

A SEA OF PLASTIC : THE CRITICISMS OF THE MEDITERRANEAN

Stranded waste, plastic at sea, tourism and maritime traffic are the factors which exert the greatest pressure on the Mediterranean. Plastic is part of people's daily lives and is a regular presence on the beaches: disposable tableware, bottles, packaging, toys, fishing nets and waste from pleasure boats continue to suffocate the sea.

THE DISPERSION OF PLASTIC IN THE MEDITERRANEAN

Where do the 53,000 tons of plastic that are poured into the Mediterranean Sea every year come from? 80% of the plastic scattered on land ends up in the sea. Unlike what happens in the oceans (whose currents accumulate the most waste offshore), in our sea more than 20% of the waste is destined to return to the coast within a year.

The main source of plastic scattered at sea is coastal activity. 78% is linked to inefficient waste management, which worsens further in the summer period due to the increase in tourist flows and related recreational activities. They follow the activities at sea with 18%: fishing, aquaculture and navigation disperse pots, nets, boxes for the transport of fish. Only 4% come from rivers.

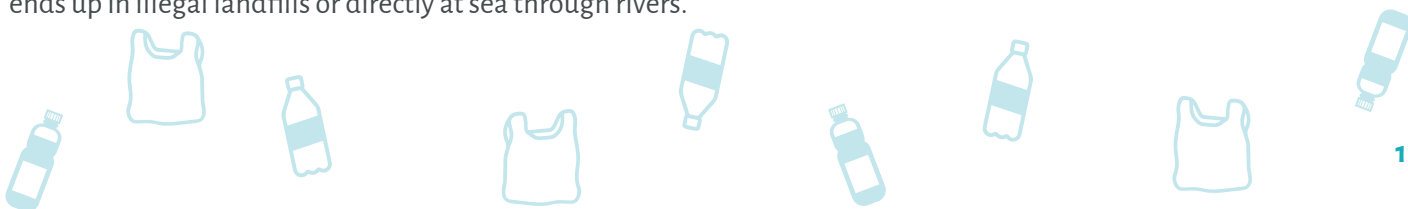
After dispersion at sea, 65% of the plastic remains on the surface for 1 year and travels for about 10 years driven by winds and currents.

The plastic that settles on the seabed is 9 times less than the one that accumulates on the coasts, but the seabed is almost impossible to clean.

The countries of the eastern Mediterranean represent the taillight in waste management, causing the greatest contribution of plastic at sea. In Italy the most critical areas are the coast of Venice close to the Po river delta and Sicily. The Po, along with Ceyhan and Seyhan in Turkey and the Nile, is among the most contaminated rivers in the Mediterranean and alone brings 1,350 tons of plastic into the Adriatic every year. The waste carried by the river is added to those generated by the intense maritime and tourist activities of Venice, Genoa, Naples, Athen, Durres, Istanbul, Beirut, Cairo, Marseille, Barcelona, etc.

Sicily has the lowest rate of separate collection in the country: in Palermo only 17% of waste is separated and the percentage drops to 10% in smaller municipalities. The figure is certainly influenced by the high tourist influx, which with 14 million visitors per year, almost triple the number of local people. Other critical areas for Italy are the large commercial ports, where there are large concentrations of waste, two examples are the Gulf of Naples and the port of the city of Ancona.

The situation in Lebanon is even worse and the few kilometers of coast of the country are invaded by garbage of all kinds due to bad management and lack of facilities. The areas particularly affected are the ports of Tripoli and Beirut. Just think that Beirut alone generates 3,000 tons of garbage per day that are in no way selected for recycling and often ends up in illegal landfills or directly at sea through rivers.



WATER ALWAYS FLOWS TO THE SEA

Most of the plastic in the sea originates in terrestrial environments from where it is transported through rivers, which are transformed into real "conveyor belts", moving plastic and other waste to the open sea.

Rivers collect both large plastic, which escapes collection and management systems, and microplastics. Microplastics can result from daily activities such as the use of body care products or detergents and from washing synthetic clothes. Unfortunately, the purification plants are able to retain only a part of the microplastics, the rest ends up **directly in the water streams**.

