LIFE
Environmental Governance and Information

LIFE DEBAG

Integrated information and awareness campaign for the reduction of plastic bags in the marine environment

LIFE14 GIE/GR/001127

Layman's Report

The **LIFE DEBAG** project "Integrated information and awareness campaign for the reduction of plastic bags in the marine environment" (LIFE14 GIE/GR/001127) is co-funded by the EU Environmental Funding Programme **LIFE Environmental Governance and Information**

Part of the approved budget of **LIFE DEBAG** project is co-funded by own funds of the Green Fund (Hellenic Ministry of Environment and Energy)

Implementation period:	1.9.2015 until 31.01.2019	
Project budget:	Total budget:	**1,257,545 €**
	EU financial contribution:	**754,527 €**

LIFE DEBAG's Participating Beneficiaries:

University of Patras- UPATRAS

Oikologiki Etaireia Anakyklosis- ECOREC

MEDITERRANEAN SOS Network- MEDSOS

TERRA NOVA Environmental Engineering Consultancy Ltd.- TERRA NOVA

Research University Institute of Sustainable Development and Human Resources, Panteion University- UEHR

www.lifedebag.eu

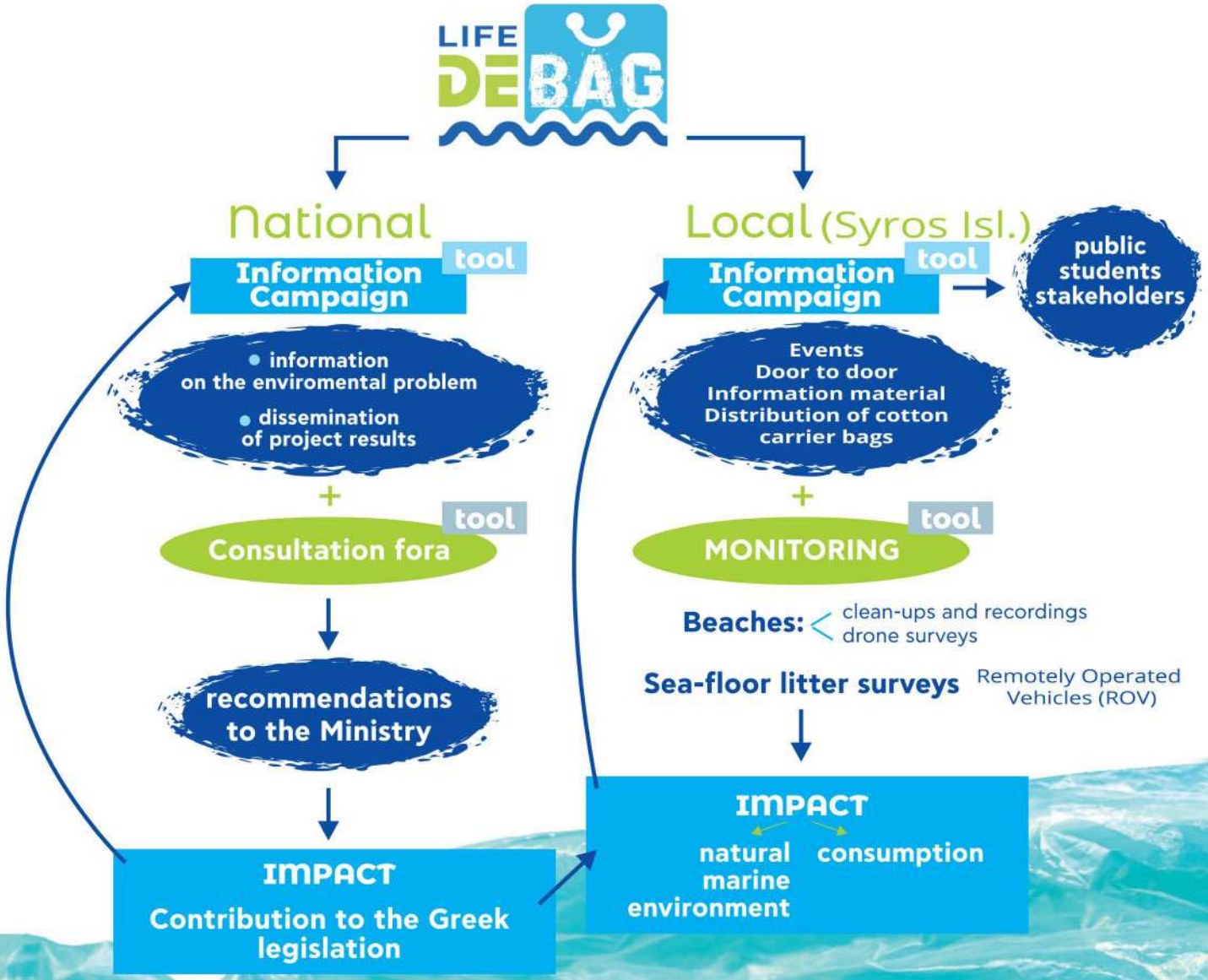
1. The LIFE DEBAG Project

LIFE DEBAG has developed and implemented an integrated information and awareness campaign to prevent - reduce plastic bag pollution in the marine environment. The project started on 1/9/2015 and was completed on 31/01/2019. LIFE DEBAG was performed on two main axes:

1. Information and awareness activities in the project's pilot area, the Island of Syros, with monitoring their impact on the marine environment and consumer habits.

