

Marine litter ingested by sea turtles

Common indicator assessment



OSPAR

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OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l’Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d’Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties contractantes sont l’Allemagne, la Belgique, le Danemark, l’Espagne, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède, la Suisse et l’Union européenne

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Key Message

There is a high incidence of litter ingestion by sea turtles in the Bay of Biscay, Azores and Macaronesia , but with regional differences. Mean abundance of ingested plastics was 9,6, 16,3 and 16,3 pieces respectively. This new common indicator provides the baseline for further monitoring and evaluation of trends.

Background (brief)

The amount of litter and micro-litter (greater than 1 mm) ingested by sea turtles may indicate adverse effects on the health of these animals, which could eventually hinder the good environmental status. The assessment provides information about environmental status in southern OSPAR : Bay of Biscay and Iberian Coast (Region IV) and Wider Atlantic (Region V).

The quantity of litter ingested by sentinel organisms reflects both the spatial and temporal trends of the impact of litter in the environment and the harm caused on wildlife and natural habitats. The wide distribution of sea turtles, their use of various marine compartments and their propensity to ingest debris make them a relevant indicator. It is representative of litter ingested within a period two weeks before stranding/by-catch (average intestinal transit period) allowing discrimination between OSPAR Regions IV and V (Bay of Biscay and Iberian Coast, and Wider Atlantic) and more specifically sub-regional entities (Azores, Macaronesia, Bay of Biscay, Iberian peninsula, etc.). Since the indicator was initially proposed in 2015, progress has been made in terms of networking and collection of standardised data to provide an assessment of the indicator in southern OSPAR Regions, where the sea turtles live.

While Macronesia is outside the OSPAR Maritime Area it nonetheless provides a useful case study.



Sample of marine litter excreted by a sea turtle *Caretta caretta* in a rescue centre © D. Gambaiani, Cestmed



Plastic collected in an oesophagus from a necropsied sea turtle *Caretta caretta* (Bay of Biscay) © La Rochelle aquarium

Background (extended)

A first protocol for monitoring litter ingestion by sea turtles, based on the Fulmar approach, was proposed by Matiddi et al., (2011) and published in the MSFD guidance (Galgani et al., 2013). It consisted in quantifying the litter found in the digestive tract extracted during necropsy of dead individuals. It also proposed the collection of the litter in the excrements of live individuals in rescue centres. The protocol has been adapted (Matiddi et al., 2019), then completed by the project INDICIT (INDICIT, 2018) and is part of the updated MSFD guidance under revision.

After the work done by the EU projects INDICIT I and II, coordinated measurements are now performed by rescue centres, stranding networks, research or veterinarian laboratories, all now using a harmonised procedure to collect sea turtle individuals in the field and extract ingested litter in the laboratory. The quality and quantity of standardised data acquired by this network highlight the collective capacity for a global and continuous monitoring of litter impact on sea turtles through ingestion. While a precise definition of a threshold is to be completed, the data collected provides a first assessment and important knowledge for reinforcing measures related to the conservation of sea turtles.

Assessment Method

Based on the protocol elaborated within the MSFD and updated in the framework of the EU project INDICIT, the indicator “Litter ingestion by sea turtles” is focusing on the loggerhead turtle *Caretta caretta* –although the evaluation of litter impacts on other species is also recommended. It consists in

quantifying the litter found in the digestive tract extracted during necropsy of dead individuals (mostly found stranded or by-caught by fishermen) or excreted by live animals in rescue centres after 1 to 2 months, the digestive transit time being evaluated as a maximum of 4 to 6 weeks (INDICIT, 2019). This protocol aims to target especially the plastic categories (MSFD compatible categories), the litter most often found ingested by sea turtles. The monitoring of litter ingested by sea turtles targets all size items, including micro-litter between 1 and 5 mm, meso-litter from 5 to 25 mm and macro-litter larger than 25 mm.

For this first assessment, the prevalence of litter ingestion in sea turtles was calculated as the percentage of dead turtles found with ingested litter, based on the occurrence (or incidence) reported as presence or absence. The quantity of ingested litter was measured as dry mass (grams) and number of pieces per plastic category. The precision of the measurements was 2 decimals.

