



# Implementation of the indicator “Impacts of marine litter on sea turtles and biota” in RSC and MSFD areas

## Indicator Impact Turtles

 [indicit-europa.eu](http://indicit-europa.eu)



Project number: 11.0661/2016/748064/SUB/ENV.C2

# The European Union's Marine Strategy Framework Directive (MSFD)

Good Environmental Status (**GES**) of the EU's marine waters by 2020 (**11 qualitative descriptors**):

→ **Descriptor 10** “Marine litter” = “Properties and quantities of marine litter do not cause harm to the coastal and marine environment”.

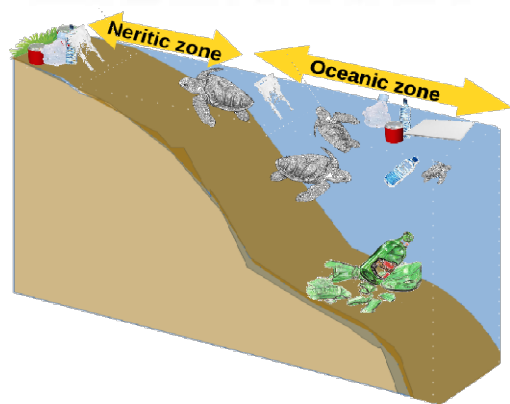
- **Primary Criteria** (amount, composition, distribution of macro (5 mm) and micro (<5 mm) litter)
- **Secondary criteria:**
  - **D10C3** of New Commission Decision 2017/848/EU: “*The amount of litter and micro-litter **ingested** by marine animals is at a level that does not adversely affect the **health** of the species concerned*”
  - **D10C4: Other impacts (e.g., Entanglement)**

**A SMART approach!**

Specific, measurable, achievable, realistic, time-bound (and ambitious...)



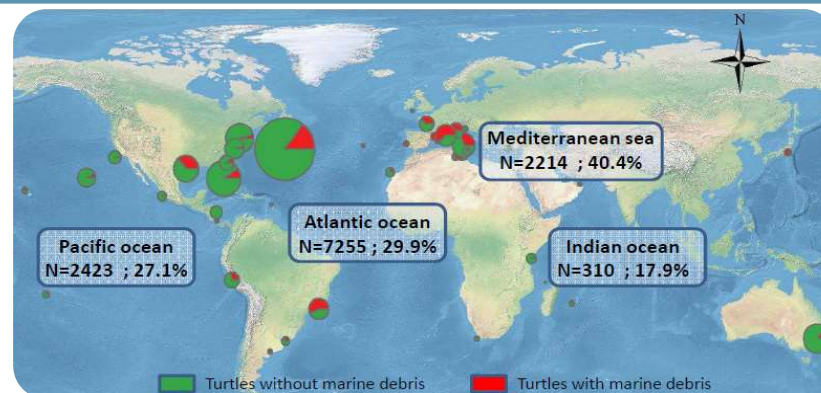
# Establishing relevant indicators at the MSFD scale



+



?



Dell'Amico & Gambaiani, 2013

- Easy to use
- Large distribution (→ harmonize RSCs)
- Propensity to be impacted by litter (e.g. ingestion, entanglement) relative to environmental pollution level
- Scientific rigour: Should show significant variations relative to restoration efforts

# INDICIT: Indicator Impact Turtle

## Implementing indicators of marine litter impact on biota



➤ February 2017-January 2019

➤ Support the implementation of EU's MSFD Descriptor 10  
"Marine Litter"

+ Barcelona and OSPAR Regional Sea Conventions

⇒ Impact indicators

- Implementation of indicators of marine litter on sea turtles and biota
- Harmonizing approaches
- Developing a set of standardized tools for the monitoring of litter impacts



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# INDICIT consortium








## 10 partner institutions





- Networking
- Collection of standard data
- Analysis of raw data to provide GES and criteria
- Disseminating standard tools to wider community

The diagram illustrates the five activities of the project and their interconnections:

