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Communication

Marine Pollution by Microplastics in the Mediterranean Sea

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Abstract: Worldwide, the waste of plastic debris into the sea is becoming a great environmental problem with serious health effects for mankind. Going in detail, in the Mediterranean Sea there is a concealed threat represented by microplastics that, through bio-accumulation processes, within the trophic net of marine ecosystems, produces high pollutant loadings in some edible species, causing severe risks for human health. In the basin, the load of microplastics comes mainly from three coastal regions as are Egypt, Turkey and Italy in decreasing order. Therefore, it is necessary to reduce the production and the use of plastics investing money in research planning and strengthening any kind of human efforts to solve this new kind of marine pollution.

Keywords: Mediterranean Sea, microplastics, bio-accumulation

The waste of plastic debris into the sea is, actually, a great environmental problem and it is becoming an incoming "world crisis" since it is everywhere from water surfaces to ocean ditches [1]. Scientific literature values an overall amount of plastic waste in marine environments variable from 86 to 140 million tons concentrated in five oceanic hotspots, nicknamed "plastic islands" distributed as follows: two in the Pacific Ocean, two in the Atlantic and one in the Indian [2]. Indeed, there is a sixth "garbage patch", invisible and concealed into the Mediterranean Sea, mainly composed by microplastics, which are sub-microscopic particles between 5.0 mm and 0.1 µm in diameter. By this way, according to updated analysis, 229.000 tons of plastic leakage flow yearly into the Mediterranean waters [3] and, actually, more than 1 million tons of plastics is widespread in the basin, representing a serious risk for marine ecosystems [4] and for human health [5]. Amongst the Mediterranean countries, about 70% of this heavy loading comes from three regions as follows: 43.1% Egypt, 19.1% Turkey and 7.6 % Italy (Figure 1), as highlighted by World Wild Fund Report 2019 [6].

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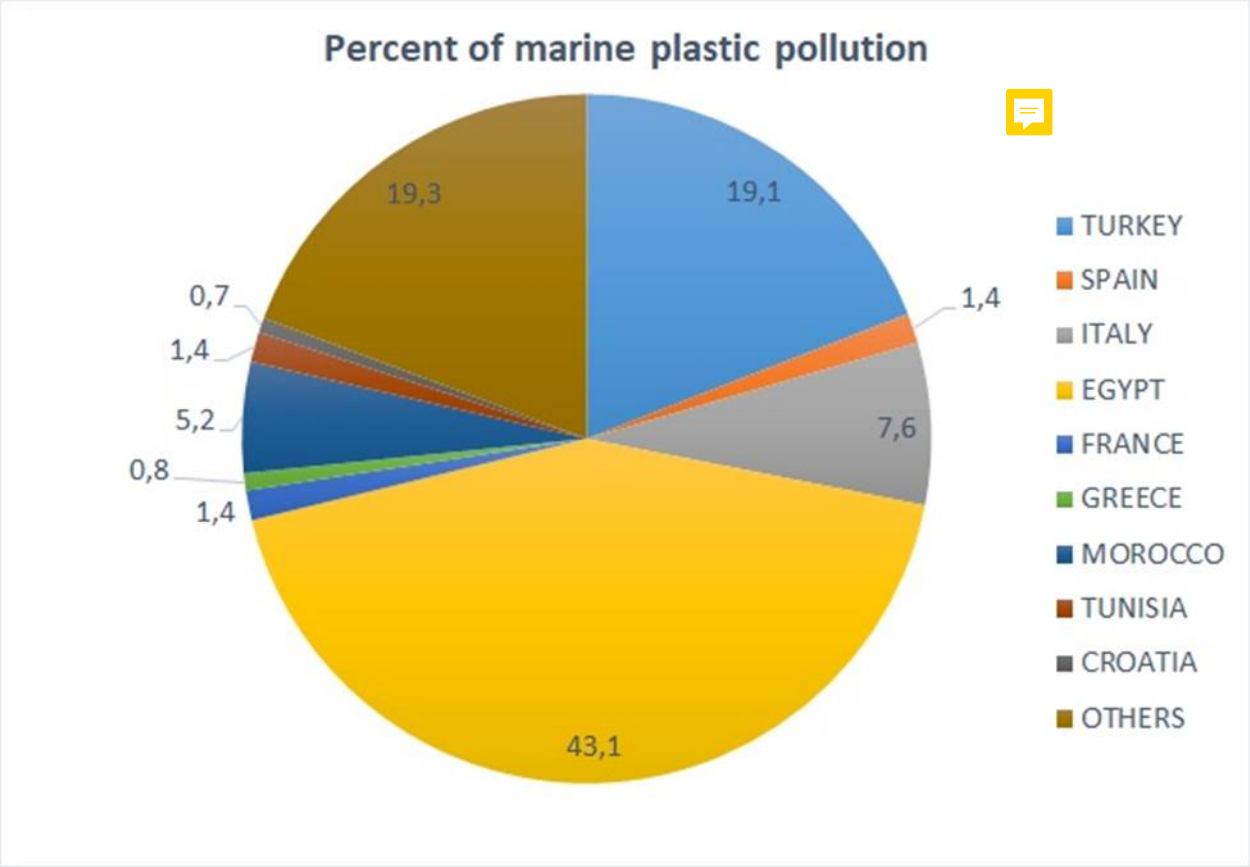

Figure 1. Rate percent of plastic leakage into the Mediterranean Sea.