2. Activities for the dissemination of the project's results, citizens' awareness-raising at national level (Greece), as well as consulting the national stakeholders to co-author legislative proposals for impact on Greek legislation.

LIFE DEBAG project has had a successful course and implementation, by accomplishing its set goals. Through effective educational and public awareness-raising activities and stakeholder engagement, LIFE DEBAG project managed to improve the environmental status of the Syros' marine environment, which was systematically measured in a scientifically documented way. In addition, LIFE DEBAG managed to influence Greek legislation on lightweight carrier plastic bags. LIFE DEBAG constitutes a good example for reproduction and transfer to other regions as well as for other single-use plastics based on its excellent results.


LIFE DEBAG
National
Information Campaign
tool
• information on the enviromental problem
• dissemination of project results
+
Consultation fora
tool
recommendations to the Ministry
IMPACT
Contribution to the Greek legislation
Local (Syros Isl.)
Information Campaign
tool
public students stakeholders
Events
Door to door
Information material
Distribution of cotton carrier bags
+
MONITORING
tool
Beaches: clean-ups and recordings
drone surveys
Sea-floor litter surveys
Remotely Operated Vehicles (ROV)
IMPACT
natural marine environment
consumption

2. Environmental Problem Targeted: Why target the plastic bag?

- Plastic bags are one-third of the litter resting on the seabed around the European Coastline.
- They end-up very easily in the marine environment due to their characteristics (light weight, buoyancy, hydrodynamic/aerodynamic shape).
- It is one of the deadliest types of litter for marine animals and birds (usually mistaken for food) along with balloons and fishing equipment.[1]
- Only an 1-3% of plastic bags is recycled.
- Plastic bags, like all plastics, sooner or later get fragmented in small pieces in the marine environment. At the moment, more than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea.[2]
- European seafood lovers are eating up to 11,000 tiny pieces of plastic each year, along with their seafood.[3]
- Plastic fibers are now present in tap and bottled water, beer and salt.[4]
- Dolphins, whales, birds, and fish are found dead with their stomachs full of plastic, including plastic bags. In 2019 a young curvier beaked whale was washed up dead, with 44 kg of plastic in its stomach, a lot of which was plastic bags.[5]

1. *Wilcox C, Mallos NJ, Leonard GH, Rodriguez A, Hardesty BD (2016) Using expert elicitation to estimate the impacts of plastic pollution on marine wildlife, Marine Policy. 65, 107-114. https://doi.org/10.1016/j.marpol.2015.10.014*
2. *Eriksen M, Lebreton LCM, Carson HS, Thiel M, Moore CJ, Borrero JC, et al. (2014) Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea. PLoS ONE. 9 (12): e111913. https://doi.org/10.1371/journal.pone.0111913*
3. *Van Cauwenberghe L, Janssen C, (2014) Microplastics in bivalves cultured for human consumption. Environmental Pollution, 193, 65-70. https://doi.org/10.1016/j.envpol.2014.06.010*
4. *Kosuth M, Mason SA, Wattenberg EV (2018) Anthropogenic contamination of tap water, beer, and sea salt. PLoS ONE 13(4): e0194970. https://doi.org/10.1371/journal.pone.0194970*
5. *https://www.nationalgeographic.com/environment/2019/03/whale-dies-88-pounds-plastic-philippines*

