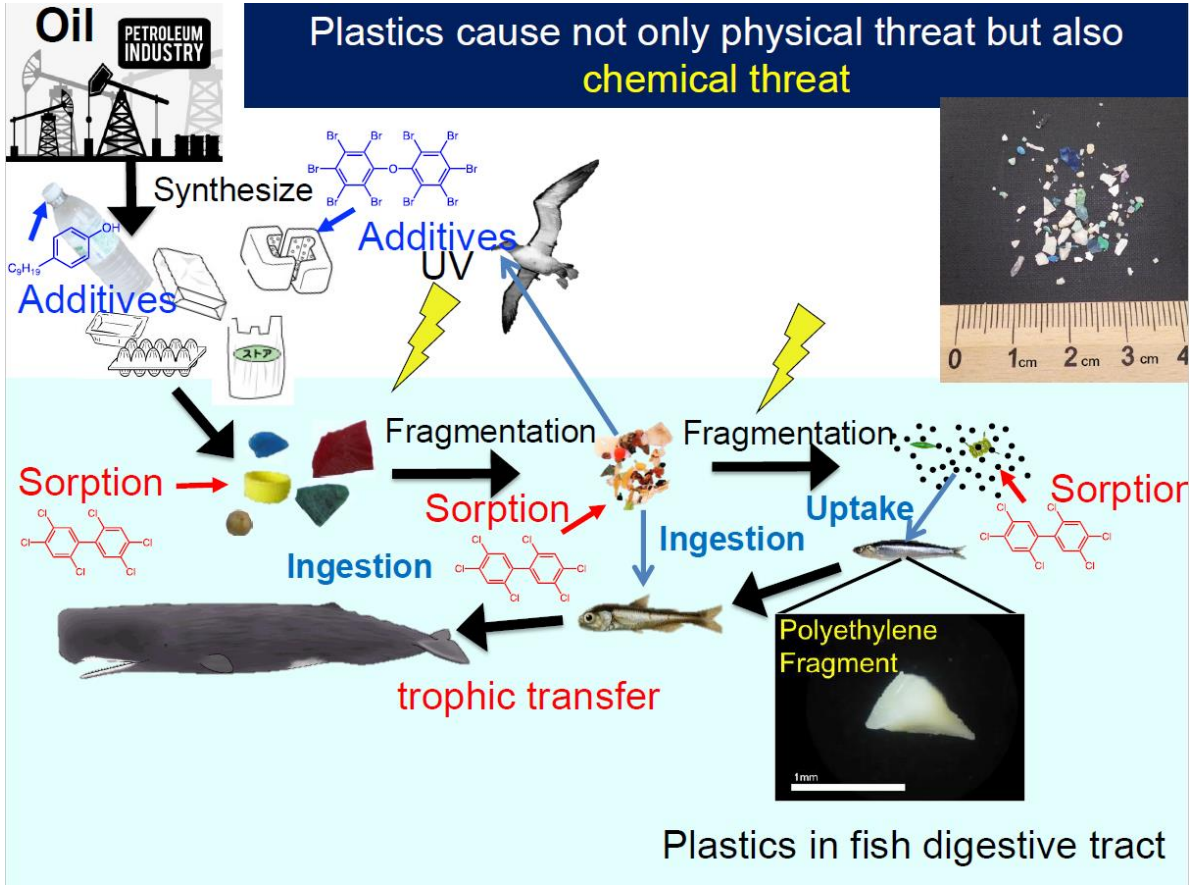
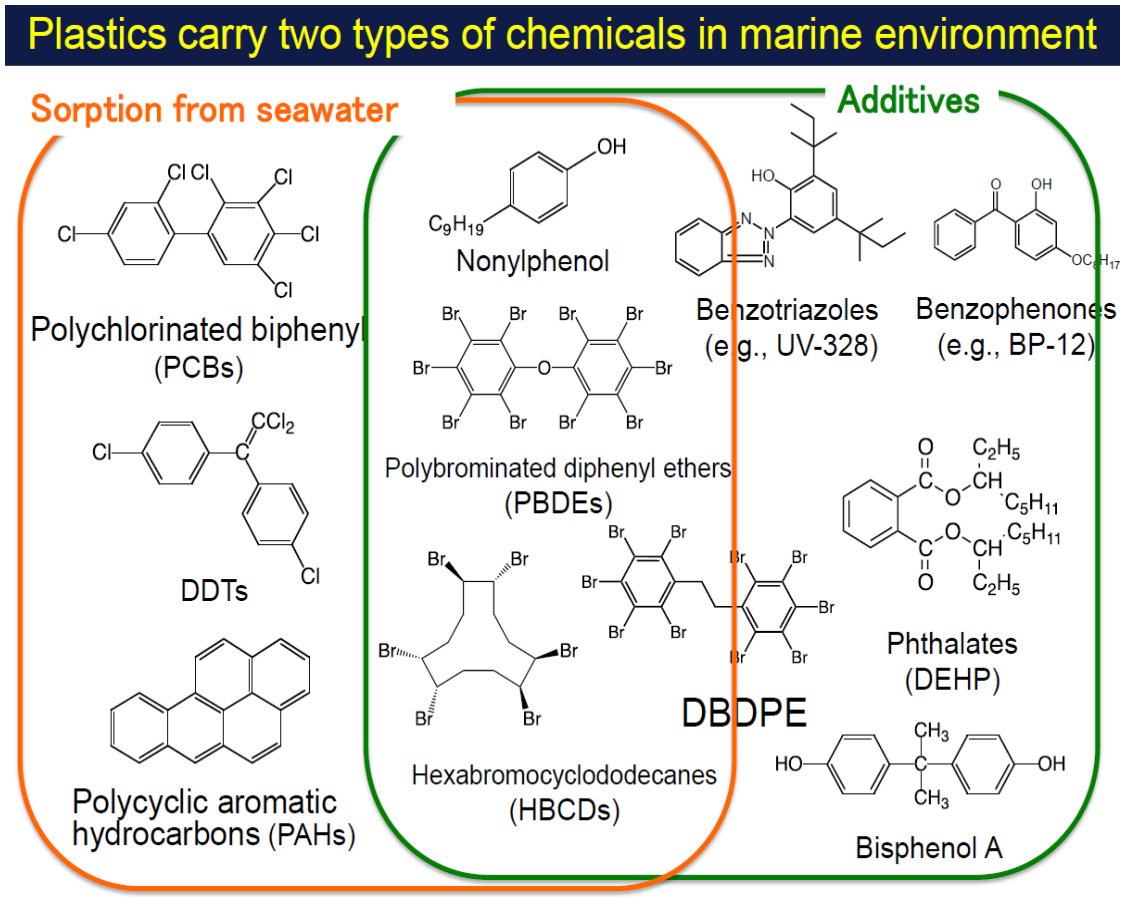
TRANSFER OF CHEMICALS FROM PLASTIC TO BIOTA



