Final report about marine litter collected

LIFE SeaBiL (Action C2)

Saving SeaBirds from marine Litter

LIFE20 GIE/FR/000114

Coordinator

Beneficiaries

Financial partners

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1. Summary

UCA analyzed all the data enabling the various project actions relating to marine waste prevention and management to be evaluated. Two reports were produced summarising the results of the beach clean-ups (B3) and the tidal bins (B9): 56 clean-ups involving 1,263 volunteers (22.5 volunteers on average per clean-up) collected 1,722 kg of waste. For tidal bins, 5 were installed in Spain, enabling the collection of 563.5 kg of waste, including 85.3 kg of marine litter.

Beyond the quantitative results, the cleanups had a profound impact on participants, fostering a deeper connection between volunteers and the marine environment. Activities involving schools and local communities were particularly effective in engaging younger generations and raising awareness about the importance of protecting marine ecosystems. The participation of Natura 2000 managers, local NGOs, and other stakeholders further strengthened the collaborative nature of these efforts.

Conversely, tidal bins have been misused, highlighting the need to raise awareness among beach visitors and raise communication campaigns by local authorities.

2. Reports

- *Monitoring the marine litter collected at beach clean-ups report*
- *Monitoring report of the implementation of tidal bins at pilot areas in spain*

MONITORING THE MARINE LITTER COLLECTED AT BEACH CLEAN-UPS

REPORT February 2025

LIFE SeaBiL *"Saving Seabirds from marine Litter"* LIFE20 GIE/FR/000114

Coordinating beneficiary

Associated beneficiaries

This report provides a summary of the results from the beach clean-up activities (Action B3) conducted in the framework of the LIFE SeaBiL project.

The LIFE SeaBiL project - *Saving Seabirds from marine Litter* - is co-funded by the European Commission.

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1. CONTEXT OF THE PROJECT LIFE SEABIL

According to estimates, almost 90% of seabirds have plastic in their stomachs. This problem not only affects their health directly, but also has long-term repercussions on the survival of individuals. Plastic ingestion can cause gastrointestinal obstruction, internal lacerations and malnutrition. In addition, toxins released by plastics can accumulate in the birds' tissues, causing toxic effects that can affect their immune system, reproductive capacity and behaviour. Recent studies have also identified a condition known as plasticosis, a type of chronic inflammation caused by the ingestion of microplastics. This disease affects the digestive tract of birds, leading to scarring and damage to their internal organs. Over time, these lesions can reduce nutrient absorption and weaken the affected individuals, further threatening their survival.

Within the context of combating marine pollution, the LIFE SeaBiL Project "Saving SeaBirds from marine Litter" aims to evaluate and reduce the impact of plastic pollution on seabirds. The project involves five pilot sites across three countries:

- France: Gironde estuary and Pertuis sea Marine Natural Park (PNMEGMP)
- Portugal: Berlengas Natural Reserve
- Spain: Ebro Delta Natural Park (Delta Ebro), Urdaibai Biosphere Reserve (Basque Country)/ Santoña Marshes Natural Park (Cantabria); Cabo de Gata-Níjar Natural Park (Almería).

Through actions such as beach clean-ups and the installation of tidal bins, the project aims not only to mitigate the immediate effects of plastic pollution, but also to raise public awareness and promote policy changes for more sustainable plastic waste management. These initiatives are crucial to protect marine biodiversity and ensure the health of ocean ecosystems.

2. OBJETIVES OF THE REPORT

The main objective of this report is to quantify and monitor the efforts on marine litter prevention and management, as well as to quantify the number of volunteers mobilized at each pilot site and country and to quantify the weight of marine litter collected from beach cleanups.

3. GENERAL OUTCOMES AND METHODOLOGY

A total of 56 beach cleanups have been carried out in the various pilot sites. France: 9 cleanups; Portugal: 11 cleanups; Spain: 36 cleanups. The beach activities began with a talk to present the project, receive volunteers and distribute the material, and in some cases organize small groups to distribute tasks (Figure 1).

Figure 1. Photos of some of the beach clean ups conducted.

For each beach cleanup, a standardized data sheet was distributed to record the type and number of items collected. Additionally, the total weight of the litter and the weight of different material fractions (e.g., plastic, metal, paper, medical waste, sanitary waste, etc.) were recorded whenever possible. This methodology ensured consistent data collection and allowed for detailed analysis of the waste composition (Figures 2 and 3).

However, during some events, particularly those involving children and school groups with limited time to conduct the activity, the characterization and identification of the waste were not possible. In these cases, only the total weight of the collected litter was recorded.

Figure 2. Methodology of classification and weight of the litter collected from beach cleanups.

Figure 3. Methodology of characterization of the litter collected from beach cleanups by identifying categories and types of items.

The total number of volunteers who participated in the beach cleanup activities was 1,263 people across the three countries (France = 285, Portugal = 312, Spain = 659). By partner, the distribution of volunteers was as follows: 182 volunteers participated through UCA, 477 through SEO, 312 through SPEA, and 285 through LPO. (see Annexes)

Figure 4. Some volunteers collecting litter during a beach cleanup in Portugal.

Although it has not been possible to identify the affiliation of all volunteers, some of these activities have been carried out with schools and institutes (Figure 5). For example, at least 75 children participated in four beach cleanups with schools (UCA). In addition, SEO organized three cleanups with a total participation of 80 children. In Portugal, cleanups were carried out with the participation of teenagers. Furthermore, in several of the beach cleanups, N2000 managers, other beach cleanup organizers, and partners from local NGOs have also participated.

Figure 5. Beach cleanups conducted with schools and children.

Beyond waste collection, these cleanups fostered a deeper connection between people and the marine environment (Figure 6). Volunteers not only contributed to the removal of debris but also gained awareness of the impact of marine litter on seabirds and coastal ecosystems. These actions highlighted the urgent need to reduce waste, promote sustainable practices, and protect marine biodiversity for future generations.

Figure 6. Photos of volunteers during beach cleanups.