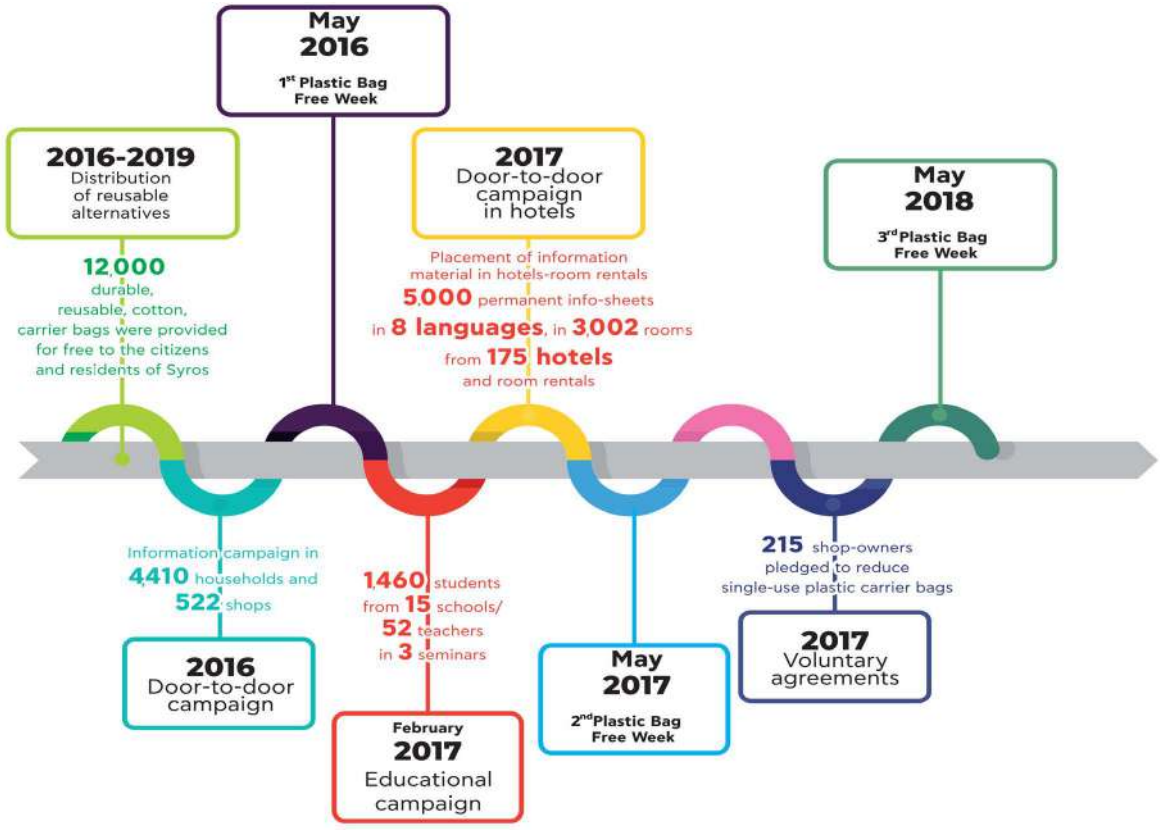
3. Information campaign

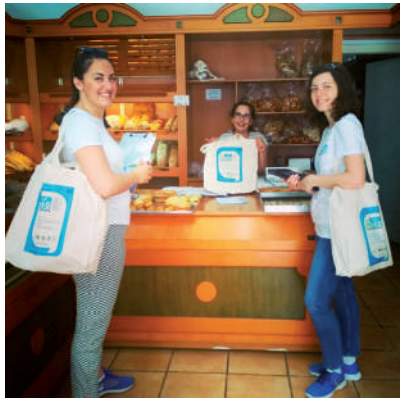
3.1 Information and education campaign in Syros Isl.

To inform and raise awareness in Syros Isl., LIFE DEBAG established the **“Plastic Bag Free Week”**, which was in effect since 2016. A celebration of the environment where every year in May, events and information campaigns on this issue took place. Musical events, educational games, exhibitions by school students and students of the University of the Aegean, were combined with important lectures by scientists and distinguished guests, such as Dr Francois Galgani, Chair of the MSFD technical group of marine litter, Chair of the UN ENV/UNESCO/IMO group of experts (GESAMP) on plastic in the environment. Furthermore, an informative booth operated on Miaoulis Square, in the centre of Ermoupolis, marking at the same time the support of the Municipality of Syros-Ermoupolis to LIFE DEBAG.

Throughout the project, 14,000 information leafl ets and about 12,000 durable, cotton, reusable carrier bags were off ered for free to residents and visitors and retail professionals of Syros, while a special brochure was placed in almost all hotels and room rentals, translated into eight languages. Two hundred and fifteen shop-owners in Syros have pledged to voluntarily reduce single-use plastic bags, while inspired by the good example of the project a growing number of retail professionals had their own reusable bags produced, initially providing them free to their customers, with the prompt to use them instead of disposable plastic bags.

Information and cultural activities


May
2016
1st Plastic Bag
Free Week
2016-2019
Distribution
of reusable
alternatives
12,000
durable,
reusable, cotton,
carrier bags were provided
for free to the citizens
and residents of Syros
2017
Door-to-door
campaign
in hotels
Placement of information
material in hotels-room rentals
5,000 permanent info-sheets
in 8 languages, in 3,002 rooms
from 175 hotels
and room rentals
May
2018
3rd Plastic Bag
Free Week
Information campaign in
4,410 households and
522 shops
2016
Door-to-door
campaign
1,460 students
from 15 schools/
52 teachers
in 3 seminars
February
2017
Educational
campaign
May
2017
2nd Plastic Bag
Free Week
215 shop-owners
pledged to reduce
single-use plastic carrier bags
2017
Voluntary
agreements



Environmental Education

In the schools of Syros, 1,460 students from 15 schools participated in educational seminars and 52 teachers were trained in 3 seminars. The students with the contribution of the Directorate of Environmental Education of Primary and Secondary Education of Cyclades, exploited LIFE DEBAG's educational material and created their own reusable bags which were exhibited and awarded during "Plastic Bag Free Week" 2017.

The environmental education program was not limited to Syros. More than four and a half thousand students (4,630) took part from 41 schools in Paros, Naxos, Mykonos, Attica and Thessaloniki. 345 teachers were also trained in 10 specifically prepared seminars at Syros, Mykonos, Attica, Thessaloniki, Aigio and Corinth. The training material is available at the LIFE DEBAG website (www.lifedebag.eu)

3.2. Communication campaign in Greece

- Project's website: http://www.lifedebag.eu
- TV spot: https://youtu.be/dW9j0e6nxs0
- Social media
  (Facebook, Twitter, YouTube, Instagram)

38,986 unique visitors to the project website
9,379 views of informational videos on facebook
5,278 YouTube views of the TV spot
3,528 views of informational YouTube
2,673 likes of the project's facebook page
> 560,00 views of the projects TV spot through the European Commission's channels
507 tweets