The retained part ends up in **sewage sludge**, which is used as fertilizers in cultivated fields. From there, through the action of rain and irrigation, the plastic fragments can be "washed away" and also end up in rivers and sea, in a real cycle of contamination.

PLASTIC TOURISM

In Italy, with its almost 8000 km of coastline as well as in Lebanon, seaside tourism is a very important economic activity, but which can generate, if not properly managed, many negative impacts on the territory. For example, it is estimated that the consumption of natural resources such as water and energy by a tourist during his stay in the resort is **10 to 100 times higher** than that of a resident. Moreover, the behaviour of tourists can damage the flora and fauna in a direct way, disturbing the natural activities of the species and devastating the vegetation. The development of tourism often leads to massive land consumption, taking land away from agriculture and traditional activities and changing the environment in a lasting way, with consequent alteration of ecosystems and disruption of migration routes.

The increase in waste production and the consequent dispersion in the environment, the increase in air pollution due to transport and the increase in noise pollution are other problems related to tourism. The damage not only affects nature, but also the tourism economy: an altered, ruined landscape, in addition to no longer playing its ecological role, loses intrinsic and socio-cultural value and in the long term will no longer be an attraction.

FISHERMEN: VICTIMS AND EXECUTIONERS

18% of plastics at sea come from marine activities. The maritime and fishing industry abandons, loses or disposes of equipment such as ropes, nets, traps, and in general fishing equipment that damages marine habitats and aquatic fauna, trapping and killing fish and other marine animals. This phenomenon is called "Ghost fishing". In the Mediterranean, plastic pollution and **ghost fishing** cause injury or death to seabirds (35%), fish (27%), invertebrates (20%), marine mammals (13%) and reptiles (5%).

A fishing line takes 600 years to deteriorate at sea and with nets it causes 65% of the entrapments in the Mediterranean.

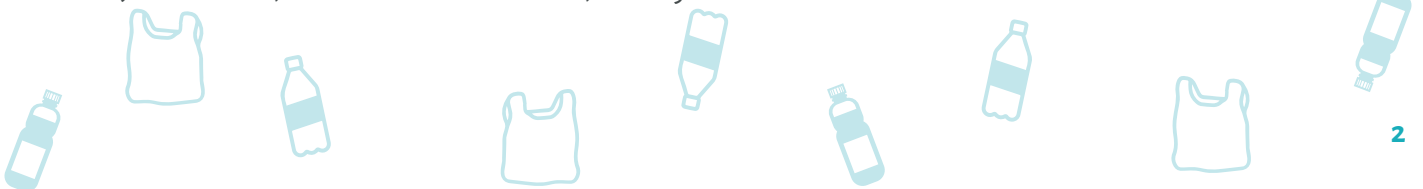
Fishing is not only one of the causes of plastic pollution, it is also a victim: plastic in the Mediterranean costs the sector about 138 million euros a year and, to Italy alone, 8.7 million a year. These costs are linked to repairs and maintenance of engines and boats, but also to delays due to the presence of plastic in the nets. Marine pollution reduces both the supply and demand of fish products, because of fewer catches and the death of many animals and because of consumer concern that fish are contaminated with plastic.

THE MOST POLLUTING CITIES

On the Mediterranean coast there are 150 million people, producing large quantities of **solid urban waste per capita, between 208 and 760 kg per person per year**.

Coastal areas contribute to **half of the plastic entering the Mediterranean Sea**.

In particular, some urban areas in heavily populated coastal areas are those that contribute most to the pollution of the Mediterranean: the Turkish region of **Cilicia** has the highest level of coastal pollution in the Mediterranean, followed by the coastal areas surrounding **Barcelona** and **Tel Aviv**. Other particularly polluting cities are **Valencia**, **Alexandria**, the coast around **Venice**, the bay of **Marseille** and **Beirut**.