4. RESULTS

A total of 57 beach cleanups have been conducted across the pilot sites, involving the participation of numerous volunteers and organizations. The combined weight of litter collected during these cleanups amounted to 1,722 kg. This waste included a wide variety of materials, such as plastics, metals, glass, and sanitary waste, reflecting the diverse sources of marine and coastal litter (Figure 7).

However, it is important to note that logistical constraints during some cleanups made it impossible to weigh the litter. These constraints included time limitations, particularly during events involving school groups or children, as well as challenges related to equipment availability or the remote locations of some cleanup sites. As a result, the actual amount of litter collected is higher than the recorded weight.

Figure 7. Photos of characterizations and items collected from beach cleanups.

Identified litter items collected from beach clean-ups

A total of 18,514 items were collected and categorized during the beach cleanup activities. The overwhelming majority of these items were plastic, accounting for 17,284 items (93.4%) of the total. This high percentage underscores the pervasive issue of plastic pollution in coastal environments and its significant impact on marine ecosystems.

Other categories of waste were far less prevalent. Paper/Cardboard items made up 189 items (1.0%), while wood (machined) accounted for 97 items (0.5%). Glass waste was slightly more common, with 232 items (1.3%) collected. Sanitary Waste was also present, totaling 259 items (1.4%).

Finally, less frequent categories included medical Waste, with only 22 items (0.1%) recorded, and the "Others" category, which comprised 86 items (0.5%) (Figure 8).

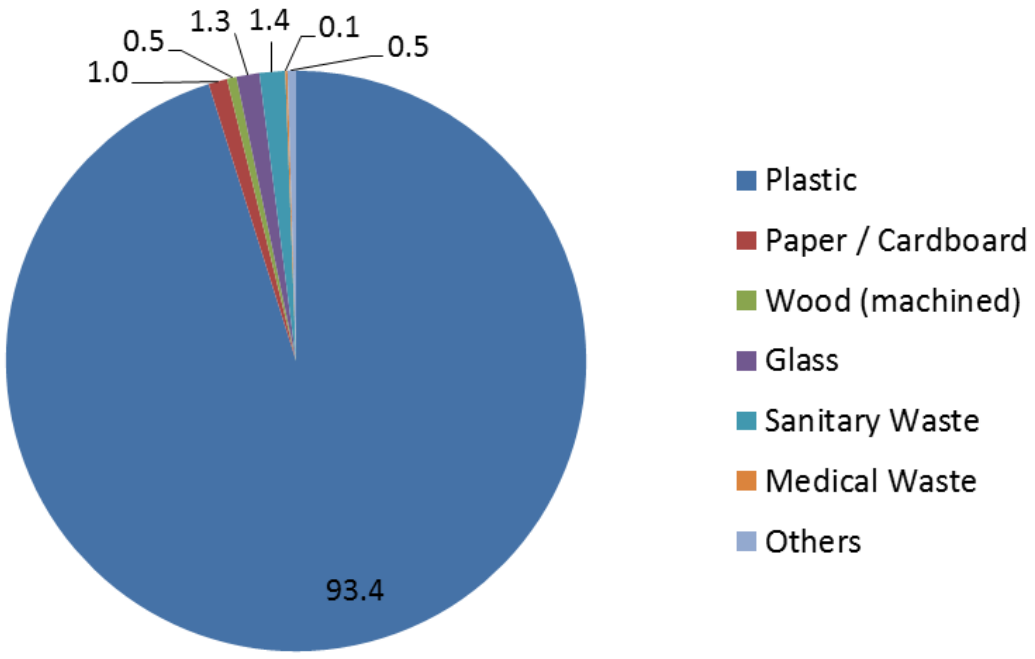

Figure 8. Percentage of the categories of the items collected during beach cleanup activities

Among the 17,284 plastic items collected during the beach cleanups, the most prevalent category was plastic pieces 0-2.5 cm, accounting for 4,081 items (23.61%) of the total plastic waste. The second most common category was items used in aquaculture, such as plastic sheeting from mussel culture, tahitians, oyster trays, oyster nets, and mussel bags, with 3,792 items (21.94%) collected (figure 9 and Table 1).

Cigarette butts were also a major contributor, with 2,582 items (14.94%) recorded, Nets and pieces of nets, cords, tangled nets, and octopus pots were another significant category, totaling 1,733 items (10.03%)

Less frequent but still present categories included straws, cutlery, cups, and fiberglass (157 items, 0.91%), foam and sponges (39 items, 0.23%), and floats/buoys (12 items, 0.07%). Items such as engine oil containers, cleaner containers, and large containers (> 25 liters) were either absent or minimal, with fewer than 10 items recorded in each category (Figure 9, Table 1).