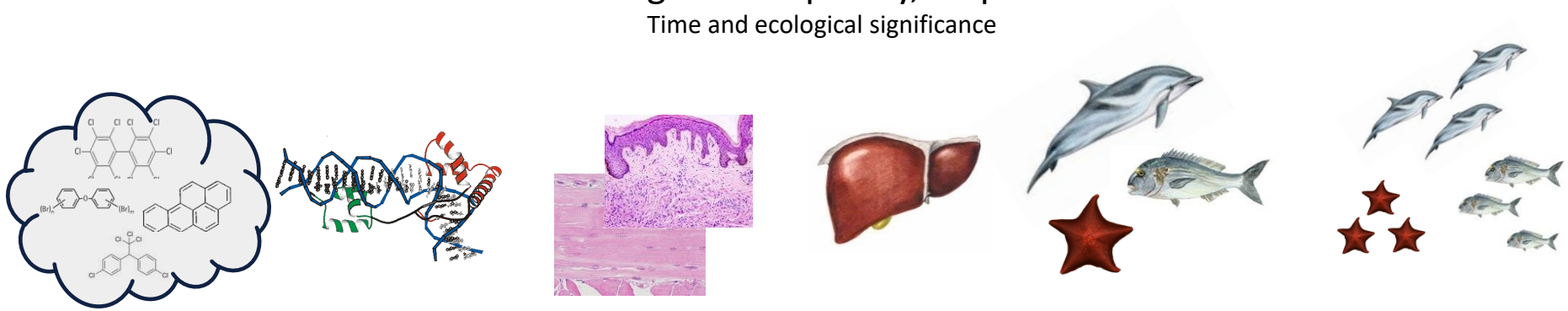


THE BIOMARKER APPROACH

Short term **Long term**

Biological Complexity, response

Time and ecological significance



Pollutants mixture → **Molecules** → **Cells and Tissues** → **Organs** → **Individuals** → **Population**

Rapid distress signal
(diagnostic biomarkers)
Prognostic for pathology

Pathology, Immunodeficiency, Physiological disturbance

Population decline,
Loss of biodiversity,
Epidiemology

Responsiviness, detectability

Modified from: Moore *et al.*, 2004, *Fund. Mol. Mech. Mut.*

THE THREEFOLD MONITORING APPROACH

Environmentally relevant species

Protected species

Plastic detections

- Analysis of the gastro intestinal (GI) contents:
  - Occurrence (%)
  - Abundance (n°)
  - Weight (g)
  - Polymer analysis

Plastic tracers detections

- Analysis of plastic additives:
  - Phthalates
  - PBDEs
  - Bisphenol A
- Analysis of PBT compounds:
  - PCBs
  - DDTs
  - PAHs
  - Mercury

Biomarkers detections

- Effects at molecular level:
  - Measure of DNA damage
  - Alterations of gene expression
  - Alteration of proteins
- Effects at cellular level:
  - Alteration of cell functions
- Effects at tissue level:
  - Hystological and hystopathological alterations

The simultaneous investigation in bioindicator species of:

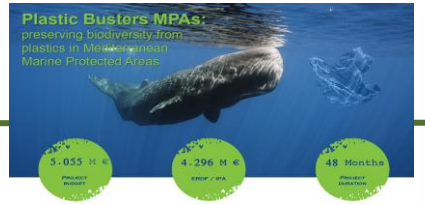
A) the analysis of **gastro-intestinal content** to evaluate the **marine litter** ingested by the organisms;

B) the analysis of **plastic additives** and PBT compounds used as plastic tracers;

C) the analysis of the effects by **biomarkers responses** at different level of biological organization

… will allow a **more complete assessment of the real impact** related to plastic debris ingestion by marine organisms.

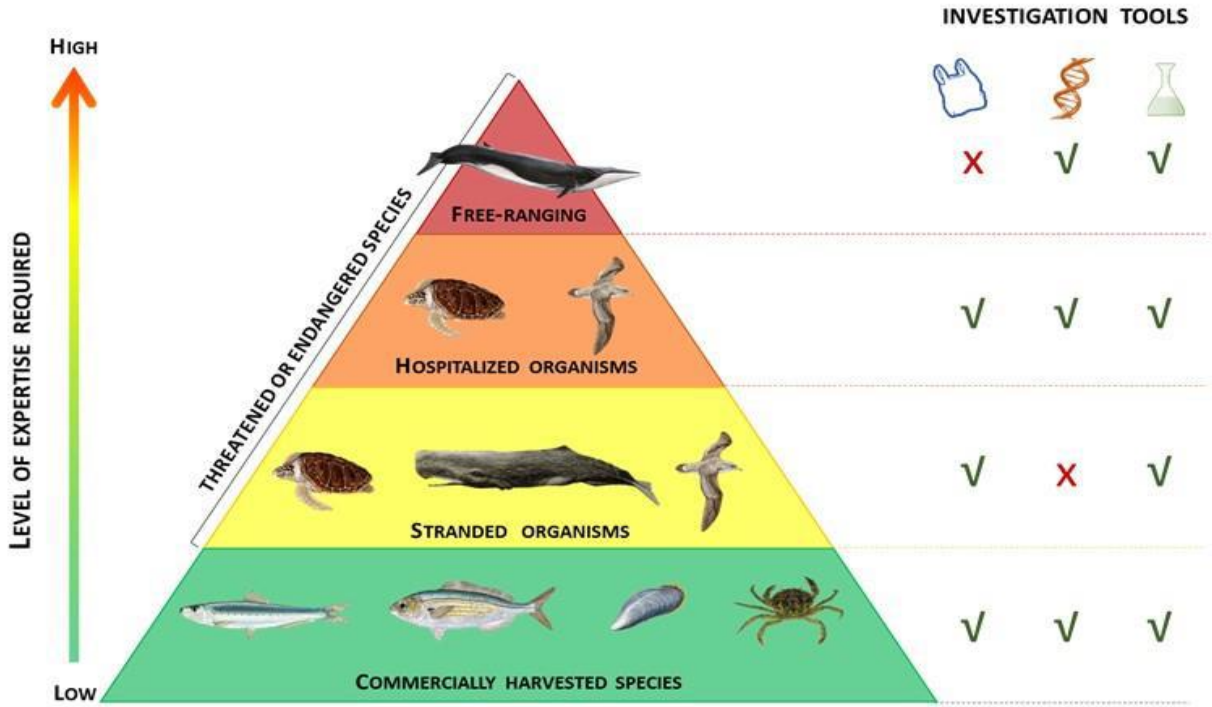
PLASTIC BUSTERS



COastal Management and MOnitoring Network for tackling marine litter in Mediterranean sea