106 articles in electronic media
26 articles in print media
39 presentations in workshops and informative events
8 presentations in Greek and international conferences
2 publications in scientific journals

3.3. Stakeholder Engagement and Consultation Forum meetings

LIFE DEBAG addressed many stakeholders at local (Syros Isl.) and national level (Greece). Consultation with local bodies was carried out on regular basis throughout the project. In Syros, special emphasis was given during the “Plastic Bag Free Weeks”, where their involvement was realized through vis-à-vis communication and joint actions with the participation of local Small-Medium Enterprises, the Municipality of Syros and other Local Authorities, the Department of Product and Systems Design Engineering - University of the Aegean, local citizens groups, etc. At a national level (Greece), the stakeholders were engaged through the LIFE DEBAG consultation forum meetings and they included: a) policy makers, the Ministry of the Environment and Energy, the Hellenic Recycling Agency (EOAN), (b) regional and local authorities, (c) producers and importers of plastic bags, (d) supermarket chains, (f) Universities and Research Institutes, (g) the Research Institute of Retail Consumer Goods (ΙΕΛΚΑ), (h) environmental NGOs, representatives of citizen’s groups/associations. Within the LIFE DEBAG project, a total of 7 consultation forums were held on a national level, carried out under the auspice of the Ministry of the Environment and Energy and the Hellenic Recycling Agency (EOAN).

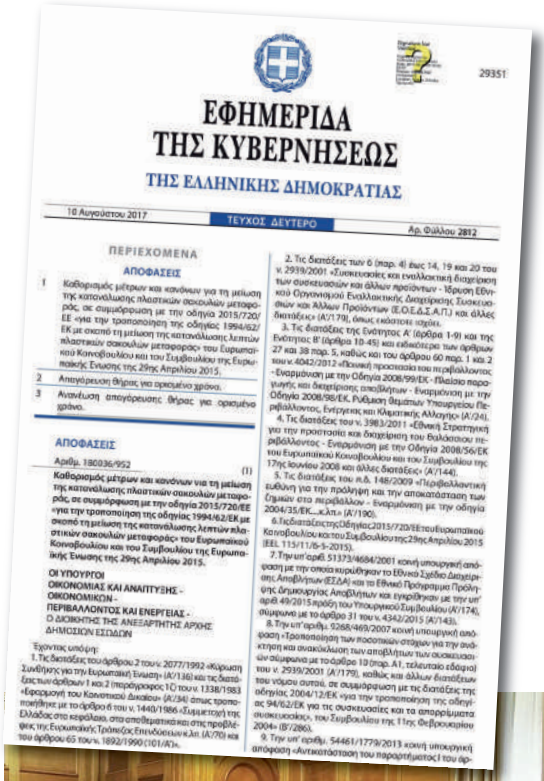
3.4. The Final Workshop

The final workshop of LIFE DEBAG was held on December 7, 2018, in Athens, with the participation of prominent Greeks scientists, representatives of all major NGOs and Institutions that work on the marine litter issue in Greece, as well as Dr Francois Galgani, Chair of the MSFD technical group of marine litter, Chair of the UN ENV/UNESCO/IMO group of experts (GESAMP) on plastic in the environment, who participated in all LIFE DEBAG's informative events. The conference was honoured with the presence of more than 180 participants.

4. The Project's Impact

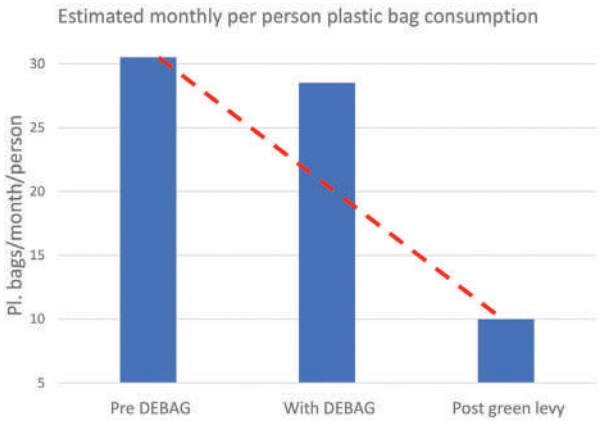
4.1 Impact on National Legislation

The project contributed signifi cantly to the integration of the Directive (EU) 2015/720 on plastic bags in Greek law. The project's stakeholders' meetings became the main consultation process between stakeholders' and Ministry of Environment and Energy representatives. The project's proposals were also submitted to the diff erent legislative bodies including the Ministry, Hellenic Recycling the Agency (EOAN) and the Special Permanent Committee on Environmental Protection of the Hellenic Parliament. The resulting legislation (article 6 of Law 4496/2017 and Joint Ministerial Decree ΦΕΚ Β' 2812 number 180036/952/10.8.2017) and measures introduced were at large the proposals that came out of project's stakeholder meetings, and/or the proposals of the Ministry and EOAN. Finally, at the Closing Workshop of the project in Athens, 5 major supermarket chains in Greece pledged to reduce single-use plastic bags, by signing LIFE DEBAG's voluntary agreement, in the presence of Mr. V. Liogas, Advisor of the Deputy Minister of Environment and Energy.