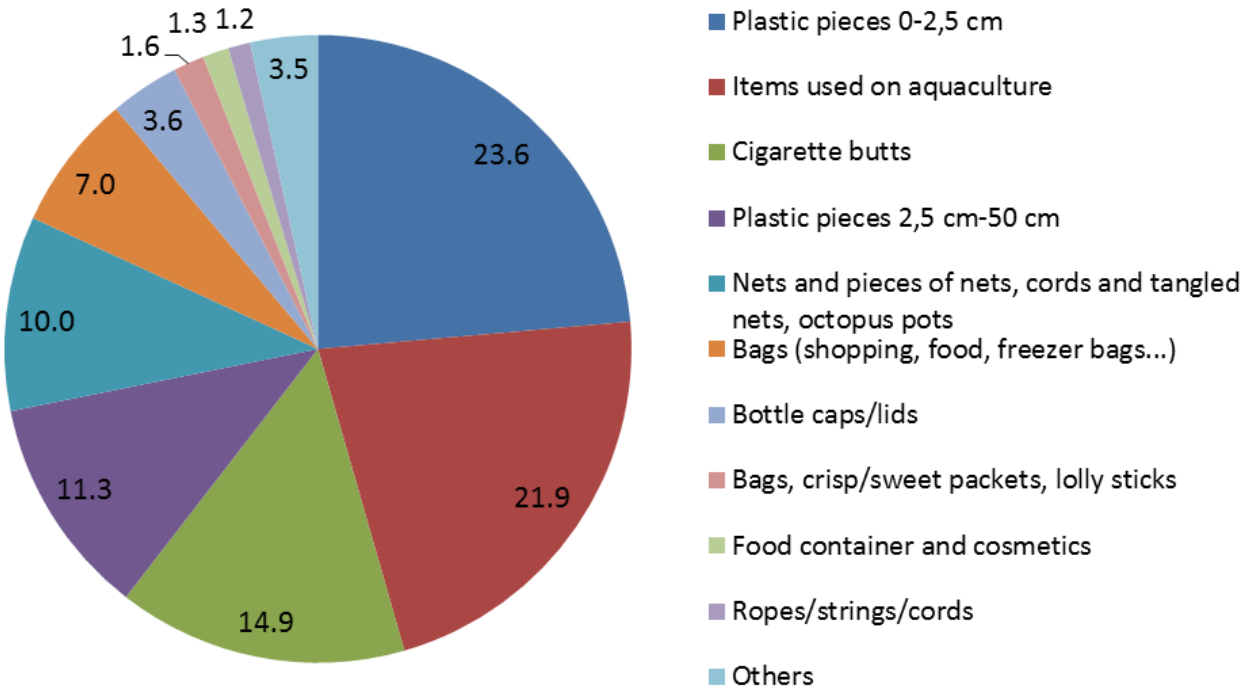

Figure 9. Percentage of plastic items identified during beach cleanup activities.

Table 1. Types of plastic items identified during beach cleanups. The table shows the sample size (n) per type of item and the frequency of occurrence relative to the total of plastic items identified.

Plastic type items	n	% occurrence
Cigarette butts	**2582**	**14.94**
Bags (shopping, food, freezer bags...)	**1211**	**7.01**
Drink bottles	130	0.75
Bottle caps/lids	**620**	**3.59**
Bags, crisp/sweet packets, lolly sticks	**276**	**1.60**
Straws, cutlery, cups, fiber glass	157	0.91
Food container and cosmetics	**232**	**1.34**
Ropes/strings/cords	**199**	**1.15**
Strapping bands	26	0.15
Industrial packaging, plasting sheeting, raffia sack	28	0.16
Foam, sponges	39	0.23
Nets and pieces of nets, cords and tangled nets, octopus pots	**1733**	**10.03**
Fishing lines, light sticks, plastic bait...	45	0.26
Items used on aquaculture	**3792**	**21.94**
Fish Boxes	5	0.03
Engine oil containers, glue, silicone (incluiding injection gun container)	0	0.00
Cleaner containers	0	0.00
4/6 pack yokes	3	0.02
Big containers (> 25 liters)	4	0.02
Pipes	4	0.02
Irrigation pipes	9	0.05
Floats/buoys	12	0.07
Plastic pieces 0-2,5 cm	**4081**	**23.61**
Plastic pieces 2,5 cm-50 cm	**1958**	**11.33**
Plastic pieces > 50 cm	39	0.23
Other plastic items (identifiable)	43	0.25
EPS seedlings	40	0.23
Plastic sheets and greenhouse fabrics	9	0.05
Other agriculture items	7	0.04

Top 10 of the identified litter items collected from beach cleanups

Among the ten most frequent items of litter found during the beach cleanups, plastic pieces between 0-2.5 cm were the most prevalent, with a total of 4,081 items collected. These small plastic fragments accounted for 22.0% of the total identified items, highlighting the widespread issue of microplastic pollution in coastal environments.

Items used in aquaculture, such as plastic sheeting from mussel culture, tahitians, oyster trays, oyster nets or mussel bags, were the second most common item collected, representing 20.5% of the total. This underscores the significant impact of aquaculture-related waste on marine ecosystems.

We also collected a large amount of cigarette butts, with a total of 2582 items counted (13.9% of the total). This reflects the persistent issue of cigarette litter, which is not only unsightly but also harmful to marine life due to its non-biodegradable filters and toxic chemicals.

Larger plastic debris, such as plastic pieces 2.5 cm-50 cm and nets/tangled nets, were also significant, contributing 10.58% and 9.36%, respectively. Other notable items included shopping/food bags (6.54%), bottle caps/lids (3.35%), and metal items (1.86%).

Finally, sanitary waste (n = 259) and food/cosmetic containers (n = 232) were less frequent items in the 10 top identified items, representing 1.40% and 1.25%, respectively (Figure 10 and table 2).

Table 2. Top 10 identified items collected during beach clean ups. Table shows the number per type of item (n) and the percentage of occurrence relative to the total number of items identified.

Items collected	n	% occurrence
Plastic pieces 0-2,5 cm	4081	22.04
Items used on aquaculture	3792	20.48
Cigarette butts	2582	13.95
Plastic pieces 2,5 cm-50 cm	1958	10.58
Nets and pieces of nets, cords and tangled nets, octopus pots	1733	9.36
Bags (shopping, food, freezer bags...)	1211	6.54
Bottle caps/lids	620	3.35
Metal	345	1.86
Bags, crisp/sweet packets, lolly sticks	276	1.49
Sanitary Waste	259	1.40
Food container and cosmetics	232	1.25