INDICIT II
INDICATOR • IMPACT • TAXA

A NEW APPROACH FOR MONITORING MARINE LITTER INGESTION & IMPACT IN MEDITERRANEAN BIODIVERSITY



i) Plastic detection

- Analysis of the ingested marine litter/microplastics:
  - Occurrence (%)
  - Abundance (n°)
  - Weight (g)
  - Polymer analysis

ii) Plastic tracers detection

- Analysis of plastic additives:
  - Phthalates
  - PBDEs
  - Bisphenol A
- Analysis of PBT compounds:
  - PCBs
  - DDTs
  - PAHs
  - Mercury

iii) Biomarkers detection

- Effects at molecular level:
  - Measure of DNA damage
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  - Alteration of proteins
- Effects at cellular level:
  - Alteration of cell functions
- Effects at tissue level:
  - Hystological and hystopathological alterations

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THE THREEFOLD MONITORING APPROACH

Commercially harvested species

invertebrates

invertebrates

fish species

THE THREEFOLD MONITORING APPROACH

Endangered species

cetaceans

sea turtles

seabirds

MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER IN INVERTEBRATES

MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA: INVERTEBRATES

Plastic detections

- Analysis of the gastro intestinal (GI) contents:
  - Occurrence (%)
  - Abundance (n°)
  - Weight (g)
  - Polymer analysis

Plastic tracers detections

- Analysis of plastic additives:
  - Phthalates
  - PBDEs
  - Bisphenol A
- Analysis of PBT compounds:
  - PCBs
  - DDTs
  - PAHs
  - Mercury

Biomarkers detections

- Effects at molecular level:
  - Measure of DNA damage
  - Alterations of gene expression
  - Alteration of proteins
- Effects at cellular level:
  - Alteration of cell functions
- Effects at tissue level:
  - Hystological and hystopathological alterations

- 80°c

DIAGNOSTIC MARKERS FOR CONTAMINANTS

- **Markers of genotoxicity** (DNA strand break, micronuclei)
- **Markers of neurotoxicity** (inibition of esterases enzymes, transcriptomics)
- **Markers of oxidative stress** (quantification of oxidative enzymes, transcriptomics)
- **Markers of xenobiotic metabolism and biotransformation** (enzymes induction and trascriptomics)

DIAGNOSTIC MARKERS FOR IMMUNE SYSTEM ALTERATION

- **Markers of immunotoxicity** (transcriptomics)

DIAGNOSTIC MARKERS FOR REPRODUCTION FUNCTIONALITY

- **Markers for reproductive system** (expression and quantification of proteins, transcriptomics)

DIAGNOSTIC MARKERS FOR INFLAMMATION AND MORPHOLOGY

Transcriptomics and histology and histopathology

ANALYSIS OF ANTHROPOGENIC CONTAMINANTS

- **OCs**
- **PAHs**
- **Mercury**
- **Plastic additives (phthalates, bisphenol A, PBDEs)**

MARINE LITTER ANALYSIS

Analysis of microplastics and ML in the whole organism

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Plastic Busters CAP

MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA: INVERTEBRATES

Plastic detections

- Analysis of the gastro intestinal (GI) contents:
  - Occurrence (%)
  - Abundance (n°)
  - Weight (g)
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  - Mercury

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- Effects at molecular level:
  - Measure of DNA damage
  - Alterations of gene expression
  - Alteration of proteins
- Effects at cellular level:
  - Alteration of cell functions
- Effects at tissue level:
  - Hystological and hystopathological alterations

	CHEMICAL COMPOUND	TISSUE/SAMPLE	ANALYTICAL METHOD
PLASTIC ADDITIVES	Phthalates	Muscle, whole organism	Baini et al., (2017), Fossi et al., (2016), Savoca et al., (2018), Avisar et al., (2019), Lo Brutto et al., (2021),
	Bisphenol A	Muscle, whole organism	Ballesteros-Gómez et al., (2009), Lo Brutto et al., (2021)
	Polybrominated diphenyl ethers	Muscle, whole organism	Muñoz-Arnanz et al., (2016), Cruz et al., (2019), Cruz et al., (2020)
ADSORBED CONTAMINANTS	Polycyclic aromatic hydrocarbons	Muscle, whole organism	Marsili et al., (2001), León et al., (2013), Benedetti et al., (2014)
	Organochlorine contaminants	Muscle, whole organism	Marsili and Focardi, (1997), León et al., (2021)
	Mercury	Whole organism, muscle	Correa et al., (2013), Fattorini et al., (2008), Besada et al., (2011), León et al., (2021)

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MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA: INVERTEBRATES

Plastic detections

- Analysis of the gastro intestinal (GI) contents:
  - Occurrence (%)
  - Abundance (n°)
  - Weight (g)
  - Polymer analysis

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- Analysis of PBT compounds:
  - PCBs
  - DDTs
  - PAHs
  - Mercury

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- Effects at molecular level:
  - Measure of DNA damage
  - Alterations of gene expression
  - Alteration of proteins
- Effects at cellular level:
  - Alteration of cell functions
- Effects at tissue level:
  - Hystological and hystopathological alterations