According to the distribution of sea turtles, the monitoring is applicable to OSPAR Regions IV and V, as well as in Macaronesia.

While a precise definition of a threshold value is under review, the data collected provides the first assessment and important knowledge for measuring the impact of actions from the first OSPAR marine litter Regional Action Plan on the ban of plastic bags. More generally it also contributes to reinforcing the measures related to the conservation of sea turtles.

The assessment was performed by the EU INDICIT project, using checked, classified and standardised data from each partner from OSPAR Regions IV and V and Macaronesia (France/Biscay, Portugal/Azores, Spain/Canaries).

References methods

- Guideline for Monitoring Marine Litter ingested by sea turtle (MSFD TG ML, 2013)

- INDICIT protocol, (INDICIT, 2018), to be integrated in MSFD TG ML's guideline

- Matiddi, M., deLucia, G.A., Silvestri, C., Darmon, G., Tomás, J., Pham, C.K., Camedda, A., Vandeperre, F., Claro, F., Kaska, Y., Kaberi, H., Revuelta, O., Piermarini, R., Daffina, R., Pisapia, M., Genta, D., Sözbilen, D., Bradai, M.N., Rodríguez, Y., Gambaiani, D., Tsangaris, C., Chaieb, O., Moussier, J., Loza, A.L., Miaud, C., 2019. Data Collection on Marine Litter Ingestion in Sea Turtles and Thresholds for Good Environmental Status. JoVE J. Vis. Exp. e59466. <https://doi.org/10.3791/59466> (including a video tutorial)

Results (brief)

182 deceased loggerhead turtles that were stranded from 1988 to the end of 2019 in the southern OSPAR area [mean standardised straight curved carapace length of $37,94 \pm 1,34$ (standard error) cm] were necropsied to measure the prevalence of ingestion (% of individuals affected) and the amount of litter ingested (dry weight of litter and number of pieces in the entire digestive tract).

The assessment was performed by the EU INDICIT project, using data from each partner (France/Biscay, Portugal/Azores, Spain/Canaries), collected before or during the project, standardised according to common criteria developed for the INDICIT database, thus being comparable.

Considering data from 2013 to 2019, there was a significant difference in occurrence among the three areas - for ingested dry mass, but not for numbers of items. The occurrence of plastic ingestion was the lowest in the Bay of Biscay 47,6% (N=21), a sub-region of OSPAR Region IV, while it reached 71,1% in Azores, a sub-region of OSPAR Region V (N=38) and was 100% in Macaronesia/Canary Islands

(N=10). The mean dry mass of ingested plastic was respectively of $0,2 \pm 0,1$ g in the Bay of Biscay, $1,0 \pm 0,3$ g in Azores, and $0,2 \pm 0,1$ g in Canary Islands). The mean abundance of ingested plastics was of $9,6 \pm 4,1$ pieces, $16,3 \pm 4,3$ pieces, and $16,3 \pm 3,1$ pieces respectively for these 3 regions.

Overall, the results indicate a high incidence of litter ingestion by sea turtles, and provide the first baseline for further monitoring and evaluation of trends within OSPAR.

Table 1: Mean prevalence (% of affected individuals), dry mass (g per individual), and number of litter items (abundance) ingested by sea turtles in the southern OSPAR area, N = sampling size (after INDICIT, 2021)

Area	N	2013-2019		Abundance
		Prevalence	Dry mass	
Biscay (OSPAR Region IV)	21	47,6	$0,2 \pm 0,1$	$9,6 \pm 4,1$
Azores (OSPAR Region V)	38	71,1	$1,0 \pm 0,3$	$16,3 \pm 4,3$
Canary islands (Macaronesia)	10	100	$0,2 \pm 0,1$	$16,3 \pm 3,1$
TOTAL	69	68,1	$0,7 \pm 0,2$	$14,3 \pm 6,7$

Bay of Biscay (OSPAR Region IV)