In these areas of intense human activity on the coasts, large quantities of waste accumulate daily. The data you can read below shows how many **new kg of plastic** are added **each day in 1 kilometre of coastline** in each of these areas:

- **Cilicia (Turkey):** 31.3 kg/km per day.
- **Barcelona (Spain):** 26 kg/km per day.
- **Tel Aviv (Israel):** 21.0 kg/km per day.
- **Venice and the Po Delta (Italy):** 18.2 kg/km per day.
- **Valencia (Spain):** 12.9 kg/km per day.
- **Alexandria (Egypt):** 12.7 kg/km per day.
- **Algiers (Algeria):** 12.2 kg/km per day.
- **Bay of Marseille (France):** 9.4 kg/km per day.
- **Izmir (Turkey):** 7.2 kg/km per day.

"PLASTIC ISLAND": There is also in our sea

Also appeared in the Mediterranean Sea, precisely between the Island of Elba and Corsica, a "Garbage patch" (a real accumulation of floating garbage), similar to the most "famous" present in the Atlantic and Pacific Oceans. Unlike these, the "plastic island" of the Tyrrhenian Sea has a **"periodic" formation** because the currents of the Mediterranean Sea have a seasonal trend that causes its formation and disintegration. Some areas of this cluster contain more than 1.25 million plastic fragments per km². The most abundant plastics are those that come from our everyday objects: polyethylene, polypropylene, polyamide, polyvinyl chloride, polystyrene. To make the discovery were the researchers of the "Institut français de recherche pour l'exploitation de la mer", who explained its formation through the study of the north-western Mediterranean currents: these move along the Tyrrhenian coast and, at the height of the Island of Elba, they move towards Corsica, accumulating waste in the diversion area for several kilometers.

MICROPLASTICS

Microplastics are all fragments smaller than 5 mm that may originate directly at sea, following the degradation of larger plastics, be produced by industry (such as pellets, exfoliating agents or additives of soaps, creams, gels, toothpastes, etc.) or accidentally generated, for example, by tyre dust or the use and washing of synthetic fibre clothing.

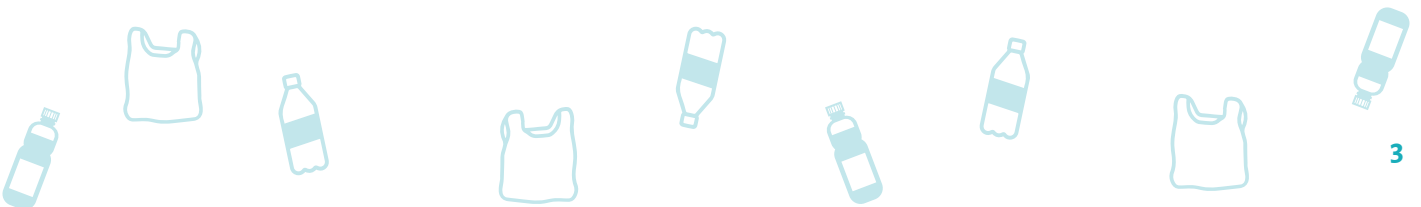
Despite being "micro" they have a huge impact on marine life and not only: in fact, they are ingested by marine animals and thus **enter the food chain**, reaching a large number of animal species and man himself.

Plastic in the sea, including the most microscopic fragments, in addition to already containing additives and potentially harmful substances, **behaves like a sponge and absorbs from the water the contaminants present**, such as pesticides and phthalates, which it then releases into the stomach of the body that ingests it. 78% of these contaminants are toxic, and accumulate in animal tissues. **Between 70 and 130 thousand tons of microplastics end every year in the Mediterranean Sea** and in the seas of Europe.

In our sea 134 species are victims of plastic ingestion. Zooplankton also feeds on plastic fragments smaller than 1 mm. Fibres and microplastics have also been found in oysters and mussels with concentrations such that the average European consumer of molluscs can reach up to 11,000 micro-fragments per year, from the latter alone.

However, the health effects of human exposure to microplastics are not yet known.

Microplastics, therefore, entering the environment and the food chain also reach us through multiple roads, contaminating our foods: microplastics have been detected in water, both tap and bottled, and in foods such as beer, the salt and honey.



MARINE ENVIRONMENTS MOST THREATENED BY PLASTIC

The Mediterranean is rich in biodiversity and its conservation is fundamental not only for the preservation of species and habitats, but also for the economy.