- Activity 1: Coordination** (Logo: )
- Activity 2: Gathering and analysing knowledge** (Logo: )
- Activity 3: Networking in OSPAR-Macaronesia** (Logo: )
- Activity 4: Networking in Barcelona** (Logo: )
- Activity 5: Communication Dissemination** (Logo: )

Interconnections and associated themes:

- Activity 1 is connected to Activity 5 by a double-headed arrow labeled *Synergies*.
- Activity 2 is connected to Activity 3 by a double-headed arrow labeled *Data gathering*, *Improvement protocols*, and *Discussion GES...*.
- Activity 2 is connected to Activity 5 by a double-headed arrow labeled *Standard tools* and *International programs...*.
- Activity 3 is connected to Activity 4 by a double-headed arrow labeled *Improvement protocols* and *Discussion GES...*.
- Activity 4 is connected to Activity 5 by a double-headed arrow labeled *Standard tools...*.

## 3 litter impact indicators



### 1. “Litter ingested by sea turtle” (micro and macro)

⇒ Pilot studies, protocol, standard data gathering and analyses, GES baseline, constraints, networking, implementation



### 2. “Entanglement with debris by marine biota”

⇒ Feasibility study



### 3. “Micro-debris ingested by sea turtles and fish”

⇒ Feasibility study

# Methods used for feasibility and pilot studies

INDICIT consortium, 2018



<https://indicit-europa.eu/indicit-documents/>



## Indicator Litter ingested by sea turtles

- State-of-art on indicator's constraints
- Existing network
- Descriptive analyses from previous non standard data

## Entanglement of marine biota in litter

- State-of-art + questionnaire
- Identification of relevant taxa / species
- Identification of indicator's constraints
- Existing networks and monitoring means

## Micro-debris ingestion by fish and sea turtles

- State-of-art
- Identification relevant fish species
- Identification of relevant methods considering field and lab contamination



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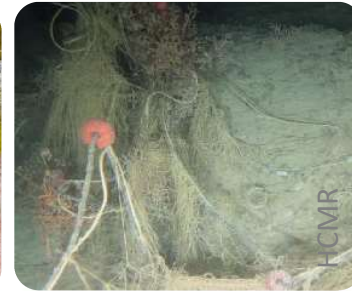
# Results for indicator “Entanglement of marine faune in debris”

## 26 Megafauna species in study area + invertebrates

Claro & INDICIT consortium, 2018



<https://indicit-europa.eu/indicit-documents/>



- No available standard data → No accurate evaluations
- Evaluation of relevant indicator species/taxa
- Need of a standardized methodology, especially to ≠ passive (e.g., ghost nets) /active (fishing activity) entanglement
- Identification of data producers/ sampling platforms, useful for MSFD TSG ML
- Need time + funds to involve identified networks

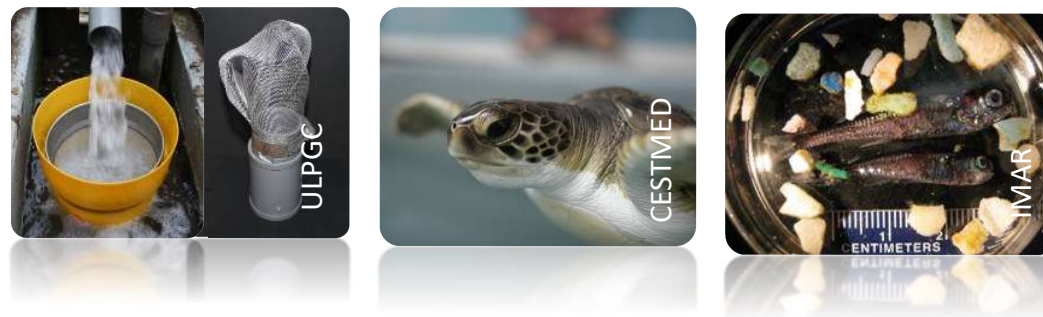


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# Results for indicators “Micro-plastic ingestion in fish and sea turtles”