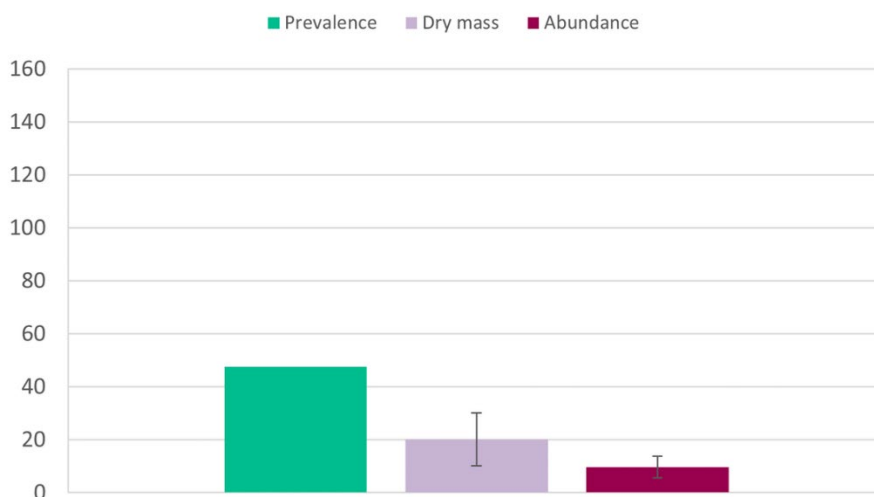


Figure 1: Mean prevalence (% of affected individuals), dry mass (g per individual X 100), and number of items ingested by sea turtles (abundance) in the Bay of Biscay, N = sampling size (after INDICIT, 2021)

Assessment confidence was reached after review and quality control of data for each individual (total masses and abundances of litter), and harmonisation of data (categories of items, size and colour, carapace lengths (cm) and body weights (g)).

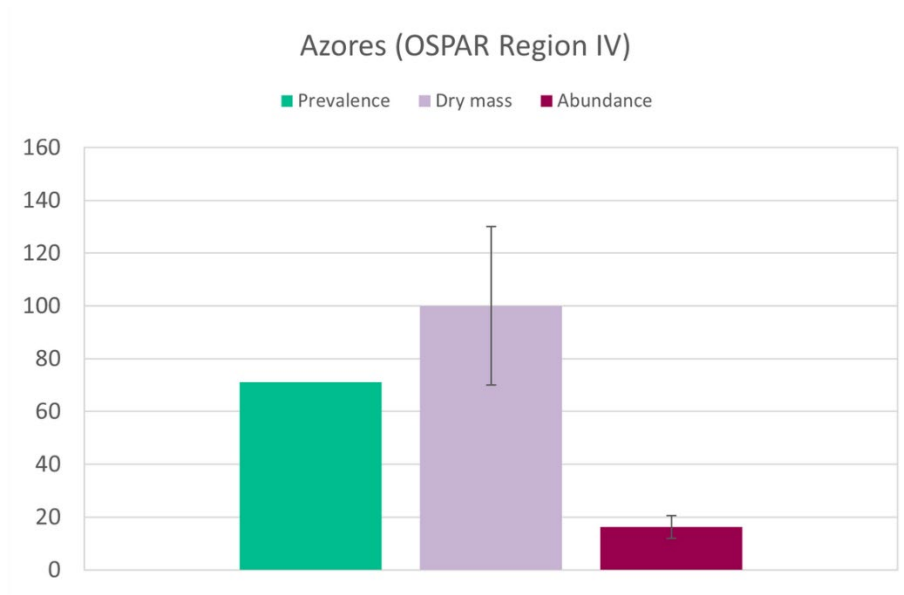


Figure 2: Mean prevalence (% of affected individuals), dry mass (g per individual X 100), and number of items ingested by sea turtles (abundance) in the Azores, N = sampling size (after INDICIT, 2021)

Assessment confidence was reached after review and quality control of data for each individual (total masses and abundances of litter), and harmonisation of data (categories of items, size and colour, carapace lengths (cm) and body weights (g)).