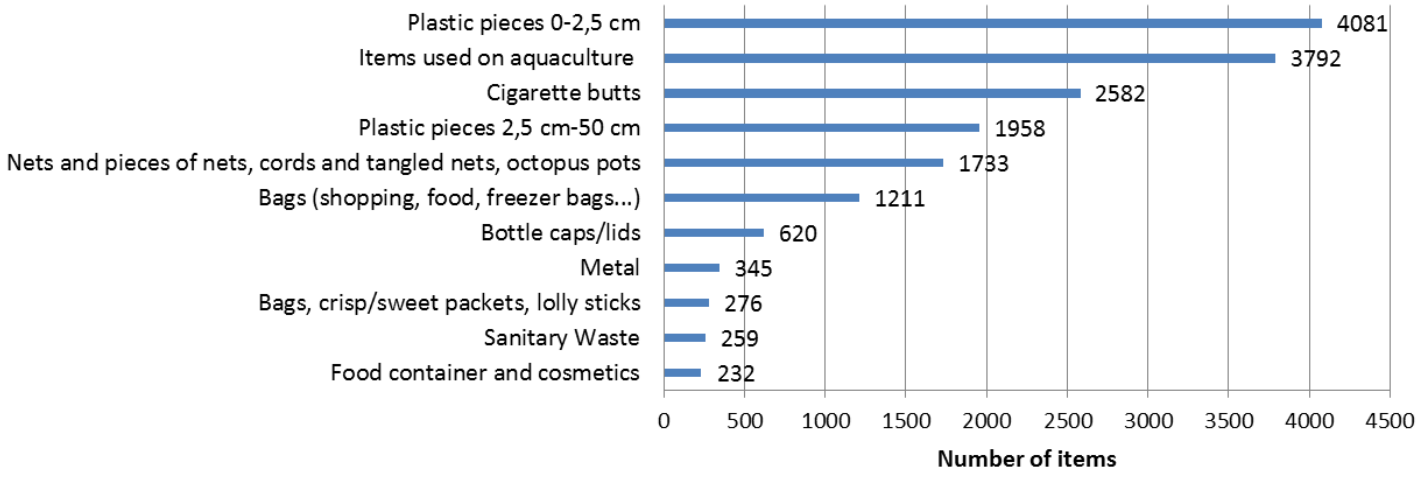

Figure 10. Number of the top 10 identified collected items from the beach cleanups.

During beach clean-ups it is common to find curious or unusual objects from tourists, industrial, agricultural or fishing activities. In our clean-ups we found some objects such as lighters, a pallet completely buried on the beach, an umbrella stand, some surgical masks, and plastic bags with dog excrement among others (Figure 11).

Figure 11. Photos of unusual or curious object found during beach cleanups.

5. CONCLUSIONS

The beach cleanup activities carried out across the pilot sites in France, Portugal, and Spain have provided valuable insights into the composition, sources, and impacts of marine litter. A total of 56 cleanups were conducted, involving 1,263 volunteers who collectively removed 1,722 kg of waste from coastal areas. These cleanups not only contributed to the immediate improvement of beach environments but also served as a powerful tool for raising awareness about the urgent need to address marine pollution.

Beyond the quantitative results, the cleanups had a profound impact on participants, fostering a deeper connection between volunteers and the marine environment. Activities involving schools and local communities were particularly effective in engaging younger generations and raising awareness about the importance of protecting marine ecosystems. The participation of Natura 2000 managers, local NGOs, and other stakeholders further strengthened the collaborative nature of these efforts.

The findings from these cleanups underscore the urgent need for targeted actions to reduce plastic pollution, particularly microplastics, aquaculture-related debris, and single-use items like cigarette butts and bags. They also highlight the importance of promoting sustainable practices, improving waste management systems, and fostering community engagement to protect marine biodiversity.

6. ANNEXES

Table 1. Beach cleanup activities by partner organization, date, location and number of volunteers.

Partner	Date of beach clean up	Place of activity	Municipality	Country	Nº volunteers
SPEA	04/11/2022	Praia do Baleal	Peniche	Portugal	45
SPEA	11/11/2022	Praia do Baleal	Peniche	Portugal	36
LPO	04/12/2022	Plage de la Phibie, Oleron	Oléron	France	36
LPO	04/12/2022	Plage de la Phibie, Oleron	Oléron	France	9
UCA	17/12/2022	Playazo Rodalquilar	Nijar	Spain	18
LPO	25/02/2023	Plage de la Phibie, Oleron	Oléron	France	20
SEO	18/03/2023	Playa de Trengandín	Noja	Spain	18
SEO	19/03/2023	Playa Eucaliptus	Delta Ebro	Spain	14
SEO	25/03/2023	Playa Laida	Ibarrangelu	Spain	Activity suspended
SEO	28/03/2023	Playa Eucaliptus	Delta Ebro	Spain	85
SEO	11/04/2023	Playa de Ris	Noja	Spain	24
SEO	11/04/2023	Playa de Trengandín	Noja	Spain	40
SEO	03/06/2023	Arena San Cristobal	Busturia	Spain	10
SPEA	03/07/2023	Lagoa Pequena	Sesimbra	Portugal	48
SPEA	16/09/2023	Praia dos Covões	Peniche	Portugal	6
LPO	17/09/2023	Saint-Trojan, Oléron	Oléron	France	13
LPO	18/09/2023	La Palmyre	Les Mathes	France	75
LPO	18/09/2023	La Palmyre	Les Mathes	France	75
SEO	23/09/2023	Playa de Trengandín	Noja	Spain	15
SPEA	28/09/2023	Praia do Baleal Norte	Peniche	Portugal	41
SPEA	29/09/2023	Praia do Porto da Areia Sul	Peniche	Portugal	41
SPEA	05/10/2023	Praia da Mareta	Sagres	Portugal	8
UCA	05/10/2023	PLaya Embarcadero Escullos	Nijar	Spain	16
SPEA	18/10/2023	Ilha Deserta	Faro	Portugal	15
SPEA	21/10/2023	Praia do Forte Novo	Loulé	Portugal	24
SEO	31/10/2023	Playa de Ris	Noja	Spain	11
UCA	11/11/2023	El arco/los escullos	Nijar	Spain	7
SPEA	12/11/2023	Praia do Molhe Leste	Peniche	Portugal	6
UCA	26/11/2023	Playazo Rodalquilar	Nijar	Spain	18
SEO	09/12/2023	Playa Laida	Ibarrangelu	Spain	9
SEO	09/12/2023	Arena San Cristobal	Busturia	Spain	9

Table 2. Continuation of table 1. Beach cleanup activities by partner organization, date, location and number of volunteers.