EFFECT	TISSUE	TEST
GENOTOXICITY	Hemolymph, digestive gland	Comet assay (Revel et al., 2019) (*) Mn test (Avio et al., 2015) (*)
OXIDATIVE STRESS	Digestive gland	LPO, CAT, SOD, GST, GSH, GR, GPX (Revel et al., 2019) (*) qPCR GPX, SOD, CAT (Ravel et al., 2019)
IMMUNOTOXICITY	Gills, Mantle, Digestive gland	CASP, TRAF, Transcriptomics (Avio et al., 2015; Revel et al., 2019) (*) Transcriptomics (Gardon et al., 2020) qPCR LYS, CASP3 (Paul-Pont et al, 2016)
REPRODUCTION	Gonads	Gamete Quality and Larval Development (Sussarellu et al., 2016) (*)
HISTOPATHOLOGY INFLAMMATION AND MORPHOLOGY	Digestive gland	Histopathology, histology (Avio et al., 2015) (*)
XENOBIOTIC METABOLISM AND BIOTRANSFORMATION	Digestive gland, whole organism	Porphyrins (Grandchamp et al. 1980; Guerranti et al. 2014) (*) EROD (Zhang et al., 2019) Transcriptomics (Gardon et al., 2020) (*)
NEUROTOXICITY	Whole organisms, muscle, gills	AChE activity (Magni et al., 2018) (*)
CELLULAR STRESS	Whole organisms, muscle, hemolymph, digestive gland	Lysosomal membrane stability-LMS (Canesi et al 2015) (*) IDH (Oliveira et al., 2013) (*) Transcriptomics (Détréé et al. 2018) qPCR IDH, HSP70 Détréé et al. 2017)

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MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER IN FISH

MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA: FISH

DIAGNOSTIC MARKERS FOR CONTAMINANTS

- **Markers of genotoxicity**
  (DNA strand break, micronuclei and nuclear abnormalities)
- **Markers of neurotoxicity**
  (inibition of esterases enzymes, transcriptomics)
- **Markers of oxidative stress**
  (quantification of oxidative enzymes, transcriptomics)
- **Markers of xenobiotic metabolism and biotransformation**
  (enzymes induction, trascriptomics and porphyrins)

DIAGNOSTIC MARKERS FOR IMMUNE SYSTEM ALTERATION

- **Markers of immunotoxicity**
  (WBC count, immune system enzymes, transcriptomics)

DIAGNOSTIC MARKERS FOR REPRODUCTION FUNCTIONALITY

- **Markers for reproductive system**
  (expression and quantification of proteins, transcriptomics)

Tissues:
- ✓ Blood
- ✓ Muscle
- ✓ Gills
- ✓ Liver
- ✓ Kidney
- ✓ Gonads
- ✓ GI tract

ANALYSIS OF ANTHROPOGENIC CONTAMINANTS

- **OCs**
- **PAHs**
- **Mercury**
- **Plastic additives (phthalates, bisphenol A, PBDEs)**

DIAGNOSTIC MARKERS FOR INFLAMMATION AND MORPHOLOGY

Transcriptomics and histology and histopathology

MARINE LITTER ANALYSIS

Analysis of microplastics and ML in the GI tract

Plastic detections

- Analysis of the gastro intestinal (GI) contents:
  - Occurrence (%)
  - Abundance (n°)
  - Weight (g)
  - Polymer analysis

Plastic tracers detections

- Analysis of plastic additives:
  - Phthalates
  - PBDEs
  - Bisphenol A
- Analysis of PBT compounds:
  - PCBs
  - DDTs
  - PAHs
  - Mercury

Biomarkers detections

- Effects at molecular level:
  - Measure of DNA damage
  - Alterations of gene expression
  - Alteration of proteins
- Effects at cellular level:
  - Alteration of cell functions
- Effects at tissue level:
  - Hystological and hystopathological alterations

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MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER IN SEA TURTLES

MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA: SEA TURTLES

DIAGNOSTIC MARKERS FOR CONTAMINANTS

- **Markers of genotoxicity**
  (DNA strand break, micronuclei, nuclear abnormalities)
- **Markers of neurotoxicity**
  (inhibition of esterases enzymes, transcriptomics)
- **Markers of oxidative stress**
  (quantification of oxidative enzymes, transcriptomics)
- **Markers of xenobiotic metabolism and biotransformation**
  (enzymes induction, trascriptomics and porphyrins)

DIAGNOSTIC MARKERS FOR IMMUNE SYSTEM ALTERATION

- **Markers of immunotoxicity**
  (immune system enzymes, WBC count, transcriptomics)

DIAGNOSTIC MARKERS FOR REPRODUCTION FUNCTIONALITY

- **Markers for reproductive system**
  (expression and quantification of proteins, transcriptomics)

DIAGNOSTIC MARKERS FOR INFLAMMATION AND MORPHOLOGY

Transcriptomics and histology and histopathology

ANALYSIS OF ANTHROPOGENIC CONTAMINANTS

- **OCs**
- **PAHs**
- **Mercury**
- **Plastic additives (phthalates, bisphenol A, PBDEs)**

MARINE LITTER ANALYSIS

Analysis of ML in GI tract
Analysis of microplastics and ML in faeces

Plastic detections

- Analysis of the gastro intestinal (GI) contents:
  - Occurrence (%)
  - Abundance (n°)
  - Weight (g)
  - Polymer analysis

Plastic tracers detections

- Analysis of plastic additives:
  - Phthalates
  - PBDEs
  - Bisphenol A
- Analysis of PBT compounds:
  - PCBs
  - DDTs
  - PAHs
  - Mercury

Biomarkers detections

- Effects at molecular level:
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- Effects at tissue level:
  - Hystological and hystopathological alterations

✓ **STRANDED**
✓ **HOSPITALIZED**

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MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER IN SEA BIRDS

MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA: SEA BIRDS

DIAGNOSTIC MARKERS FOR CONTAMINANTS

- **Markers of genotoxicity**
  (DNA strand break, micronuclei, nuclear abnormalities)
- **Markers of neurotoxicity**
  (inhibition of esterases enzymes, transcriptomics)
- **Markers of oxidative stress**
  (quantification of oxidative enzymes, transcriptomics)
- **Markers of xenobiotic metabolism and biotransformation**
  (enzymes induction, trascriptomics and porphyrins)

DIAGNOSTIC MARKERS FOR IMMUNE SYSTEM ALTERATION

- **Markers of immunotoxicity**
  (immune system enzymes, WBC count, transcriptomics)

DIAGNOSTIC MARKERS FOR REPRODUCTION FUNCTIONALITY

- **Markers for reproductive system**
  (expression and quantification of proteins, transcriptomics)