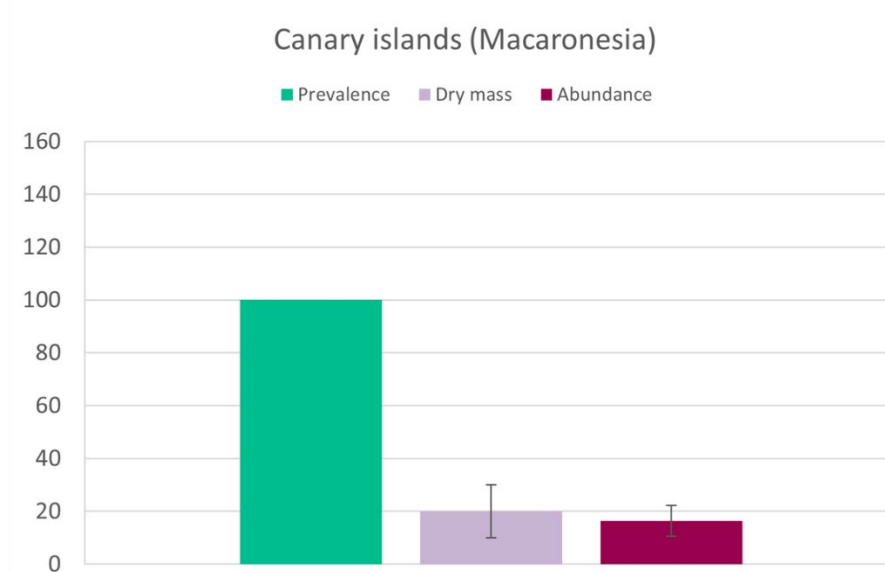


Figure 3: Mean prevalence (% of affected individuals), dry mass (g per individual X 100), and number of items ingested by sea turtles (abundance) in the Canary Islands, N = sampling size (after INDICIT, 2021). Assessment confidence was reached after review and quality control of data for each individual (total masses and abundances of litter), and harmonisation of data (categories of items, size and colour, carapace lengths (cm) and body weights (g)).

Results (extended)

For this first assessment, 182 loggerhead turtles obtained from 1988 to the end of 2019 in the southern OSPAR area [mean straight carapace length of $37,94 \pm 1,34$ (standard error) cm] were necropsied to measure the prevalence of ingestion (% of individuals affected) and amount of litter ingested (dry mass and abundance of litter in the digestive tract).

The assessment was performed by the EU INDICIT project, using data from each partner from the area (France/Biscay, Portugal/Azores, Spain/Canaries), collected before or during the project, standardised according to common criteria developed for the INDICIT database, thus being comparable. Data was checked, classified and standardised, e.g., to minimize the number of factors for qualitative parameters (e.g., circumstances of discovery or causes of death).

The prevalence of litter ingestion in sea turtles was calculated as the percentage of dead turtles found with ingested litter, based on the occurrence (or incidence) reported as presence or absence. The quantity of ingested litter was measured as dry mass (grams) and number of pieces. The precision of the measurements was 1 decimal.

A total of 52,5% of the turtles have been found with ingested litter (plastics) in their digestive tract, and on the average $0,6 \pm 0,1$ g, equivalent to $13,1 \pm 2,0$ pieces were found per individual's digestive tract. By considering data collected from 2013 to 2019 included, which could testify a more standardised collection of data in line with the MSFD protocol, the occurrence of litter ingestion increased to 68,1%, while the mean dry mass and the mean abundance of ingested plastics reached respectively $0,7 \pm 0,2$ g and $14,3 \pm 6,7$ pieces.

Considering data from 2013 to 2019, there was a significant difference in occurrence among the three areas for ingested dry mass but not for number of items. The occurrence of plastic ingestion was the lowest in the Bay of Biscay 47,6% (N=21), while it reached 71,1% in Azores (N=38) and was 100% in Canary Islands (N=10). The mean dry mass of ingested plastic was respectively of $0,2 \pm 0,1$ g in Bay of Biscay, $1,0 \pm 0,3$ g in Azores, and $0,2 \pm 0,1$ g in Canary Islands). The mean abundance of ingested plastics was of $9,6 \pm 4,1$ pieces, $16,3 \pm 4,3$ pieces and $16,3 \pm 3,1$ pieces respectively for these 3 Regions.