The entire Mediterranean Sea, as well as the oceans around the world, are threatened by human activities, but there are more fragile habitats, more precarious balances on which it is important to focus efforts.

Among the most interesting marine ecosystems certainly fall **the priority habitats identified by the European Habitat Directive 92/43/EEC, namely the SCI (Sites of Community Importance) and the SAC (Special Areas of Conservation)** established in each Member State to safeguard biodiversity.

Priority habitats and protected areas function as valuable **reservoirs of resilience** that can strengthen environmental balances and make them more adaptable to change, but at the same time represent **fragility on which greater attention must be paid**.

In the Mediterranean Sea have been recognized 16 habitats related to the marine environment, divided into:

marine and tidal habitats, sea cliffs and pebble or pebble beaches, Atlantic and continental flooded marshes and pastures, Mediterranean marshes and flooded pastures and thermo-Atlantic, halophilous internal steppes and gipsophile. Of these, 4 are given priority for the conservation of biodiversity:

DID YOU KNOW THAT?



HAVE YOU EVER HEARD OF RESILIENCE?

Resilience is the ability that a system (also understood as an ecosystem or a living being) has to respond to an external event finding its balance after it has been damaged.



POSIDONIA GRASSLAND



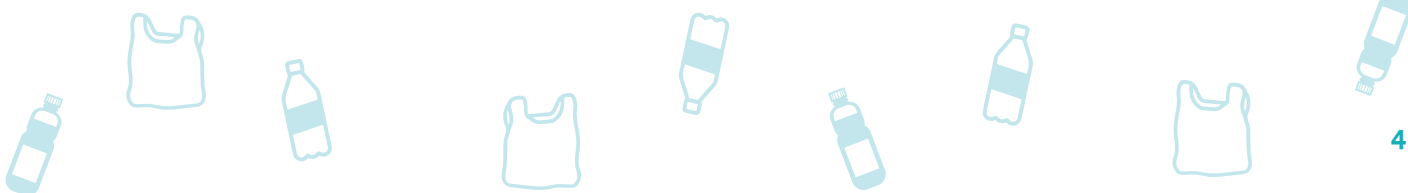
COASTAL LAGOON



INUNDATED CONTINENTAL PASTURE



MEDITERRANEAN SALTY STEPPES



Among these, the habitats most affected by the pollution are the posidonia fields, the coastal lagoons and the salty steppes, while the continental flooded pastures are not directly linked to the marine environment, which, although not coastal, are natural salty basins.

MARINE PHANEROGAMS: POSIDONIA OCEANICA

The impact of the plastic on the *Posidonia oceanica* affects the entire life cycle of the plant, from the submerged prairies, to the dead leaves carried by the wave motion on the beaches, where they form structures called "banquettes".

From an ecological point of view, posidonia meadows, "banquettes" and terrestrial vegetation slow down coastal erosion and constitute a natural habitat for many plant and animal species.

In the submerged part of the coast, the *Posidonia oceanica* is the key species of the Mediterranean marine ecosystem due to the abundant production of oxygen and biomass, essential in the trophic network and for the habitat.

Each leaf of Posidonia represents a micro world, with algae growing on it providing an additional micro-habitat to many other species such as micro-invertebrates and small fish that feed on it.

The root system of the plant develops in vertical and horizontal rhizomes, which interlocking hold and cement the sediment forming submerged terraces called "mattes". The leaves, to counteract the silting due to the normal processes of sedimentation, grow vertically for over a meter in the direction of light and dampen the strength of the wave motion. This is why the **structure of the prairie is a natural breakwater barrier**.

In autumn-winter, like the terrestrial plants, the *Posidonia* loses the leaves, which are transported by the tides close to the shore, where they form accumulations called "banquettes": **they too slow the action of the wave motion on the beach and, therefore, the coastal erosion**. Freshly formed, the "banquettes" consist almost exclusively of dead leaves intact, but the action of the wind and the mass of water causes it to mix with the sand particles: *Posidonia* closes its life cycle becoming an indispensable nutrient for the sand dune vegetation.

The Posidonia field is therefore a very important habitat to protect, nowadays seriously threatened by pollution, trawling, anchoring at anchor and works at sea.