Partner	Date of beach clean up	Place of activity	Municipality	Country	Nº volunteers
UCA	20/01/2024	La fabriquilla	Nijar	Spain	4
UCA	21/01/2024	Genoveses	Nijar	Spain	16
UCA	27/01/2024	Las negras	Nijar	Spain	8
LPO	28/01/2024	Yves	Réserve d'Yves	France	50
UCA	28/01/2024	Playazo Rodalquilar	Nijar	Spain	7
SEO	30/01/2024	Playa de Trengandín	Noja	Spain	24
SEO	03/02/2024	Arena San Cristobal	Busturia	Spain	10
UCA	19/02/2024	Cabo Gata	Nijar	Spain	15
UCA	20/02/2024	Cabo Gata	Nijar	Spain	18
UCA	21/02/2024	Cabo Gata	Nijar	Spain	22
UCA	22/02/2024	Cabo Gata	Nijar	Spain	20
UCA	02/03/2024	Las Negras	Nijar	Spain	13
SEO	23/03/2024	Playa Laida	Ibarrangelu	Spain	7
SEO	23/03/2024	Arena San Cristobal	Busturia	Spain	7
SEO	27/03/2024	Playa de Ris	Noja	Spain	20
SEO	05/04/2024	Playa de Berria	Santoña	Spain	19
SEO	12/04/2024	Playa de Berria	Santoña	Spain	18
SPEA	30/04/2024	Praia da Cova do Vapor	Trafaria	Portugal	42
SEO	10/05/2024	Playa de Berria	Santoña	Spain	19
SEO	13/05/2024	Playa Eucaliptus	Delta Ebro	Spain	22
SEO	03/06/2024	Playa Eucaliptus	Delta Ebro	Spain	20
SEO	07/06/2024	Arena San Cristobal	Busturia	Spain	17
SEO	19/06/2024	Playa Eucaliptus	Delta Ebro	Spain	37
LPO	11/07/2024	Rochefort	Rochefort	France	7
SEO	21/07/2024	Playa Eucaliptus	Delta Ebro	Spain	22
LPO	18/09/2024	Bassin des Chalutiers	La Rochelle	France	7

MONITORING REPORT OF THE IMPLEMENTATION OF TIDAL BINS AT PILOT AREAS IN SPAIN

REPORT 2025

SeaBiL *"Saving Seabirds from marine Litter"* LIFE20 GIE/FR/000114

Coordinating beneficiary

Associated beneficiaries

This report presents a comprehensive analysis of the implementation of tidal bins at pilot areas in Spain (Action B9, subaction 2) under the LIFE SeaBiL project.

The LIFE SeaBiL project - *Saving Seabirds from marine Litter* - is co-funded by the European Commission.

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1. CONTEXT OF THE PROJECT LIFE SEABIL

It is estimated that nearly 90% of seabirds have plastic in their stomach. This alarming figure highlights the severe threat plastic pollution poses to their survival, habitats, and reproduction. Even when ingestion does not directly result in death, it significantly compromises their health and ecological roles.

Within the context of the fight against marine pollution, the LIFE SeaBiL Project "Saving SeaBirds from marine Litter" aims to evaluate and mitigate the impact of plastic pollution on seabirds. The project involves five pilot sites in three countries:

- France: Gironde estuary and Pertuis sea Marine Natural Park (PNMEGMP)
- Portugal: Berlengas Natural Reserve
- Spain: Ebro Delta Natural Park (Delta Ebro), Urdaibai Biosphere Reserve (Basque Country)/ Santoña Marshes Natural Park (Cantabria); Cabo de Gata-Níjar Natural Park (Almería).

One of the key objectives of the Project is to identify the sources of marine litter and develop territorial solutions to reduce them. In this context, action B9 focuses on strengthening knowledge sharing and collaboration within the French pilot site (PN these experiences to other LIFE SeaBiL pilot sites and territories.

In France, tidal bins have been successfully used for year. The project seek to adapt this process for Spain in order to reduce marine litter on beaches, and thereby lessening its impact on seabirds. Currently, more than 20 tidal bins are installed on PNMEGMP beaches by local authorities, such as the Communauté de communes de l'Île d'Oléron. Across the French Atlantic coast, approximately 150 tidal bins are operational. These bins not only collect waste but also provide valuable data about marine litter found at sea. Tidal bins serve as an effective tool for raising public awareness and encouraging citizens to adopt waste-reduction practices at home.

2. OBJECTIVES OF THE REPORT

The main objective of this report is to monitor the implementation of tidal bins installed in Spain and assess their effectiveness in marine litter prevention. This will be achieved by quantifying the total weight of collected waste and analyzing its composition.

3. GENERAL OUTCOMES AND METHODOLOGY

Five tidal bins have been installed in the framework of LIFE Seabil in diferent pilot sites in Spain. Two of them in Cantabria (Trengandín and Ris beaches, Figure 1), one in the Basque Country at Laida beach and two more in Natural Park Cabo de Gata- Níjar el Arco and Embarcadero beaches (Almeria) In Cantabria and Basque country tidal bins were installed in January 2023 while in Almeria; tidal bins were installed in September 2023 (Figure 2).

Regarding the methodology, the tidal bins were visited twice a month during the autumn-winter season in all areas and until the end of March-April, when they were uninstalled, coinciding with the beginning of the visitor and spring season. During these visits, the percentage of the container's volume was recorded on a data sheet and, whenever possible, the type of waste it contained and its weight were characterized.

Figure 1. Photos of tidal bins installed in Tregandin and Ris beaches (Cantabria) in the framework of the project LIFE SeaBiL.

Figure 2. Photos of tidal bins installed in Natural Park Cabo de Gata-Níjar (Almeria) in the framework of the project LIFE SeaBiL.

In the case of the tidal bins installed in Cabo de Gata, one was initially placed on Mónsul Beach but had to be removed a week later due to improper use by visitors. Cabo de Gata is a highly touristic area where the climate allows for visits throughout the year, not just during the summer season, although there is lower visitor influx in autumn and winter.