**159 fish species + sea turtles**

Silvestri & INDICIT consortium, 2018



- Identification of sampling technics
- Identification of target fish species
  - Allow target other areas (e.g., HELCOM)
  - Allow target debris <<1mm
- Proposition of methodologies (sea turtles)
  - Already existing and trained network
  - Debris 1-5 mm
- Need standard protocol and data

<https://indicit-europa.eu/indicit-documents/>



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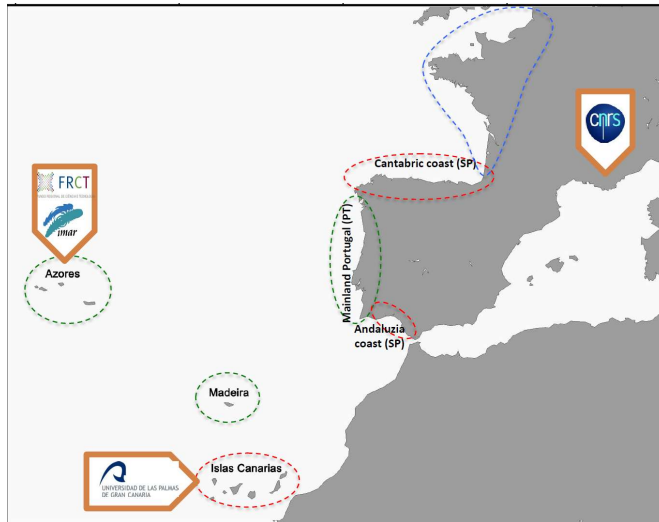
## Implementation of the indicator “Litter ingested by sea turtle”





# Networking in OSPAR-Macaronesia and Barcelona RSCs

106 institutions mobilized and a large area covered → a Google map



- Rescue centres
- Stranding networks
- Institutions with both activities
- Research centres
- Regional authorities
- Several other contacts: Collection of stakeholders' **conditions for involvement**

- Creation of a new network in the Atlantic area
- Numerous training sessions
- Improvement of the standard protocol
- Sharing of a common database
- Discussions on the GES scenarios



# Co-building of a standard protocol

INDICIT consortium, 2018



<https://indicit-europa.eu/protocols/>

5 languages



## Basic data (→ Litter ingested sea turtles)

- Debris >1mm
- Classification and quantification

## Optional data (→ Adjust indicator's constraints; collect data on other impacts)

- Litter description
- Biometry, health status, injuries, digestive capacity
- Entanglement
- Micro-debris (1-5 mm) ingestion

## 2 approaches

- From dead individuals (necropsies)
- From alive individuals (feces)