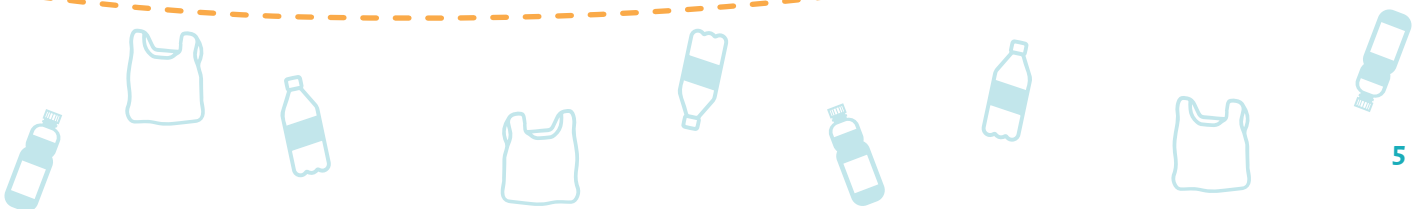
It is essential to inform operators in the tourist-bathing sector and bathers, to explain the ecological role of stranded vegetation and develop a greater tolerance of natural material stranded. It is precisely the ecological maintenance of sandy beaches that represents the umpteenth challenge linked to plastic: **plastic pollution affects the submerged posidonia fields and moves in autumn/late summer on the beaches with thousands of rubbish mixed with banquettes**. The plastic must then be separated from the plant material and placed in landfill or sent for recycling. This greatly complicates the conservation of a beach and increases its management costs, but there are several projects in Italy for the management of *Posidonia* residues on the beach.

DID YOU KNOW THAT?



WHAT IS A PHANEROGAM?

The **phanerogams** (marine in this case) are superior plants with visible reproductive organs (the flower), in fact this name comes from the Greek "manifest wedding". So *Posidonia*, even if it lives in the sea, is not an alga! It has roots, stem, leaves, flowers and makes fruits like a terrestrial plant, while the algae do not have a "body" (a botanist would say "thallus") differentiated.



SPECIES MOST THREATENED BY PLASTIC

The ingestion of the plastic has been documented in over 180 marine species: turtles, mammals and seabirds, invertebrates and fish. The ingestion of plastic waste causes suffocation, malnutrition and exposure to toxic substances contained or absorbed by plastic.

In addition, waste provides a means of transport for alien species that can reach new environments outside their natural borders, endangering biodiversity.

Among the many species to be protected and preserved, we highlight below the most significant for the Mediterranean.



TURTLES CARETTA CARETTA

The Calabria region hosts between 60 and 80% of the nests of *Caretta caretta* laid in Italy (including islands). Most of the broods are concentrated along the Ionian coast between Bianco and Melito di Porto Salvo, in the province of Reggio Calabria. This stretch of coast, also known as the Costa dei Gelsomini, is now recognized as the most important Italian reproduction area of *Caretta caretta*. In Lebanon the site of reproduction of this marine turtle is in the Marine Reserve of Tyre.

The presence of plastic on the beach hinders the movements of the female during the deposition and, above all, the path of the young towards the sea once they have emerged from the nest. Different is the situation in the open sea where plastics and microplastics can be ingested by turtles (or taken and bioaccumulated indirectly) causing several problems to the animal both in terms of intestinal obstructions and in terms of food poisoning. A recent study coordinated by the University of Siena (Italy) and conducted in the northern Tyrrhenian Sea on the turtle *Caretta caretta*, documents the ingestion of plastic waste in 71% of the individuals for whom the gastro-intestinal tract has been analyzed. In 22 samples, 483 fragments of marine litter were found, with an average of over 16 pieces per sample.



THE CETACEANS OF THE PELAGOS SANCTUARY

The Pelagos Sanctuary is the area with the highest presence of cetaceans in the Mediterranean. Studies by the WWF team have confirmed high levels of microplastic contamination and the presence of small plastic fragments in this area as well.

In addition to the potential ingestion of plastic and micro-plastics by whales and dolphins, these large predators are also victims of bioaccumulation. It is also sadly known how plastic kills directly: trapping and suffocating animals. 65% of the cases the cause of death of the cetaceans is of infectious origin, followed by environmental causes, that is the pollution, in which the plastic plays a fundamental role.