DIAGNOSTIC MARKERS FOR INFLAMMATION AND MORPHOLOGY

Transcriptomics and histology and histopathology

ANALYSIS OF ANTHROPOGENIC CONTAMINANTS

- **OCs**
- **PAHs**
- **Mercury**
- **Plastic additives (phthalates, bisphenol A, PBDEs)**

MARINE LITTER ANALYSIS

Analysis of ML in GI tract

Analysis of microplastics and ML in faeces and in nests

Plastic detections

- Analysis of the gastro intestinal (GI) contents:
  - Occurrence (%)
  - Abundance (n°)
  - Weight (g)
  - Polymer analysis

Plastic tracers detections

- Analysis of plastic additives:
  - Phthalates
  - PBDEs
  - Bisphenol A
- Analysis of PBT compounds:
  - PCBs
  - DDTs
  - PAHs
  - Mercury

Biomarkers detections

- Effects at molecular level:
  - Measure of DNA damage
  - Alterations of gene expression
  - Alteration of proteins
- Effects at cellular level:
  - Alteration of cell functions
- Effects at tissue level:
  - Hystological and hystopathological alterations

✓ **STRANDED**

✓ **FREE-RANGING**

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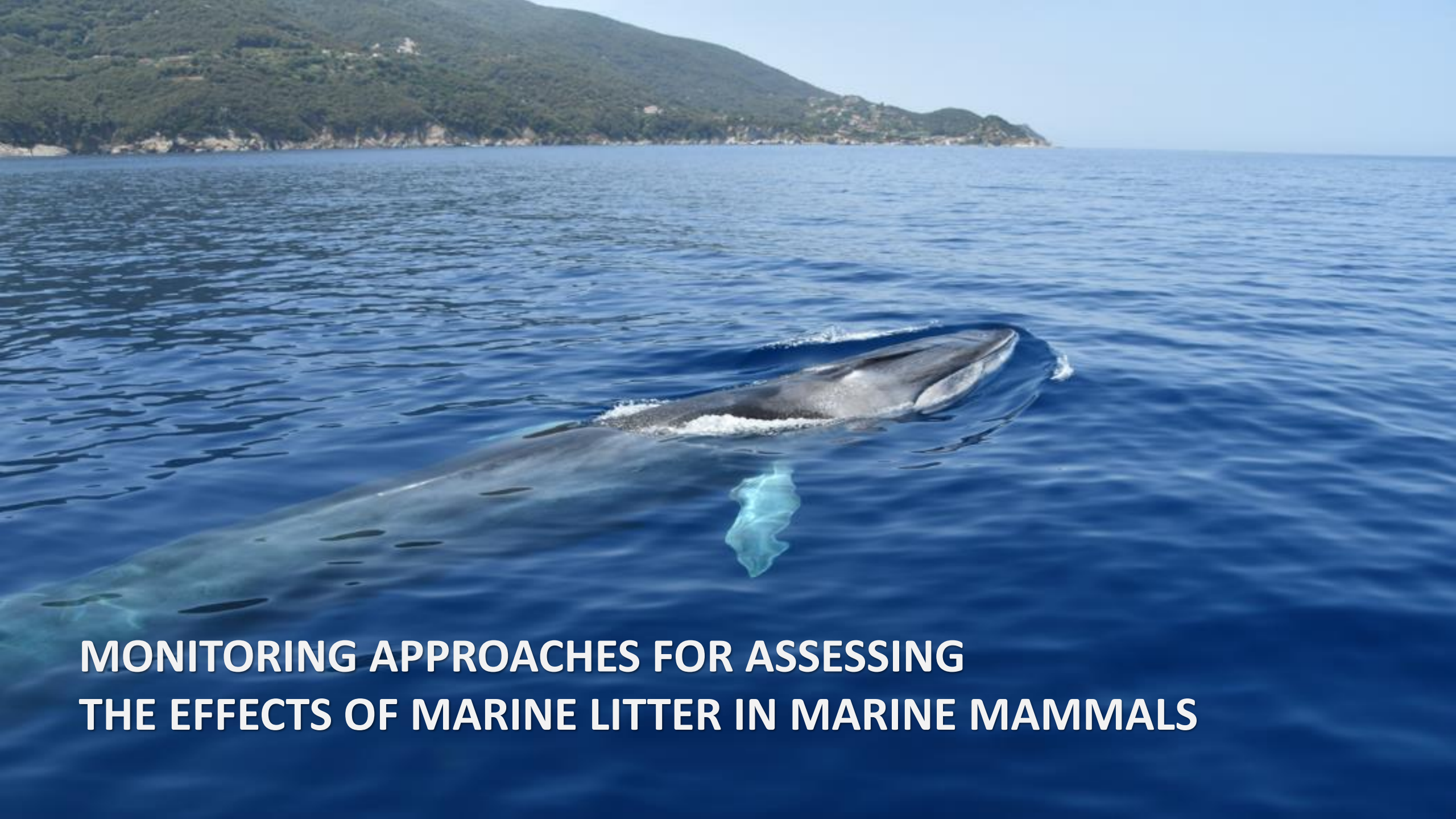


MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER IN MARINE MAMMALS

MONITORING MARINE LITTER IMPACTS IN CETACEANS

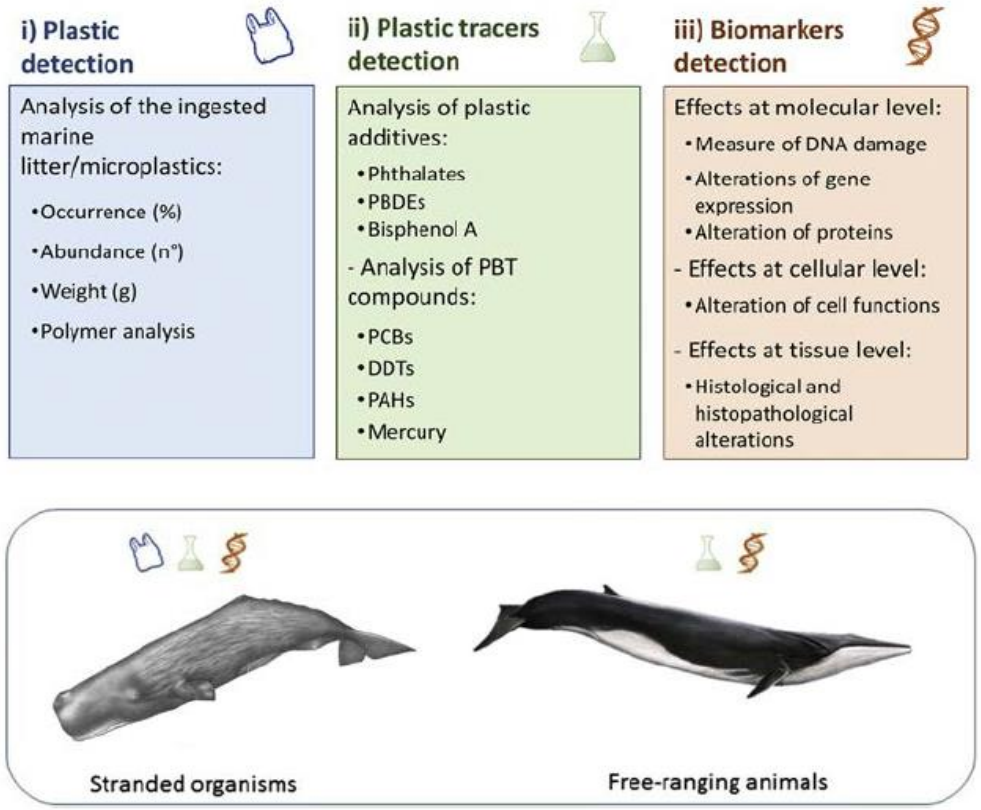
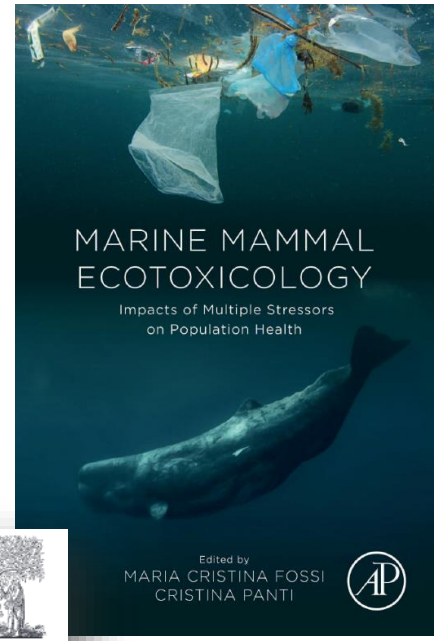


FIGURE 6.3 The threefold monitoring approach to detect marine litter presence and impact in cetacean species (stranded and free-ranging organisms).



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MONITORING APPROACHES FOR ASSESSING THE EFFECTS OF MARINE LITTER ON BIOTA: CETACEANS

DIAGNOSTIC MARKERS FOR CONTAMINANTS

- **Markers of genotoxicity**
  (DNA strand break, micronuclei and nuclear abnormalities)
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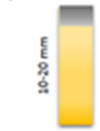
  (inhibition of esterases enzymes, omics)
- **Markers of oxidative stress**
  (quantification of oxidative enzymes, omics)
- **Markers of xenobiotic metabolism and biotransformation**
  (enzymes induction, omics and porphyrins)

DIAGNOSTIC MARKERS FOR IMMUNE SYSTEM ALTERATION

- **Markers of immunotoxicity**
  (WBC count, immune system enzymes, cytokines, omics)

Skin biopsy
Epidermis-Dermis-Blubber



DIAGNOSTIC MARKERS FOR REPRODUCTION FUNCTIONALITY

- **Markers for reproductive system**
  (expression and quantification of proteins, omics)

DIAGNOSTIC MARKERS FOR INFLAMMATION AND MORPHOLOGY

Omics and histology and histopathology

ANALYSIS OF ANTHROPOGENIC CONTAMINANTS

- **OCs**
- **PAHs**
- **Mercury**
- **Plastic additives (phthalates, bisphenol A, PBDEs)**

MARINE LITTER ANALYSIS

Analysis of microplastics and ML in GI tract

Analysis of microplastics and ML in faeces

Plastic detections

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  - Weight (g)
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  - Alteration of cell functions
- Effects at tissue level:
  - Hystological and hystopathological alterations

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MONITORING MARINE LITTER IMPACTS IN CETACEANS: STRANDED ORGANISMS

i) Plastic detection

- Analysis of the ingested marine litter/microplastics:
  - Occurrence (%)
  - Abundance (n°)
  - Weight (g)
  - Polymer analysis

ii) Plastic tracers detection

- Analysis of plastic additives:
  - Phthalates
  - PBDEs
  - Bisphenol A
- Analysis of PBT compounds:
  - PCBs
  - DDTs
  - PAHs
  - Mercury

Ziphius cavirostris

A new prototype to isolate macro and microplastics in the gastrointestinal tract of stranded cetaceans

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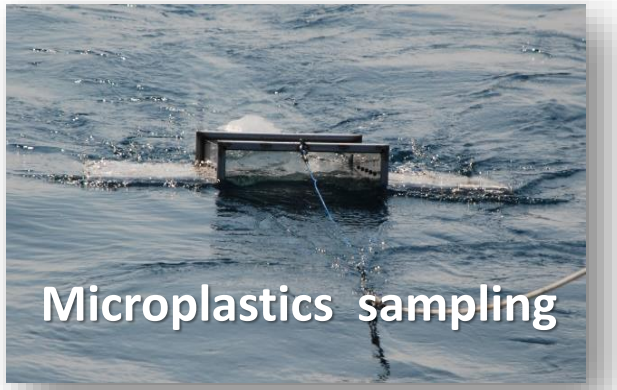
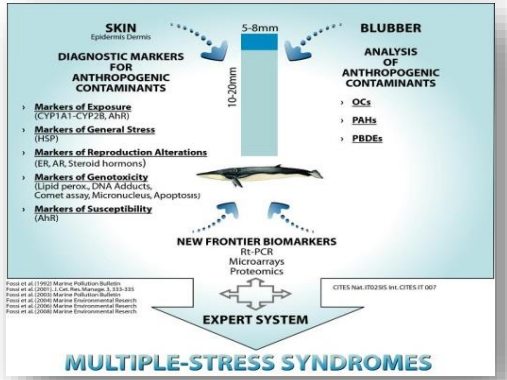
MONITORING MARINE LITTER IMPACTS IN CETACEANS: FREE-RANGING CETACEANS