## A video-tutorial (Matiddi et al., 2019)

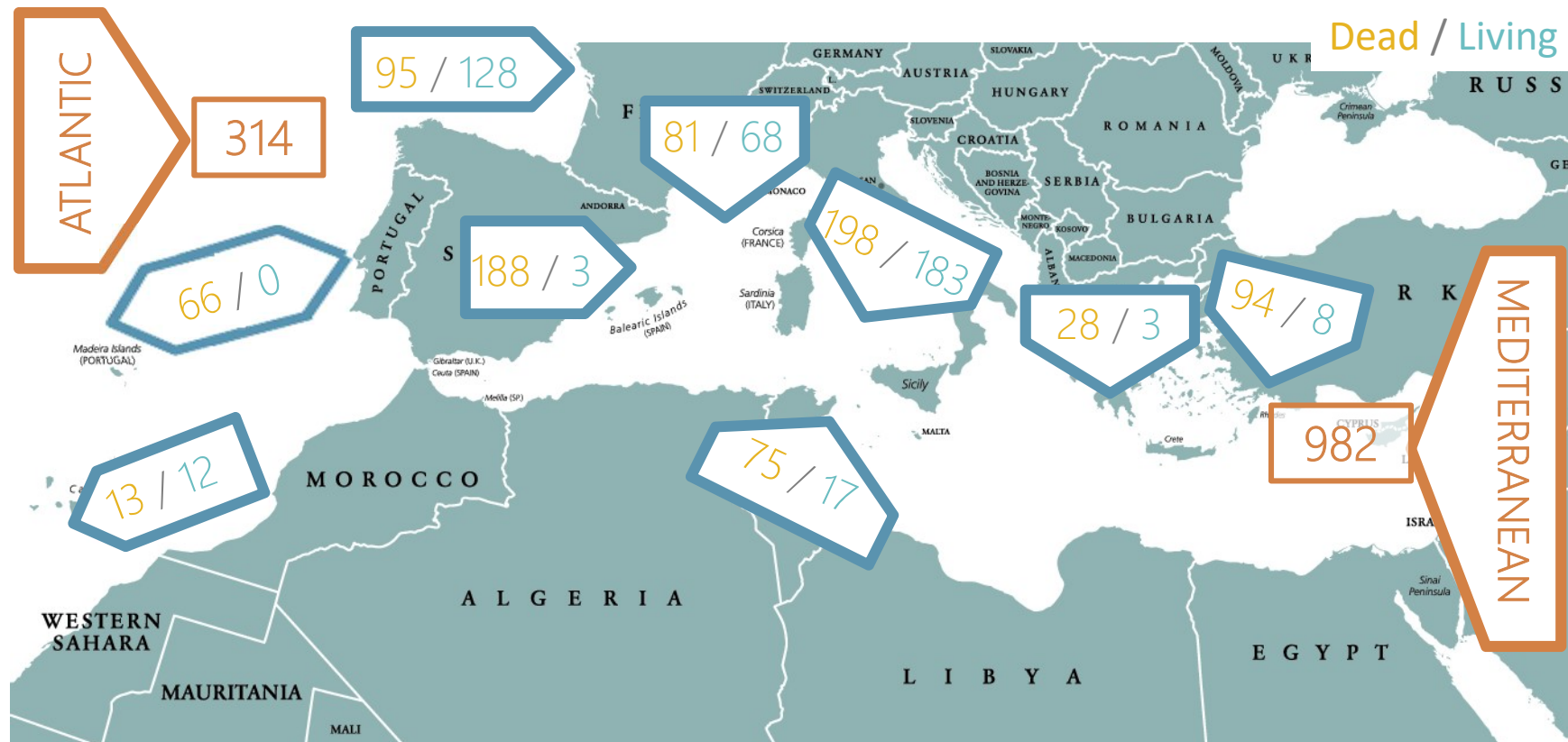


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A large standard dataset collected collectively