A GREAT MOLLUSC: THE NOBLE PEN SHELL (*Pinna nobilis*)

Among the most endangered species in the Mediterranean Sea there is definitely the *Pinna nobilis*. This bivalve mollusc endemic to the Mediterranean Sea, commonly called "noble pen shell", often lives in the prairies of *Posidonia oceanica*, from a few meters up to 40 meters deep. With its maximum length, it is the largest bivalve in the Mediterranean Sea. Victim of

collectors and pollution, since the 1950s its decline has been inexorable, up to the threshold of extinction.

Today its collection is prohibited, as a species of community interest that requires strict protection (it is included in Annex IV of the Habitats Directive). Beyond the status of protected species, being a filtering mollusc, it is extremely risky to eat it as it accumulates, absorbing them from the sea, large quantities of pollutants and pathogens. For this reason, it has been used as an indicator of marine pollution.



Its conservation goes hand in hand with that of the *Posidonia oceanica* and with the conservation of the sandy bottom habitat.



SEABIRDS

Images of seabirds dying from the ingestion of plastic waste or entrapment have travelled around the world and shocked and shook everyone's consciences. Unfortunately, little is known about the non-lethal effects of plastic ingestion.

Some researchers quantified and measured the plastic accumulated in the stomachs of 171 specimens of seabirds belonging to 9 different species in the period between 2003 and 2010 in the western Mediterranean area. The following species were found to be the most at risk: shearwaters (minor, major and balearic), booby, major dung and gulls (royal, coral, Mediterranean, tridactyl). The presence of plastic debris and waste on our beaches is also changing the habits of some species that have started to build their nests with plastic fragments.

Birds nesting in the sand dunes of beaches are particularly in danger. An example is a small limicolous bird: the friar (*Charadrius alexandrinus*) that nourishes of insects and small molluscs it finds digging in the sand. The nest of the friar is very simple: a hole in the sand, which usually houses three eggs. It chooses saline and muddy soils with little vegetation, close to the water but sheltered from possible floods. The presence of its nest is an excellent sign of the state of health of a marine environment and a properly protected and preserved beach. Nesting on the ground among the dunes, it is often the victim of the pollution of the beaches, especially in the summer period, when with the seaside tourism the abandonment of waste grows exponentially.

FOCUS: SCOPOLI'S SHEARWATER

The Shearwaters are tireless flyers, they can travel hundreds of kilometers, touching the 50 km per hour of speed, they can stay at sea for weeks, even for months without ever touching the ground. It was their characteristic call to inspire the ancient myth of mermaids. The greater shearwater is one of the most extraordinary birds of the whole Mediterranean and its flight needs to be protected, also by the plastic.

Among the birds, in fact, the greater shearwater is the species most affected by plastic ingestion (94%) with the highest percentage of plastic particles detected in the stomach (from 15 to 24 particles on a total mass of stomach contents of 24/50 mg); follows the shear minor (70%) whose levels found are referable to (up to 8 particles on 42/100.0 mg mass); the shear balearic 70% (with 3/4 units on 5/10 mg). The study on shearwaters focused on the amount of plastic introduced by the animal found: no distinctions were made between the characteristics of the plastic, the sex of the birds or its particular physical conditions. Some sources cite a figure: in 2050 99% of seabirds will have a diet that includes plastic. But what causes the ingestion of plastics and microplastics if it does not lead directly to death? Researchers at the Institute for Marine and Antarctic Studies are investigating the long-term consequences. In particular, they have conducted a study on a particular species: the Shearwater *Ardenna carneipes* analyzing blood and plastic samples of the population living in Lord Howe Island. The researcher who conducted the study, Jennifer Lavers, explains that «The populations of *Ardenna carneipes* are decreasing throughout the south-western Pacific Ocean and the south coast of western Australia. Plastic ingestion is implicated in this decline, but the mechanisms by which it affects shearwaters are little understood». It emerged that the birds that ingest plastic have suffered a reduction in blood calcium levels, body mass, wing length and head and beak length. The presence of plastic also damages the kidney function of birds.