In particular, it has been value loading rate of microplastics variable from 5% to 10%, concentrated in the Mediterranean Sea, in r d to the global one widespread in the Ocean waters [7]. It has been estimated that this heavy environmental loading could reach on 20 year an amount of 2.576 tons [8]. So, microplastics, although spread in every aquatic environment [9,10], show in the basin a concentration about four times than the global one [11]. Besides, these micro-particles tend to increase proceeding from coastal waters to pelagic ones [12], so that it could be possible to suppose a process of concentration by microplastics from coastline to the open sea. From an ecological point of view, it is established that the extreme threshold bearable by marine biota is 120,000 fragments for m3 but this limit has been already exceed in some "hot spots" of the Western Mediterranean Sea [13], as the marine waters close to the Tuscan Archipelago (Tyrrhenian Sea, Northern Italy) [14]. Indeed, this new kind of marine pollution conceals a serious threat for the good functioning of marine ecosystems. In fact, the sub-microscopic particles of this plastic debris enter the trophic system since the first steps of the marine food chain represented by planctonic biomass [4,15]. Then, these polluting fractions move in the next steps of the scale from herbivores to carnivores up to predators through a process of bioaccumulation in a decimal logaritmic increase proceeding step by step along the trophic chain (Figure 2).

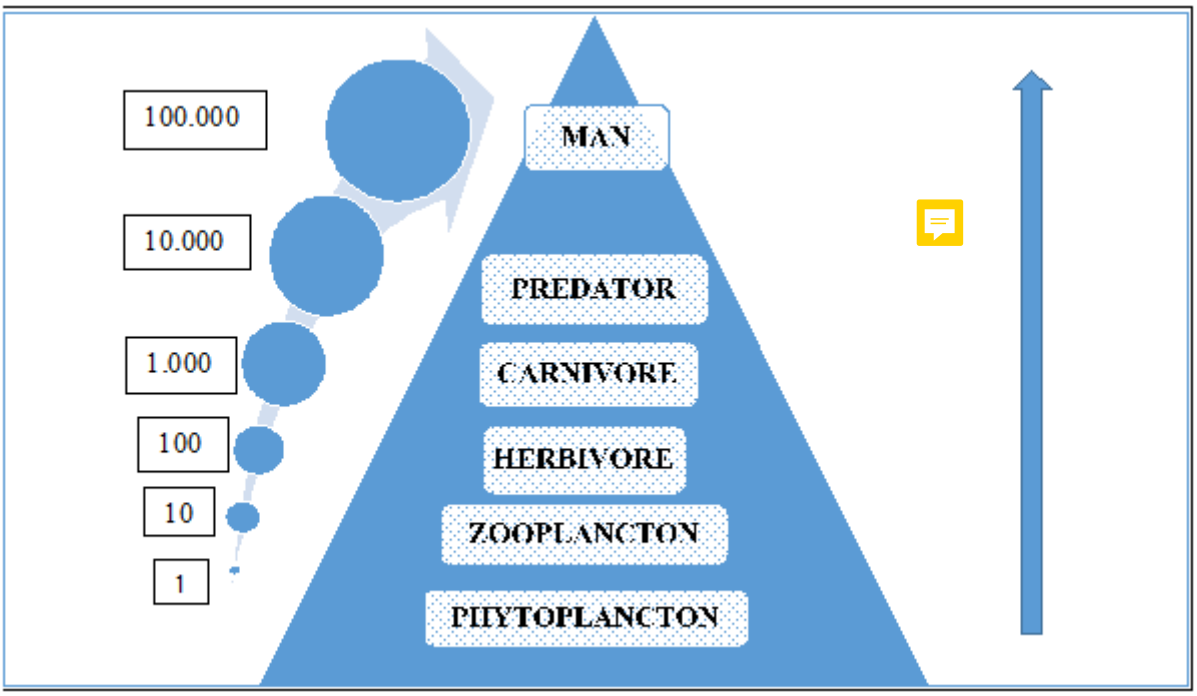

Figure 2. Pyramidal trophic chain of marine ecosystems.

According to a report issued by World Wild Fund [11], in the Mediterranean biota there are 134 faunal species threatened by the presence of plastic waste in their stomachs with the following rates: 35% birds, 30% fishes, 20% invertebrates and 15% marine mammals. In particular, the bioaccumulation rates of microplastics in the digestive systems of the most important marine target species are the following ones: marine turtles (35%), sword fishes (19%) and tuna fishes (18%). Therefore, such process of biological concentration produces high polluting loadings especially in some edible species of high commercial value [16], causing serious risks for the public health [17]. In this critical state, it could be envisaged an international agreement, legally binding all the Mediterranean countries, based on the following statements [18]:

1. Avoid plastic wasting in natural environment.
2. Develop national plans effective for the prevention, the control and the removing of plastic litter from marine environments.
3. Ban plastic products being a real risk for the presence of disposable plastic waste.
4. Prevent the discharge of plastics into rivers and freshwaters.
5. Establish a scientific international commitee specialized on plastic pollution.

Anyway, the solution of this environmental problem must be realized at the source, reducing the production and the use of any kind of plastic. In conclusion, it is necessary to invest money and energy in researching plans to set up effective countermeasures aimed to solve this new type of marine pollution.

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