ΕΦΗΜΕΡΙΔΑ
ΤΗΣ ΚΥΒΕΡΝΗΣΕΩΣ
ΤΗΣ ΕΛΛΗΝΙΚΗΣ ΔΗΜΟΚΡΑΤΙΑΣ

4.2 Impact on public awareness in Syros Isl.

Questionnaire surveys were carried out on citizens of Syros Isl., in a total of 17 sampling periods. Inquiries included questions about how consumers feel about the plastic bag levy, how many plastic bags they use at the supermarket, if they use reusable bags, etc. They were also asked about the impact of the plastic bags on the marine environment.



During the intensive monitoring of plastic bag consumption of citizens that was held outside supermarkets of the Island of Syros:

- **17** questionnaire survey periods were carried out in three years.
- **1,500** consumers participated in the research.
- **67%** was the decrease in the monthly per person plastic bag consumption (from **30** to **10** plastic bags per month).

4.3 Impact on the coastal and the marine environment of Syros Isl.

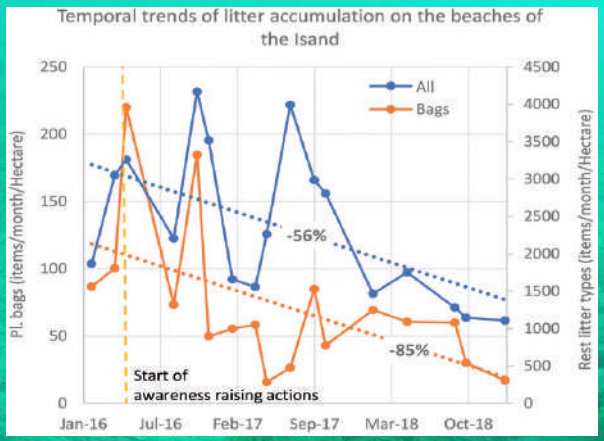
Research on litter pollution with emphasis on plastic bags, was carried out in selected beaches and was extended in the seabed of two bays (Ermoupolis and Kini) in Syros Isl.

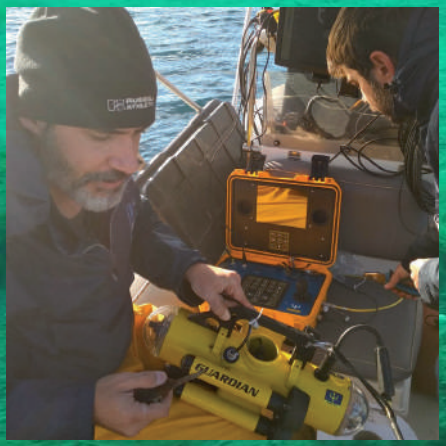
Through intensive monitoring, the improvement of the marine environment was observed as well as the changes in consumer habits, as a LIFE DEBAG project effect.

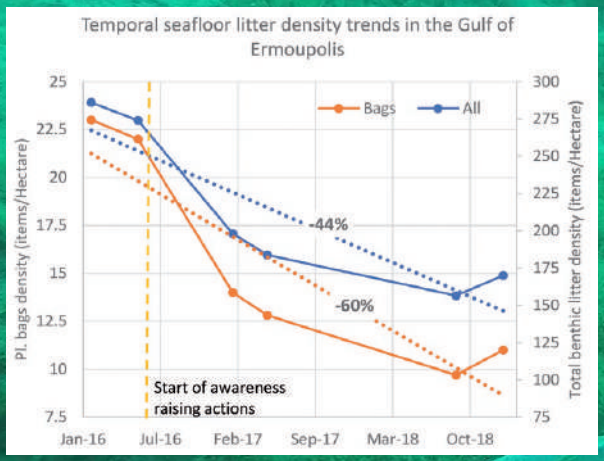
During the intensive monitoring of the coastal and the marine environment of Syros:

- **17** sampling periods of litter on the beaches and the seabed around the island were carried out during **3** years.
- **64,562** pieces of litter were collected and recorded on selected beaches of the island, of which **2,246 (3.5%)** were plastic bags from supermarkets and retail shops.
- **3,675** pieces of litter were identified and classified from underwater video recordings from the seabed around the island (Ermoupolis and Kini bays), of which **314 (8.5%)** were plastic bags from supermarkets and retailer shops.


ΑΤΛΑΝΤΙΚΗ
ΕΝΩΣΗ
Blue Star Ferries
Blue Star Ferries
Φαρμακειο
53
52







The results from the seabed around Syros were impressive. After 3 years of underwater monitoring, there was a 60% reduction in the plastic bags found resting on the seafloor, especially after the initiation of the LIFE DEBAG's intensive information campaign: the 1st "Plastic Bag Free Week, 2016".

The impact on the marine environment of Syros Isl. is:

- **85%** reduction of plastic bags on selected beaches.
- **60%** reduction of plastic bags on the seafloor around island (Ermoupolis and Kini bays).

Looking at litter from above

In Syros Isl., aerial beach litter monitoring with the use of drones was carried out for the development of new methodologies for monitoring the presence of marine litter on remote coasts. During the aerial surveys, 6,000 square meters of coastline were recorded.