The study showed that the mere presence of plastic is sufficient to cause negative consequences, regardless of the amount, suggesting that any plastic ingestion is sufficient to have an impact. Understand how individual seabirds are affected is complicated by the fact that most deaths occur at sea where they are not visible or where carcasses are soon consumed by opportunistic predators.



SHARKS TO BE SAVED

The fact of being predators at the top of the trophic net does not only make sharks fearsome predators in the collective imagination, but also a kind of "accumulation basin" of chemical and solid pollutants that are at sea and, in fact, among the most frequent victims of ingestion or harmful interactions with plastic.

In literature, not many studies deal with the interaction between plastic and sharks in the Mediterranean. Among these there is one published by a research group of the Universities of Genoa and Siena (Italy), which has for the first time analysed the plastic ingested by sharks, with a focus on the *Prionace glauca*, a species classified by the IUCN (International Union for Nature Conservation) "in critical danger" in the Mediterranean. Analysis showed that a quarter of the sharks caught in the Pelagos Sanctuary had ingested microplastics and macroplastics, mostly sheets of "cellophane". The phenomenon seems to affect more young specimens.

The data is alarming for the impact of plastic debris with a key role in the food network.

Another study, examining young specimens of blue shark caught in the Mediterranean and in the Atlantic, has evidenced the frequent presence of rings and bands of plastic entangled on the back, at the gills with serious consequences on their ability to feed and breathe.



JELLYFISH EAT PLASTIC

Plastic has something in common with jellyfish: it behaves like them, being carried passively by the current. It is therefore in all respects a new planktonic element that adds to the marine ecosystem... damaging it!

The jellyfish that spend a lot of time in the midst of plastic vortices, are probably led to use their stinging tentacles to catch false prey "made of plastic".

Although it is known that jellyfish are able to recognize a prey from an inedible object thanks to the tentacles, an Italian/Russian team of researchers has documented how several Pelagiidae (*Pelagia noctiluca*) observed and photographed off Ponza's Island, had in the stomach cavity, not only among the tentacles, pieces of plastic.

DID YOU KNOW THAT?



WHAT IS PLANKTON?

Plankton is often believed to be just a microscopic organism or, much more simply, "what whales eat". In reality, "plankton" means everything that "does not know how to swim", but is carried passively by the current. Therefore, algae, different microorganisms, larvae, eggs, jellyfish (large and small) and even... plastic are part of the plankton



DID YOU KNOW THAT?



PHENOMENON OF "PLASTICRUST"

Although not in the Mediterranean, this strange phenomenon deserves to be included among the points of interest for plastic pollution, because it is a completely new type of pollution borne by the marine ecosystem. The discovery was made by a group of Portuguese researchers from the "Marine and Environmental Sciences Centre" in Coimbra who, in 2016, observed strange colored encrustations on the volcanic cliffs of Madeira Island.

From the analysis, it emerged that in three years the crusts had passed from a single sighting to cover almost 10% of the rocky surface, and the subsequent chemical analysis of the material revealed that it was polyethylene (PET), the type of plastic used for food containers and bottles. Probably the encrustations originated from the crash of large pieces of plastic on the rock. The "plasticrust", in Madeira, is gradually replacing the biological incrustations on the rocks, surfaces on which marine organisms, such as barnacles and sea snails live.

Research has not yet identified other sites where the phenomenon has been observed, but understanding more is important to assess its impact on the marine environment.

SOURCES AND INSIGHTS



-  [Discovering Posidonia Oceanica meadows - YouTube \(English\)](#)
-  [Inquinamento: nei Paesi del Mediterraneo 24 milioni di tonnellate di rifiuti in plastica l'anno - YouTube \(Italian\)](#)
-  [Lebanon's Litani River faces environmental crisis - YouTube \(English\)](#)
-  [الشاطئ ملوث - Lebanon's sea is polluted - YouTube \(Arabic\)](#)
-  [Special Report: Lebanon's pollution crisis - YouTube \(English\)](#)
-  [Cleaning up Lebanon's coastlines - YouTube \(English\)](#)

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