1406 data on living + dead loggerheads + dead leatherbacks

Number of sampled loggerheads



From Darmon, INDICIT consortium & Miaud, 2019

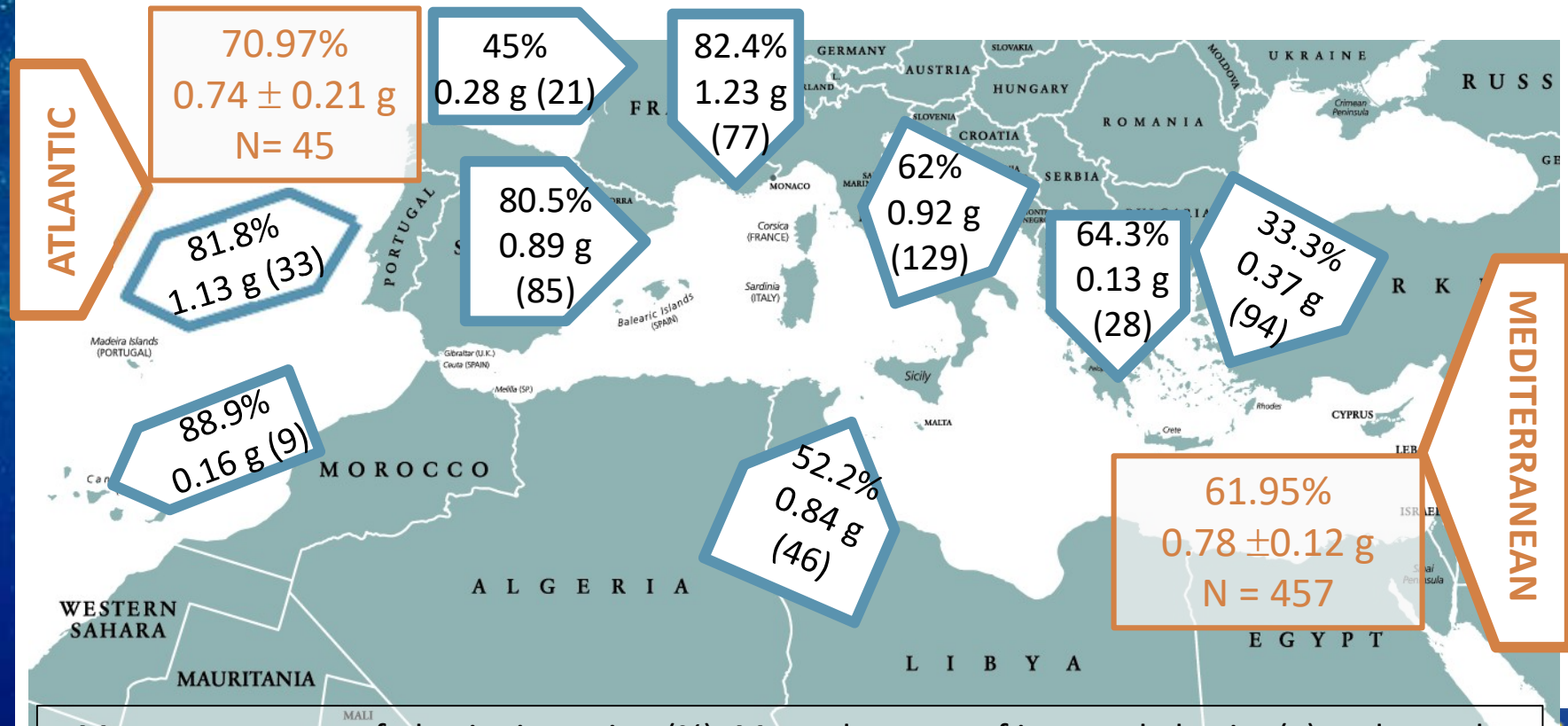
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## A high occurrence of litter ingestion in *Caretta*

On a 6-year cycle (data > 2013)  
From necropsies

**63.03% of dead turtles found with litter**  
 **$0.78 \pm 0.11$  g / indiv.**  
**16.76 % with plastics > food remains**



Mean occurrence of plastics ingestion (%); Mean dry mass of ingested plastics (g) and sample size (N) in necropsied *Caretta* (From Darmon, INDICIT consortium & Miaud, 2019)

## Mostly plastics with a high diversity of current single-use items



Bags, cups, lollipops, packaging, fragments...)