The "good example" of LIFE DEBAG

During the project two MoUs were signed for the replication of LIFE DEBAG. Several other areas in Greece started similar initiatives (Paros, Mykonos, Astypalaia, Litochoro, Skiathos, Thira, Achaia, Kea, Municipality of Voula-Vari-Vouliagmenis, etc.) while many other Municipalities and relevant actors expressed interest for replication of the project and its activities. Since the successful completion of the project, the Replication Handbook is available on the project's website. The Replication Handbook is designed to provide guidance to organizations and individuals that are interested in implementing an integrated information campaign to reduce the plastic bag or similar single-use plastics in the marine environment.

Plastic bags and microplastics

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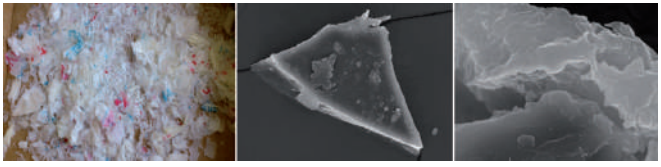
Pollution by plastics has been reported in many studies(involving the geographical distribution, impacts on a variety of organisms, as well as sorption of organic pollutants, and interaction with microbes, to name but a few) (Takada and Karapanagioti, 2019). Polyethylene and oxo-degradable plastic bags are one of the main marine litters with significant environmental ramifications. Due to their low weight and shape, theycan be transferred by the wind in great distances at different directions. Recently the maximum record of a plastic bag in Marianna Trench, the deepest point in the global ocean, has been recorded by Chiba et al. (2018).

Scientific results have shown increased weight loss of oxo-degradable polyethylene in contrast with low and high density polyethylene under soil conditions but without the formation of new functional groups, proof of the polymer degradation. In other words, degradation of starch that is the glue of the synthetic polymer pieces in an oxo-degradable plastic bag was observed but no degradation of the synthetic polymer (Orhan et al., 2004). Working with experiments in seawater, Alvarez-Zeferino et al. (2015)found that plastic bags tend to fragment before significant differences in functional groups were identified, i.e. before chemical degradation.

In our studies, we took plastic bags from coastal areas and we used Scanning Electron Microscopy (SEM)for optical observations, i.e. to produce images of the plastic litter surface topography as well as to observe microscopic plastic particles and attenuated Total Reflectance– Fourier Transform Infrared spectroscopy (ATR-FTIR) for the determination of functional groups on polymer surface and thus, the identification of plastic samples andthe detection of differences in the degradation.We found that both oxo-degradable and polyethylene plastics (e.g. shopping bags) can break down into microplastics (as seen in the attached photo and photomicrographs) before they are chemically degraded.

In conclusion, in the marine environment,many plastic bags may be present and persist in the form of microplastics which is highly difficult to detect with naked eyes. In this form, it is easier for them to diffuse in the environment and to enter the trophic chain (Takada and Karapanagioti, 2019). The scientific research on microplastics that already exist in the oceansmust be emphasized,while at the same time the entrance of macro plastics, such as plastic bags, in the aquaticenvironment should be stopped to prevent the formation of microplastics if a safer and cleaner environment isdesired.



Figures from left to right:Oxo-degradable plastic bag particles in a variety of sizes(left), SEM image of a microplastic item (~ 100 μm in diameter) from this plastic bag(middle) and SEM image of a crackedarea (~ 10 μm) of this microplastic item of the same plastic bag, creating more microplastics (right).

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Acknowledgments

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Policies for macroplastics are relevant to microplastics, but some policies for microplastics are unique and should also be considered

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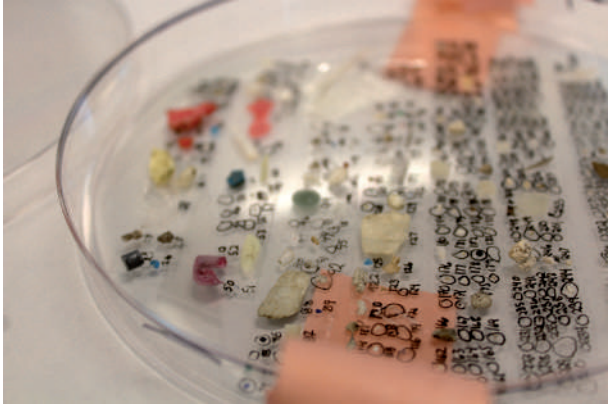

By weight, large plastic debris such as fishing nets, make up the largest percentage of plastic floating in our oceans. However, by count, microplastics by far exceed the number of plastic in our environment (Lebreton, 2018). Thus, as we design policies aimed at plastic pollution, we must be mindful to include policies specific to microplastics. Because some sources of microplastics are unique (e.g., microfibers, tire dust, pre-production pellets), policies will also be unique to larger items of plastic waste. As such, it is important that we invest time thinking about creative and effective solutions for mitigating microplastics.