Table a: Mean prevalence (% of affected individuals), dry mass (g per individual), and number of litter items (abundance) ingested by sea turtles in the southern OSPAR area, N = sampling size (after INDICIT, 2021)

Area	All data			Abundance
	N	Prevalence	Dry mass	
Biscay (OSPAR Region IV)	99	26,5	$0,1 \pm 0,0$	$3,9 \pm 1,7$
Azores (OSPAR Region V)	72	81,7	$1,3 \pm 0,2$	$22,9 \pm 4,0$
Canary Islands (Macaronesia)	11	100	$0,3 \pm 0,1$	$32,6 \pm 5,8$
TOTAL	182	52,5	$0,6 \pm 0,1$	$13,1 \pm 2,0$

Conclusion (brief)

The compilation of data on ingested litter by the sea turtle *Caretta caretta* in OSPAR Regions IV, V, and Macaronesia, provides consistent data on the evaluation of impact of litter on this marine organism.

This first assessment of the Common Indicator “marine litter ingested by sea turtles” indicates a high incidence of litter ingestion by sea turtles in OSPAR Regions IV, V, and Macaronesia, but with regional differences. Still at the initial stage, the use of this new OSPAR Common Indicator provides the first baseline for further monitoring and evaluation of trends. The approach will enable the evaluation of the efficiency of reduction measures, including some specific actions such as the ban of certain single use plastics.

Conclusion (extended)

As it stands, this initial assessment provides consistent data and the technical and scientific basis for future implementation of monitoring. Further implementation of sampling will also enable a larger coverage of sampling, to record all stranded animals in all parts of Regions IV, V, and Macaronesia. A long-term management of sampling and data collection will also enable the evaluation of trends. Alignments of data with the threshold value, as defined by the EU project INDICIT and to be agreed by OSPAR, indicate that the population of sea turtles is strongly affected by marine litter in the OSPAR Maritime area, requiring reinforced actions.

Knowledge Gaps

As it stands, this initial assessment provides consistent but partial data when considering the geographic scale of assessment. Critical points still must be considered in the next cycle to improve the monitoring and assessments. This will include (i) a larger coverage of sampling, (ii) a better coordination, and (iii) evaluation against the threshold that is actually under review.

Knowledge Gaps (extended)

As it stands, this initial assessment provides consistent but partial data when considering the geographic scale of assessment. Three critical points will have to be considered during the next cycle to improve the process:

1. A larger coverage of sampling to record all stranded animals in all parts of OSPAR Region IV, V, and Macaronesia. More specifically, data on dead animals (stranded or by-caught) from the coasts from mainland Portugal and Spain will be required for a complete assessment.
2. While a long-term management of sampling and data collection is possible by relying on both existing infrastructures and skills (rescue centres, stranded networks, scientific institutions, NGOs, Aquaria, etc.), coordination and optimisation will have to be better formalised to enable the use of other data than those provided only by scientific projects.
3. Evaluation of the data against the threshold value will normally be possible during the present cycle (definition of thresholds under way within the INDICIT and MSFD work plans), but will have to be finalised through an OSPAR formal agreement.

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Assessment Metadata

Field	Data Type	
Assessment type	List	Indicator Assessment
Summary Results (template Addendum 1)	URL	https://odims.ospar.org/en/submissions/ospar_litter_turtles_msfd_2022_06/
SDG Indicator	List	SDG 14.1.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
Thematic Activity	List	Biological Diversity and Ecosystems - Management of specific human pressures
Relevant OSPAR Documentation	Text	<p>OSPAR Agreement 2020-10 - CEMP Guidelines on Litter ingested by sea turtles</p> <p>OSPAR- EIHA 16/5/13, (2016). Marine Litter in sea turtles: A risk assessment as a scientific background for including ingestion of debris by sea turtles as a candidate indicator for impact of marine litter on biota in southern OSPAR area (region IV)., in: Agenda Item 5 Document EIHA 16/5/13 Presented by France. OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic. Presented at the Meeting of the Environmental Impact of Human Activities Committee (EIHA), Berlin (Germany).</p>
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Our vision is a clean, healthy and biologically diverse North-East Atlantic Ocean, which is productive, used sustainably and resilient to climate change and ocean acidification.

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