One week after the tidal bin was installed, and following the removal of other regular waste containers by the municipality at the beginning of autumn, visitors filled the tidal bin with trash, reaching approximately 160 kg, with bags scattered everywhere (Figure 3). Due to this situation and after several calls from the director of the natural park, it was necessary to uninstall and relocate it to Embarcadero Beach.

Figure 3. Problematic tidal bin installed at Monsul beach (Natural Park Cabo de Gata-Níjar, Almeria)

4. RESULTS

The continued monitoring of these tidal bins has allowed the collection of marine litter carried by the tide. During the visits, a record of the percentage of fullness of the container was made. In addition, we performed a visual assessment of the contents and, whenever possible, a characterization of the waste and the weight of the containers. Sometimes the containers were empty at the time of the check-up.

The average filling volume of the tidal bins was 27.7% (SD 35.28%). Out of a total of 9 visits, the containers were found empty. During most visits, it was reported that the bins contained large amounts of non-marine litter, which often made it difficult to accurately track marine litter (Figure 4 and 5). As a result, some of the data may be biased.

The total weight recorded in the tidal bins was 563.5 kg. However, a significant portion of this waste did not originate from the sea but rather from picnics or regular waste left by visitors. The total amount considered and accounted as marine litter was 85.3 kg. Therefore, it is estimated that approximately 478.2 kg of the waste was unrelated to marine sources, representing 84.8% of the total waste collected.

Figure 4. Some of the debris collected in tidal bins installed in Cantabria and not related to marine debris.

Figure 5. Some of the debris collected in tidal bins installed in Almeria and not related to marine debris.

Identified items of marine litter collected in tidal bins

Regarding the marine litter characterized from tidal bins, a total of 1115 items were collected and characterized. When classifying these items by categories according to their main material type, we see that most of these pieces are plastics (92.0%, n= 1026 items). This is followed by the rest of the categories with a percentage of presence of 2.3% for other waste (e.g. rubber, clothes; n= 26 items), 1.6% for glass, and 1.3 % for sanitary waste. No medical waste was recorded during the monitoring period (Figure 6 and Table 1)

Table 1. Identified items of marine litter collected in tidal bins. The table shows the sample size per type of category and the frequency of relative occurrence of the total of identified items collected.

	N	Percentage %
Total items	1115	100.0
Plastic	1026	92.0
Paper / Cardboard	5	0.4
Wood (machined)	6	0.5
Metal	11	1.0
Glass	18	1.6
Sanitary	14	1.3
Medical	0	0.0
Others	26	2.3

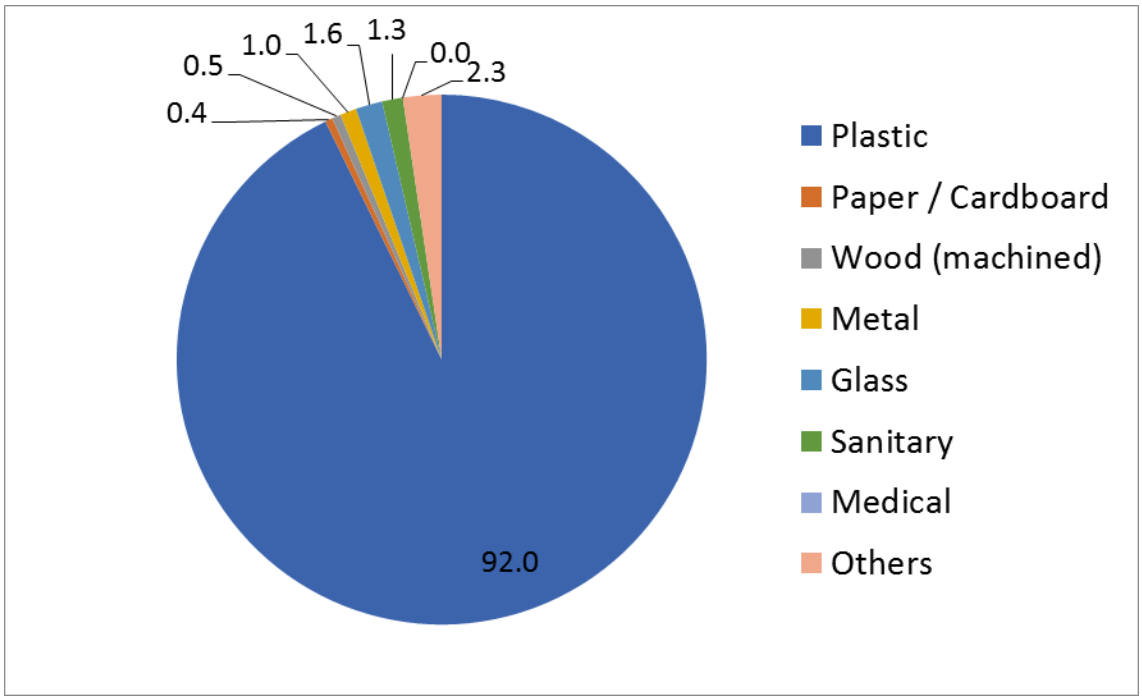

Figure 6. Percentage of frequency of the items collected from tidal bins classified by category of type of material. N = 1115 items.

Among plastic debris, bottle caps and lids were the most frequently found items, accounting for 306 items (29.82%) of all plastic waste. Nets, tangled cords, and octopus pots, with 204 items (19.88%) collected, also represented a significant portion of the total. Additionally, Plastic pieces 2.5 cm-50 cm were also a major contributor, representing 196 items (19.10%), while plastic pieces 0-2.5 cm accounted for 96 items (9.36%)(Figure 7 and Table 2).

Other notable plastic waste included drink bottles (n = 28, 2.73%), cigarette butts (n = 20, 1.95%), and food containers and cosmetics packaging (n = 14, 1.36%). Items related to aquaculture, such as oyster trays and mussel bags, contributed 0.78% (n = 8), while fishing lines, light sticks, and plastic bait made up 1.75% (n = 18). Industrial packaging, plastic sheets, and foam materials were also present in small amounts (Table 2).