**SHE , FRA, FOA, THR categories the most often found  $\approx 0,2$  g / indiv.**



# Study of biological constraints and units

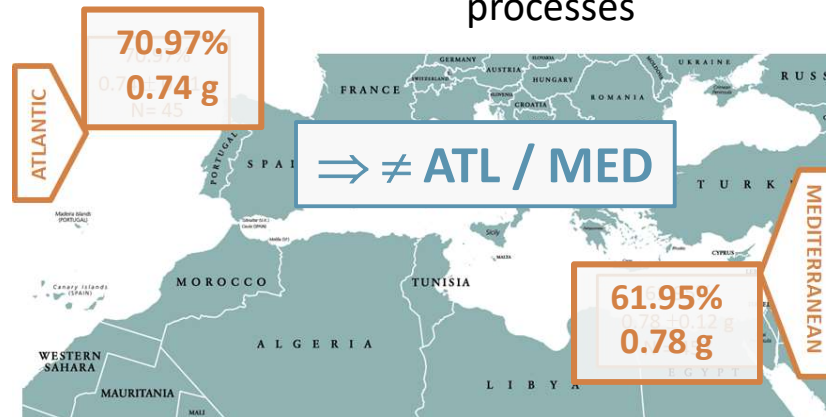
## Biological constraints

- **Circumstances of discovery** ~ Country (+++ bycatch, stranding)
- **Probable causes of death** (4 of 189 deaths due to litter ingestion)
- **Individual's size** ~ Country X parameter used (lengths, weight, stage, fat, injuries...)   
⇒ **Further data needed!** + Need knowledge on impact on individual's health

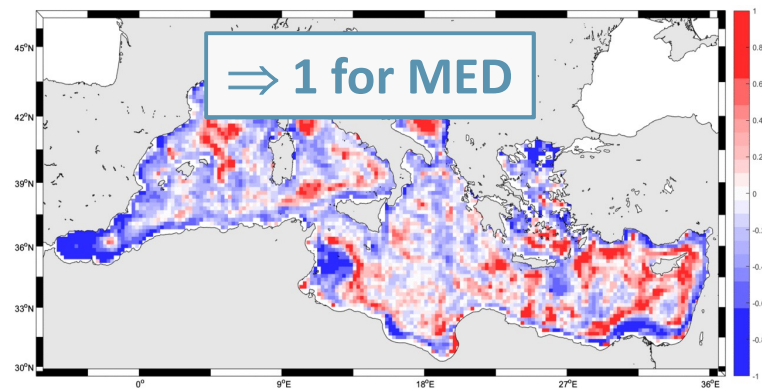
⇒ Data should not be stratified

## Spatial unit

No stat ≠ between Atl and Med but ≠  
in sample size and ecological  
processes



Further data needed to verify ≠  
within Med (West/East)



From Mansui; Collaboration MedSeaLitter

## Time unit

⇒ 6-year cycle (≡ MSFD)



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## *GES proposal for the indicator “ingestion in Sea Turtle”*

"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 " (New COM DEC 2017/848/EC)

### **2 scenarios selected**

**1<sup>st</sup> scenario** was based on **baselines** as for the Fulmar approach.  
on a combination of prevalence and mass of ingested litter

**“There should be less than X % of turtles with more than Y g of ingested plastics”**

Reference:

- **Pristine area:** no debris in the environment (precautionary principle) (*option not relevant*)

→ Area where the pressure (ingestion) is evaluated as the **lowest**: based on **means** calculated from current situation evaluated from last 6-year period (*option selected*)

⇒ Scenario 1= “There should be less than 33 % (Med) / 45% (Atl) of turtles with more 0.37 g (Med) / 0.13 g (Atl) of ingested plastics on average”



## *GES proposal for the indicator “ingestion in Sea Turtle”*

"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 " (New COM DEC 2017/848/EC)

**2<sup>nd</sup> scenario** was based on **thresholds** (considers the impact on health)

- Hyp 1: Ingesting litter affects individual's health
- Hyp 2: A negative effect is expected when the proportion of ingested litter > proportion of natural food

**“There should be less than X % of turtles with more plastics than food remains in the digestive tract”**

Reference:

→ Area where % is the **lowest** based on **means** calculated from last 6-year data

⇒ Scenario 2= “There should be less than 3.7 % (Med) / 11.11 (Atl) of turtles with more plastics than food remains” (*scenario selected*)

Consider other approaches? i.e., use **median** instead of means. Choose a reference at the worldwide scale? Test GES through eco-toxicological approaches...