Microplastics are any plastic particle between 100nm and 5mm in size. Although we often think of microbeads when we think of microplastics, the term microplastic incorporates a large diversity of plastic types, including those that were produced as microplastics (e.g., microbeads, pre-production pellets often referred to as "nurdles") and those that are literally degraded bits of larger plastic products (e.g., tire dust, microfibers and fragments of bottles, bags and film). The former is called primary microplastics and the latter is referred to as secondary microplastics. Secondary microplastics are the most common type of microplastic waste found at sea (Law et al., 2010). Still, we must not forget the primary sources of microplastics as well as the sources that emit secondary microplastics into the oceans (e.g., microfibers). These particles, specifically microfibers, are some of the most common microplastic types found in global ecosystems. Researchers estimate that there are between 15 and 51 trillion microplastic particles floating around in our oceans (van Sebille et al., 2015), reaching from the poles to the equator. Microplastic particles are found in large concentrations in Arctic sea ice and are also present in sediments and wildlife from the deepest parts of the ocean. Consequently, this widespread contamination has led to the contamination of 100s of species of wildlife across all trophic levels. Laboratory studies demonstrate that microplastics can lead to mortality, reduced growth, and decreased reproductive output in marine animals (Foley et al., 2018; Rochman et al., 2016). Although we do not yet understand how they may affect human health, they are also found in sea salt, seafood and drinking water.

Although policies that mitigate large plastic debris also reduce microplastic debris, we need to make sure we consider microplastics when we consider all of the policy options for plastic pollution. Policies specific to microplastics may include, but are not limited to, emissions standards for microplastics (e.g., from washing machine effluent, wastewater, stormwater, etc...), filters on washing machines to trap microfibers, increasing participation for operation clean sweep and extend this model to textiles, material innovation, and banning microbeads.

The above mitigation strategies are simple solutions to combat some sources of microplastics. Still, when it comes to plastic pollution, we know the least about sources, fate and effects of microplastics. As such, while we begin implementing policies now related to known sources of microplastics, we must continue to put resources into research that helps us better understand what some other sources of microplastics are and which may be prioritized for policy based on quantities and risk.

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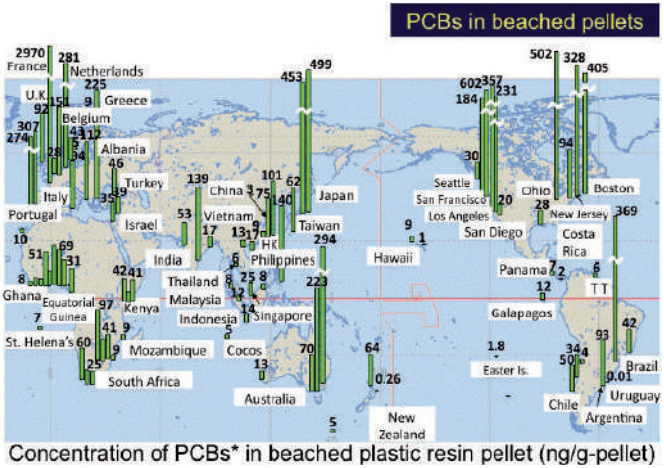
Plastic bags are a significant source of microplastics that carry toxins to marine organisms and humans. “Plastic” is a term collectively used for various polymers, of which polyethylene (PE) is the most widely used, surpassing polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), and polyethylene terephthalate (PET). The most common application of PE is plastic shopping or carryout bags (“plastic bags” hereafter), which have a key physicochemical property which is lightweight or low-density. Since PE is lighter and has a lower density than water, it can float on the water surface and travel long distances, as far as the open ocean. On the sea surface, PE is exposed to sunlight, leading it to break down into smaller pieces or microplastics.

Plastic products including shopping bags contain additives to maintain or increase the properties of plastics such as plasticizers, UV stabilizers, and antioxidative agents. Some of them give adverse effects on organisms when they are exposed to biota. These additives are retained in plastics, even after they are fragmented into smaller pieces such as microplastics. In addition, microplastics in the marine environment accumulate pollutants, such as oil, PCBs, and organochlorine pesticides from seawater. This process that pollutants sorb onto or into plastics is considered the “toxification” of plastics. The critical factor of PE in the marine environment is that it has the highest capacity of toxification among all the polymers. Figure 1 illustrates that PE is dispersed throughout the globe and that all the PE resin pellets are toxified with PCBs. The same toxification occurs for PE fragments derived from plastic bags because they are made of the same polymer type as the resin pellets.

Ingestion of microplastics by shellfish and fish has been reported in recent studies. Because plastics carry pollutants, ingestion of plastics by marine organisms can be considered internal exposure of the biota to pollutants. We have confirmed the transfer of pollutants from ingested plastics to the tissue of the shellfish. The amount of plastics used in the experiment was larger than those observed in the current marine environment. However, the amounts of plastics in the marine environment are steadily increasing and microplastics are persistent in the marine environment since they cannot be removed once they enter the ocean. As a precautionary principle, we must reduce the inputs of plastic waste to the sea. Government policies, such as plastic bag bans, fees and taxes on single-use carryout bags, have already shown to be successful in cities, states, and countries around the world, leading to significant reduction of plastic bag usage and effectively working as a countermeasure against plastic pollution. Regulation of plastic shopping bags is the first step toward sustainable society without single-use plastics.



Marine debris in the Mediterranean Sea. From science to management

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The Mediterranean Sea is one of the most affected areas by marine litter in the world with plastics and other artificial polymer materials as the most common types of marine litter, representing some 80% of the items found. As larger pieces of plastic debris fragment into smaller pieces, the highest known concentration of microplastics was found in the eastern part reaching up to 64 million particles per km2 when the highest sea floor concentration was discovered in 2019 in the northern Ionian Sea, reaching up to 1.3 million items per km2. The marine litter problem in the Mediterranean is exacerbated by densely populated coasts, 30% of the world's maritime traffic, the basin's limited exchanges with other oceans, large inputs from large rivers such as the Nile, the Po the Rhone rivers, an highly developed coastal tourism, and a deficient treatment of waste waters. Hot spots of accumulation have been found, in the eastern Basin, southern Adriatic and, for the sea floor, around large cities.

