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

Indicator Impact Turtles

[indicit-europa.eu](indicit-europa.eu)

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

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Establishing relevant indicators at the MSFD scale

- 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
INDICIT consortium

10 partner institutions

+ Stakeholders (collaboration, contracts...) → data, skills, advice
+ External Advisory Board (authorities, experts) → advice, means
Activity 1: Coordination
Activity 2: Gathering and analysing knowledge
Activity 3: Networking in OSPAR-Macaronesia
Activity 4: Networking in Barcelona
Activity 5: Communication Dissemination

Strategy and structure:

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

5 inter-related Activities

Synergies
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

**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

[https://indicit-europa.eu/indicit-documents/](https://indicit-europa.eu/indicit-documents/)
Results for indicator “Entanglement of marine faune in debris”

26 Megafauna species in study area + invertebrates

Claro & INDICIT consortium, 2018

→ 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

https://indiciti-europa.eu/indiciti-documents/
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/
Implementation of the indicator “Litter ingested by sea turtle”

- Loggerhead sea turtle: *Caretta caretta*
- Leatherback sea turtle: *Dermochelys coriacea*

INDICIT targeted areas (RSCs)
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

**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)
https://indicit-europa.eu/protocols/

5 languages
A large standard dataset collected collectively

1406 data on living + dead loggerheads + dead leatherbacks

Number of sampled loggerheads

From Darmon, INDICIT consortium & Miaud, 2019
A high occurrence of litter ingestion in *Caretta*

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

- **Atlantic**: 70.97% mean occurrence, 0.74 ± 0.21 g mean dry mass, N = 45
  - 81.8% with plastics > food remains, 1.13 g mean dry mass, N = 33
  - 89.9% with plastics > food remains, 0.16 g mean dry mass, N = 9

- **Mediterranean**: 63.03% mean occurrence, 0.78 ± 0.11 g mean dry mass, N = 457
  - 61.95% with plastics > food remains, 0.78 ± 0.12 g mean dry mass, N = 457

61.76% 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

SHE, FRA, FOA, THR categories the most often found ≈ 0.2 g / indiv.
Study of biological constraints and units

- **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

### Biological constraints

- **Spatial unit**
  No stat ≠ between Atl and Med but ≠ in sample size and ecological processes
  - ATL: 70.97% 0.74 g
  - MED: 61.95% 0.78 g
  ⇒ ≠ ATL / MED

- **Time unit**
  ⇒ 6-year cycle (≡ MSFD)

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

From Mansui; Collaboration MedSeaLitter
**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**

1st **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)

2nd 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
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

- 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

- Development of a standard database for reporting with Ifremer
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)

From INDICIT to INDICIT-II
2. Entanglement with debris by marine biota

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

Feasibility study

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?)
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?)
Example

Objective: Analysis of **gastro-intestinal content of bioindicator species** to evaluate the **marine litter** ingested. Analysis of **plastic additives** and PBT compounds used as plastic tracers ⇒ **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 (nⁿ)
  - 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