## Dissemination of technical tools and Awareness

- Dissemination meeting (~60 pers.)
- 9 Conferences and 4 Workshops
- 14 training sessions
- 2 Peer-reviewed publications
- Use of 6 languages
- Regular news (56 on website + 67 on Facebook)
- Documentary
- Press (59 coverages)
- Pedagogical materials, e.g. “Turtle story”
- INDICIT Challenge (607 participants)



More than 12 730 people reached



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## Synergies with other programs

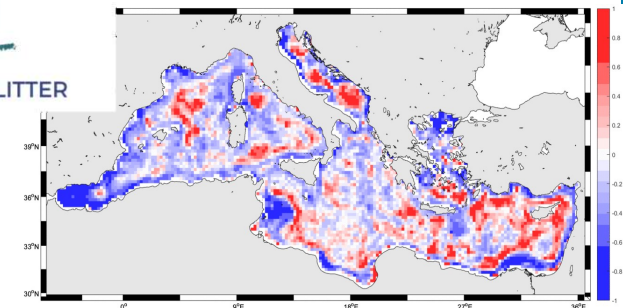
- Interaction and collaboration with other experts/programs (UNEP RAC/SPA, MEDSEALITTER, CLEANATLANTIC, MISTIC SEAS, MARCET...) → **Proposals for harmonized approaches** (e.g., common protocols, GES unit, risky areas, data banking...)



- Building a common protocol



- Development of a standard database for reporting with Ifremer



- Sharing protocol, sharing data, developing tools and maps of litter distribution (a paper submitted)



- Consider knowledge on sea turtles behavior and population dynamics in Atlantic/Macaronesia



# From INDICIT to INDICIT-II



## 1. Litter ingested by sea turtle

Implementation, baseline, criteria, GES



Evaluate **Programs of Measures** at the OSPAR /Barcelona RSCs and MSFD scales in pilot areas

Strengthen the networks for the global implementation of the indicator

Update the baselines and constraints at region or sub-region RSCs scale

Evaluate constraints more accurately and impact on **health** (Threshold approach)

INDICIT

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# From INDICIT to INDICIT-II



## 2. Entanglement with debris by marine biota

Feasibility study



Implement the indicator “**Entanglement in floating debris by sea turtles, birds and cetaceans**” at the OSPAR and Barcelona RSCs and MSFD areas

Networking and standardization of monitoring (tools, typology...)

Propose GES scenarios at the RSC scale / sub-scales

Collection of standard data

Test in pilot areas (PoM?)

INDICIT

INDICIT II





## From INDICIT to INDICIT-II



### 3. Micro-litter ingested by sea turtles and fish

Feasibility study



Implement the indicator “**Micro-litter by fish and sea turtles**” at the OSPAR and Barcelona RSCs and MSFD areas

Networking and standardization of monitoring (provide tools)

Propose GES scenarios at the RSC scale / sub-scales

Collection of standard data

Test in pilot areas (PoM?)

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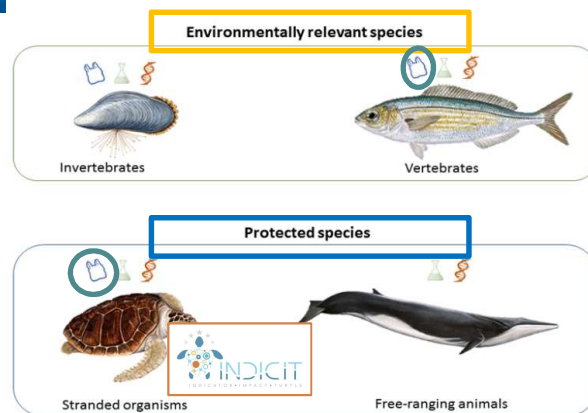


# From INDICIT to INDICIT-II

## Synergies with other programs

### Example

Objective: Analysis of **gastro-intestinal content of bioindicator species** to evaluate the **marine litter ingested** X Analysis of **plastic additives** and PBT compounds used as plastic tracers  $\Rightarrow$  **More complete assessment of the real impact** related to plastic debris ingestion on individual's health.



#### 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
- Alterations of gene expression
- Alteration of proteins

- Effects at cellular level:

- Alteration of cell functions

- Effects at tissue level:

- Histological and histopathological alterations







Miaud & Raymond



ULPGC



Catteau



Cestmed



Darmon



Darmon



Darmon



Darmon



Darmon



Darmon



Kelonia