Pelagos Sanctuary



Sea of Cortez

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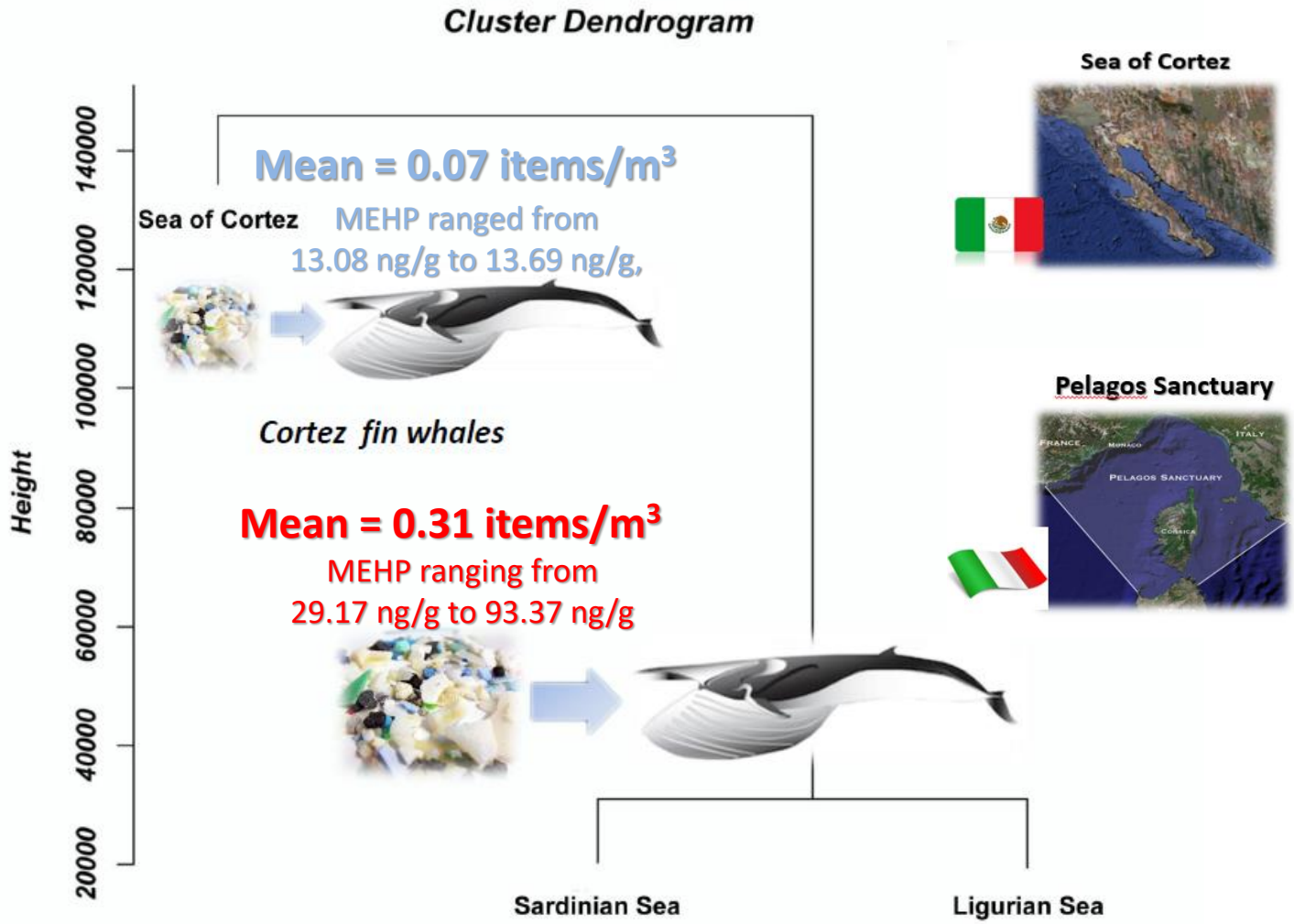
FIN WHALE AS INDICATOR OF THE HEALTH STATUS OF TWO BASINS

Microplastic and phthalates concentration **are 4 times higher** in the Mediterranean Sea than Sea of Cortez

Underline a higher risk of exposure in the whale from the Pelagos Sanctuary



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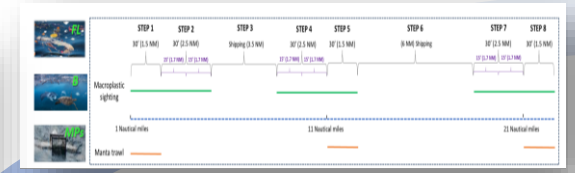
LESSONS LEARNED FROM ML MONITORING IN MED

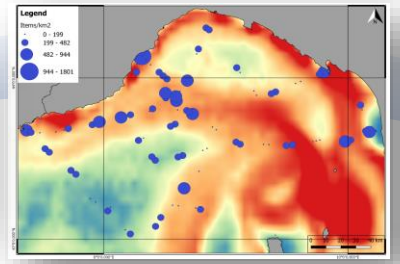
Monitoring All Env. Comp.

TYPE OF SAMPLE/SURVEY	N°
Floating macrolitter	314
Floating microlitter	213
Beach macrolitter	135
Beach microlitter	810
Seafloor sediment	51
Seafloor macrolitter	51
ROV	7