Certain objects, such as large plastic containers (>25 liters), irrigation pipes, and floats/buoys, were found in minor quantities; with each representing around 1% of the total waste (Figure 8). Some items, like EPS seedlings and greenhouse fabrics, were not collected in tidal bins.

Table 1. Identified items of plastic collected in tidal bins. The table shows the sample size per type of category and the frequency of relative occurrence of the total of identified items of plastic collected.

Type of item	n	% occurence
Total items	1026	
Bottle caps/lids	306	29.8
Nets and pieces of nets, cords and tangled nets, octopus po	204	19.9
Plastic pieces 2,5 cm-50 cm	196	19.1
Plastic pieces 0-2,5 cm	96	9.4
Drink bottles	28	2.7
Ropes/strings/cords	27	2.6
Cigarette butts	20	1.9
Fishing lines, light sticks, plastic bait...	18	1.8
Cleaner containers	18	1.8
Food container and cosmetics	14	1.4
Floats/buoys	13	1.3
Other plastic items (identifiable)	12	1.2
Bags (shopping, food, freezer bags...)	11	1.1
Big containers (> 25 liters)	11	1.1
Irrigation pipes	10	1.0
Others	41	4.0

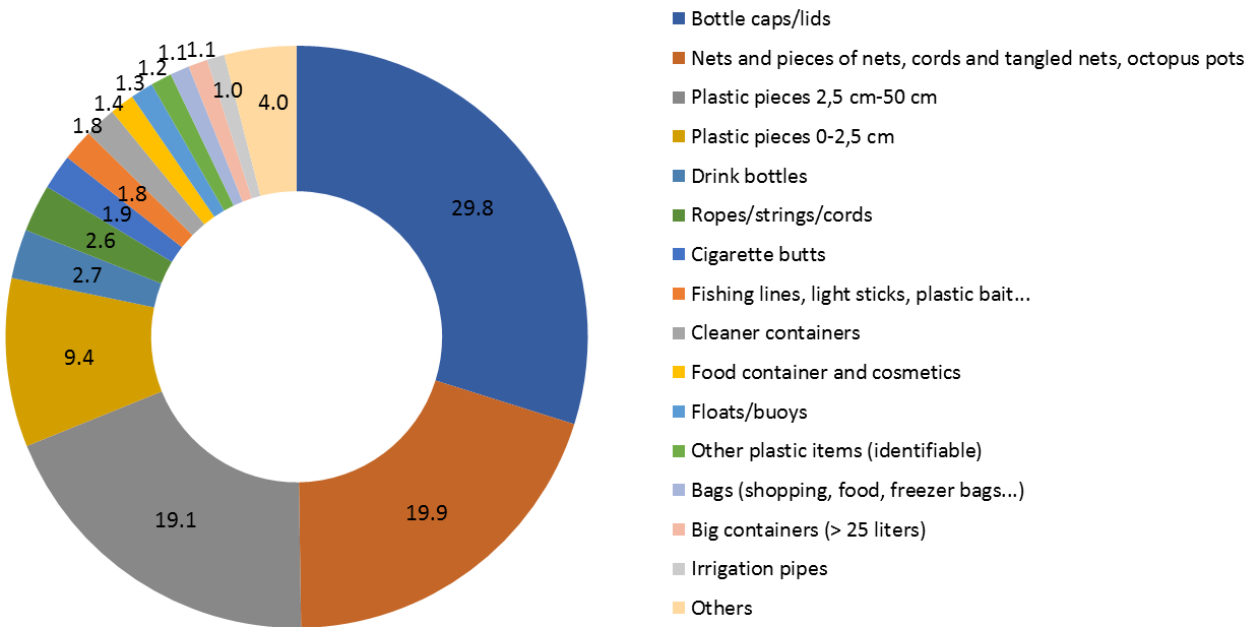

Figure 7. Percentage of the identified items of plastic collected from tidal bins. N = 1026 items

Figure 8. Different objects from marine litter collected from tidal bins installed.

Top 10 of identified items of marine litter collected in tidal bins

The "top 10" most frequent objects found in the total collections from tidal bins are bottle caps (n = 306 items) followed by nets and pieces of nets or octopus pots (n = 204 items) and, plastic pieces between 2.5 and 50cm (n= 196 items). These items represent 27.4%, 18.3% and 17.6% of the total amount of identified objects (Figure 9 and 10).

The remaining categories in the top 10 include plastic pieces from 0-2.5cm (n = 96 items, 8.6%), drink bottles (n = 28, 2.5%), ropes/strings/cords (n =27, 2.4%) and cigarette butts (n = 200, 1.8%) among others categories with lower occurrence (i.e. fishing lines, cleaner containers and food containers and cosmetics)