Entanglement in Plastic or fishing gear and ingestion of debris. For example, ingestion of plastics by marine species is one the most documented impacts in the Mediterranean with 76 Mediterranean affected species belonging to different taxonomic groups including invertebrates, fish, sea turtles, seabirds and marine mammals. Damage costs to marine ecosystems and the services, for example the introduction of alien invasive species and the rafting of species, including species at risk such as toxic dinoflagellates of pathogens to marine organisms must also be considered despite a limited understanding of the detrimental impacts

Marine litter also creates an economic burden on local authorities through clean-up costs, and potential loss of income and jobs from tourism. The damage and associated social costs also extend to other sectors such as aquaculture and fishery where litter damages nets and reduce (ghost fishing) catches. Marine litter also creates economic pressures on the shipping sector, including yachting and risks to human health, via injuries and accidents, or through the potential release of chemical substances. Links to human health are, however, not sufficiently addressed especially when it comes to nanoplastics, which, may have even greater impacts on marine ecosystems with a possible transfer through the trophic chain and then human.

The overall objectives of existing policies on marine litter are to provide scientific and technical basis for monitoring and develop strategies with stakeholders, industries and NGOs to support management practices and propose policy options. The main international agreements and conventions (Sustainable Development Goal 14 from, UN environment and its Global Partnership on Marine litter MARPOL, London and Basel conventions, FAO code), global initiatives (G7, G20, International Coastal Clean-ups, etc.) and the European directives, including the re-examination of the directive on port reception facilities provide basic principles to be used all over the basin to support / connect actions in different country and contexts and at a variety of geographic and governance scales. These frameworks include potentials actions and means to evaluate strategies effectiveness in order to reduce amount and impacts of marine litter.

Despite the recent advances made within the framework of the Barcelona Convention Regional Plan for Marine Litter Management in the Mediterranean and the EU Marine Strategy Framework Directive (MSFD), there is still a long way ahead to tackle marine litter in the basin and reduce the risks posed to Mediterranean marine wildlife. The Regional Plan on Marine Litter Management in the Mediterranean has been adopted in 2013, as the first legally binding instrument at a regional level, also urging to cooperate and support monitoring. Together with the MSFD, they both support a programme of measures in a coherent and coordinated way. The Plastic strategy is planning to reduce the amounts and effects of marine litter, supporting recycling, eco-design, the use of new materials, the reinforcement of waste water treatment, the bans of Single Use Plastics and specific measures for fishing gear. It has clearly defined the Mediterranean Sea as a priority.

Ingestion and entanglement: a critical impact of litter on marine life

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Marine litter is a global issue for biota, of which 1,400 species have been reported to be impacted through ingestion and entanglement. Seals, cetaceans, turtles and birds as well as fish and invertebrates like corals. For example in sea turtles, in Mediterranean sea, up to 58% of individuals have been reported to be entangled while up to 100% showed marine debris in their digestive tract. Debris generate direct mortality but also indirect effects which are deleterious for individuals and may threaten the survival of marine species populations. Plastic bags are often found in the digestive tract of sea turtles, which probably misidentify them as gelatinous preys. Plastic bags are a main issue since they may totally block the digestive transit, and lead to the death of the individual. On along term, when having ingested a lot of debris, an individual will ingest less natural food and suffer of denutrition, with consequences on health (digestive pathology) and fitness (growth, breeding success etc.). Entangled animals are prevented to move easily, to search for food or escape predators, and lots of them will suffer from complications due to wounds. Benthic invertebrates, like corals, urchins etc, are also impacted by marine debris like plastic bags, which cover and in certain cases smother some of them.

The issue is obviously underestimated since the detection of specimens impacted by debris is uneasy. Monitoring networks and biologists measure the number of stranded or resting animals on the coast, or report observations of specimens at sea. However this reflects only an unknown part of the entire number of interactions that really occurred with debris. Some individuals are missed because they float in water column or have sought towards sea floor after death, while others have been predated.

Furthermore, detecting ingestion of marine debris is often impossible since stranded carcasses are already too degraded for enabling any examination. On the other hand, in the case of entanglement in fishing material, it is not always possible to distinguish if the entanglement is due to true debris (pieces of nets, trawls or lines which were abandoned or lost), or reflects an interaction with gears during fishing operations.

The rate of interaction between debris and marine life depends on several factors, in particular the species, the age/developmental stage of animals, and the density of debris in the environment. Marine policies and european projects such as Life Debag are consequently not only developping measures for tackling the debris issue, but they also contribute to reinforce capacities for monitoring the impact, rescue and rehabilitation of marine biota. They promote the use of standard procedures for measuring the interaction occurrence and impact of debris on wildlife in each subregion. They also develop indicators using marine biota that are particularly sensitive to marine debris. In Mediterranean sea, the loggerhead sea turtle Caretta caretta, which is wide distributed and shows a particular propensity to ingest and interact with debris, is a common indicator for Marine Strategy Framework Directive and UNEP Mediterranean Action Plan.

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