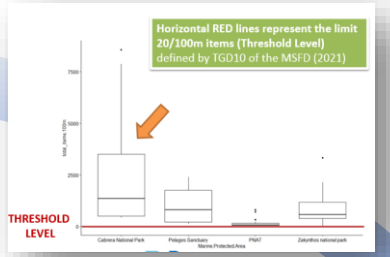
Simulaneus Monitoring ML and Biota



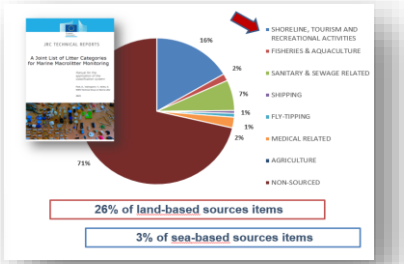
MPs Model Validation Hot Spots



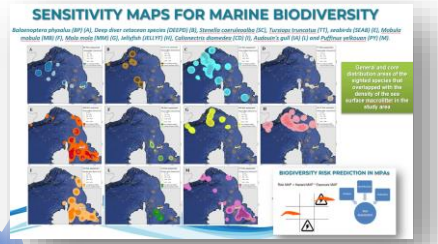
ML Threshold level



Sorces Identifications

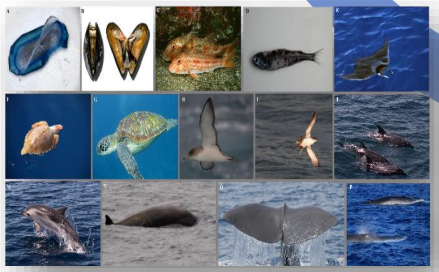


Biodiversity Risk Prediction

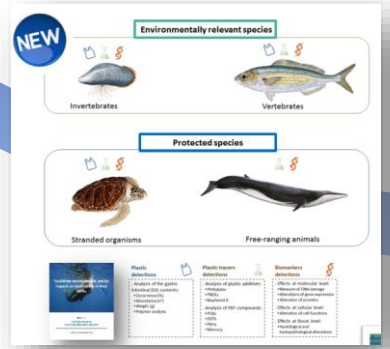


SUPPORTING MSFD AND IMAP INDICATORS

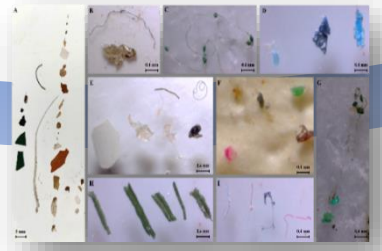
Monitoring Med Biodiversity



ThreeFold Monitoring



MPs Ingestion in Endangered Species



New Diagnostic Methods

From the Diagnosis to Mitigation

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Resource link

This resource has been developed within the framework of the Interreg Med Plastic Busters MPAs project.

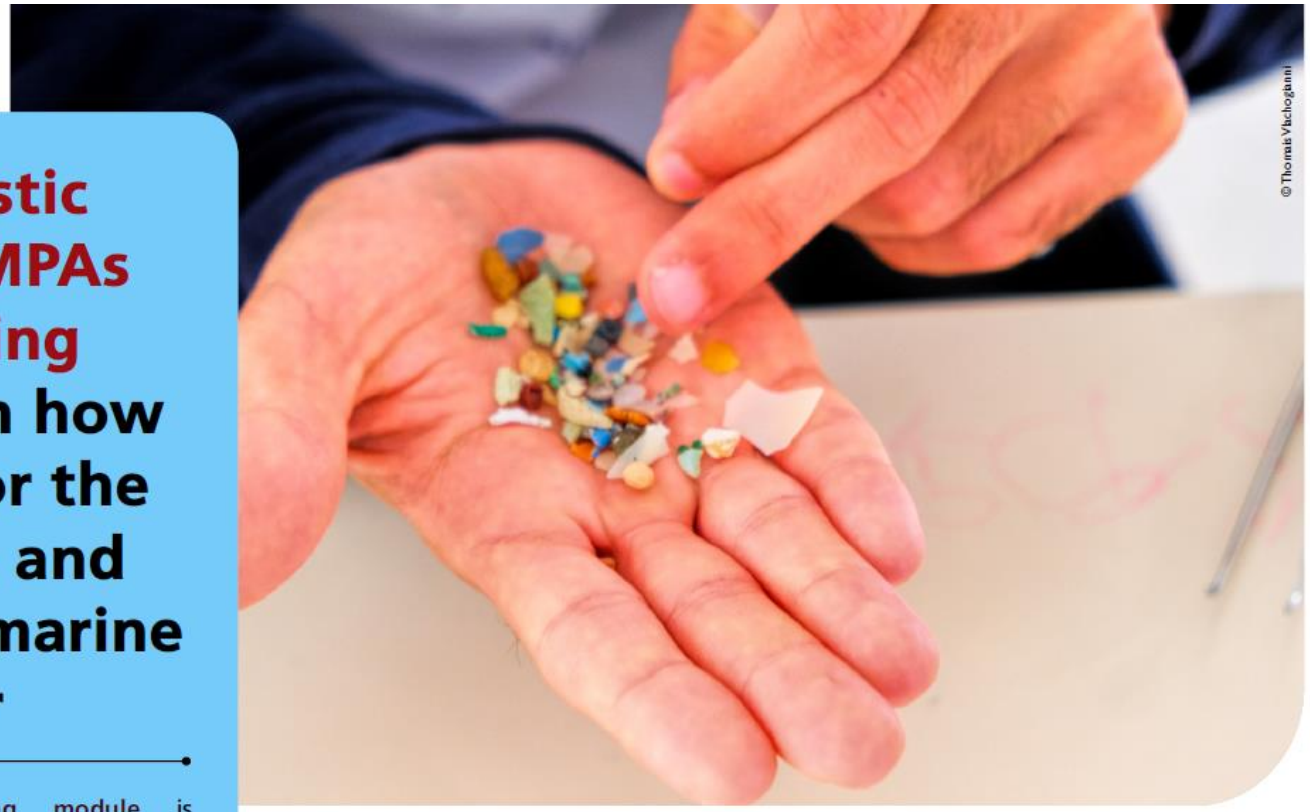
Find more info here

The Plastic Busters MPAs protocols on how to monitor the presence and effects of marine litter in Mediterranean MPAs

This document features a compilation of all the protocols that should be applied in order to elaborate a comprehensive diagnosis of the presence and effects of marine litter in the Mediterranean. It takes stock of all recent advances made by the European Marine Strategy Framework Directive Technical Group on Marine Litter and the Barcelona Convention Correspondence Group on Monitoring.

The Plastic Busters MPAs e-learning module on how to monitor the presence and effects of marine litter

This self-paced e-learning module is designed specifically for the busy practitioner, conservationist, researcher, professional and student working for litter-free coasts and seas. By following this module, participants will learn how to design and implement marine litter monitoring campaigns and how to generate fit-for-purpose, reliable and comparable data on the presence and effects of marine litter, thus contributing with essential knowledge for a targeted response to address the urgent marine litter threat in the Mediterranean.



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COastal Management
and MOnitoring Network
for tackling marine litter in Mediterranean sea
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