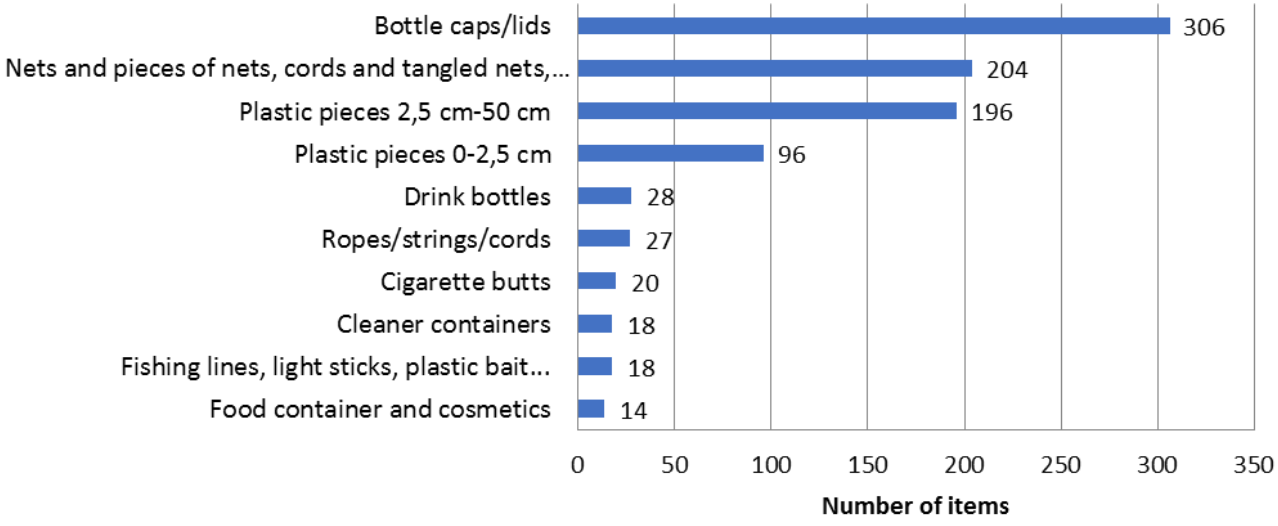

Figure 9. Sample size of the top 10 identified items collected from tidal bins.

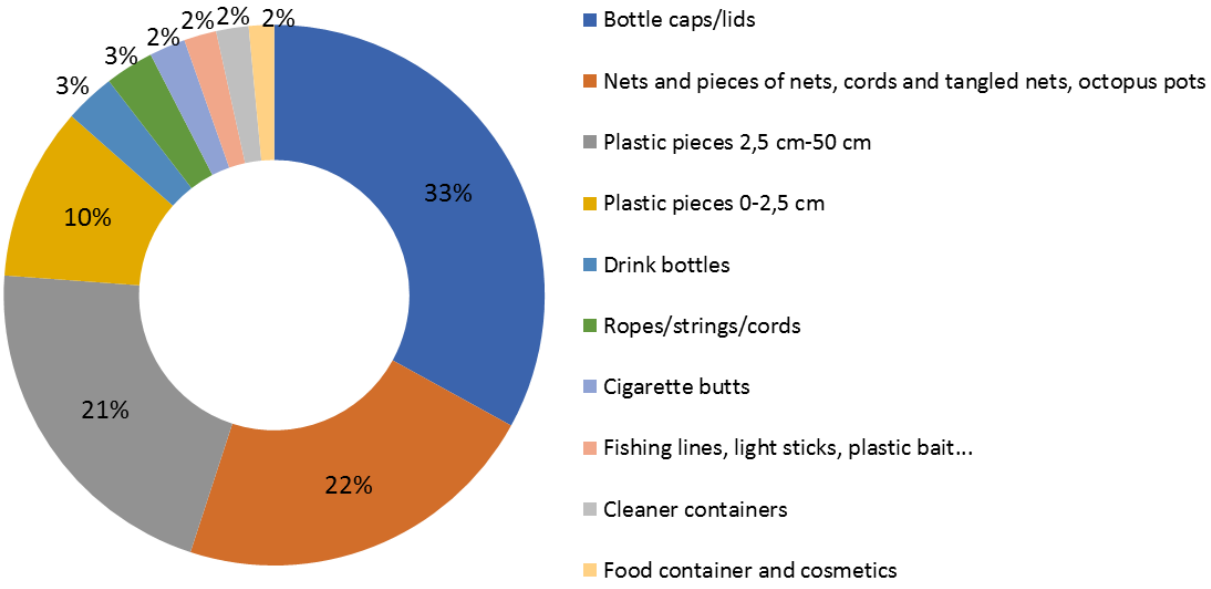

Figure 10. Percentage of the top 10 identified items collected from tidal bins.

5. CONCLUSIONS

The installation of tidal bins as part of the LIFE Seabil project in different pilot sites across Spain (Cantabria, the Basque Country, and Almería) has provided valuable data on the presence and composition of marine litter in these coastal areas. However, the results indicate that the initiative has not achieved the expected outcomes regarding proper public use, which has limited its effectiveness in collecting marine litter.

Despite the efforts made, a significant portion of the waste collected in the tidal bins did not originate from the sea but was instead generated by visitors, such as picnic leftovers or household waste. This was reflected in most waste characterizations, where it was evident that the majority of the collected litter was not marine litter. In terms of weight, out of the 563.5 kg of waste collected, only 85.3 kg corresponded to marine litter, representing a very low proportion of the total (15.1%).

This issue was particularly evident in tourist areas such as Cabo de Gata, where the bin installed on Mónsul Beach had to be removed after just one week due to improper use, accumulating 160 kg of non-marine waste. Preventive measures were attempted, such as installing informational signage adapted to the local context to educate visitors on the correct use of tidal bins (Figure 11). However, these actions did not have the desired impact, as misuse persisted in several locations. This suggests that while signage is a useful tool, it is not sufficient on its own to ensure proper use of the bins in high-tourism areas.

Regarding the marine litter collected, data show that 92% of the identified waste consisted of plastics, with bottle caps and lids, nets and ropes, and plastic fragments between 2.5 and 50 cm being the most common items (see Figures 4 and 5). These results highlight the need to continue efforts to reduce plastics in the marine environment, as they pose the greatest threat to coastal ecosystems. However, the fact that only 15.1% of the total waste collected (85.3 kg out of 563.5 kg) was marine litter indicates that most of the debris did not align with the intended purpose of the tidal bins.

Figure 11. Additional signage added to ensure the proper use of tidal bins in Cabo de Gata, where tourists from France, Germany, and England reside almost permanently in vans around the beach areas.

In conclusion, although tidal bins have proven to be a potentially useful tool for marine litter collection, their implementation in Spain has not yielded the expected results due to improper public use. This highlights the need to strengthen awareness and environmental education campaigns, as well as to explore additional strategies such as active supervision or collaboration with local authorities to ensure that these bins are used correctly. Furthermore, it is essential to tailor solutions to the specific characteristics of each area, particularly in high-tourism locations where visitor behavior can compromise the success of environmental initiatives.