COMPOSITION AND SPATIAL DISTRIBUTION OF MARINE LITTER ALONG THE ROMANIAN BLACK SEA COAST

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ABSTRACT

During the last years, marine pollution with anthropogenic litter has become a worldwide major environmental concern that has no simple solution. Black Sea Romanian coast is also affected by marine debris and thus, Mare Nostrum NGO started in 1999 to monitor beach marine litter and in 2014 to apply the beach litter monitoring methodology included in "The Guidance on Monitoring of Marine Litter in European Seas", a guidance document within the Common Implementation Strategy for Marine Strategy Framework Directive, covering Romania's compulsoriness to monitor Descriptor 10 – Marine Litter for beaches. The surveys covered 8 sectors, totaling 41547 m^2 of beach. Marine litter was classified in 8 categories and 157 types. The results exhibited predominance of artificial polymer materials (80.6%); the most common litter found on the Romanian beaches was the cigarettes butts, reaching 18 836 items. Marine debris left on beaches for a long time is a danger to birds and other animals that can ingest them. Moreover, there is a risk that their decomposition will release harmful pollutants to human health; litter as syringes, diapers, pads are carriers of pathogens. Unless appropriate measures are undertaken to address this problem, the abundance of marine litter in the area is likely to increase.

Key-Words: Romanian Black Sea coast, marine litter, beach monitoring, MSFD

AIMS AND BACKGROUND

The Black Sea is one of the most isolated inland seas in the world and its waters are used for shipping, fishing (along with a limited amount of aquaculture), mineral exploitation, tourism, recreation, military exercises and for liquid and solid waste disposal. In addition, the seabed and the catchment area are under permanent pressure from other human activities, including urban development, industry, hydro-

and nuclear energetic, agriculture and land-improvement. It is generally acknowledged that the Black Sea and its coasts are subjected to high levels of solid wastes pollution[1], although very few special studies of its extensiveness, sources and patterns have yet been made. There are very limited data regarding the quantities and composition of marine litter in the Black Sea.

Marine litter is defined as "any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment"[2]. The issue has been highlighted by the United Nations Environment Program[2] and was included in the 11 Descriptors set by Europe's Marine Strategy Framework directive (2008/56/EC) (MSFD)[3]. The MSFD requires each Descriptor in all European marine waters not to deviate from the undisturbed state and reach Good Environmental Status (GES) by 2020.

Besides the unquestionable aesthetic issue, litter can be mistaken for food items and be ingested by a wide variety of marine organism. Over 267 animal species are known to suffer from entanglement and ingestion of marine debris, including 86% of sea turtles, 44% of seabirds, and 43% of marine mammals. The Black Sea receives the drainage from a 1.9 million km^2 basin covering about one third of the area of continental Europe[4]. For this reason, the Black Sea is very vulnerable to pressure from land-based human activity. The overloading of the Black Sea marine and coastal environment with marine litter constitutes one of the most urgent and difficult environmental problems in the region, extending over the entire catchment area of the drainage basin[1].

In order to have a better overview of the problem, Mare Nostrum started in 1999 to monitor marine litter and since 2014 applied the methodology included in "The Guidance on Monitoring of Marine Litter in European Seas", a guidance document within the Common Implementation Strategy for Marine Strategy Framework Directive.

EXPERIMENTAL

According to the monitoring requirements of the MSFD, in Article 11 (1) it is specified that "on the basis of the initial assessment made pursuant to article 8 (1), Member States shall establish and implement coordinated monitoring programmes for the ongoing assessment of the environmental status of their marine waters on the basis of the indicative lists of elements set out in Annex III and the list set out in Annex V, and by reference to the environmental targets establish pursuant to Article 10."[5]

The beach litter monitoring methodology used is included in the "Guidance on Monitoring of Marine Litter in European Seas", a guidance document within the Common Implementation Strategy for Marine Strategy Framework Directive, covering Romania's compulsoriness to monitor Descriptor 10 – Marine Litter for beaches. Monitoring of litter on the coastline quantify and characterize litter pollution and provide comparable datasets to support national and regional assessments of marine litter. Consequently it provides the basis for the development of management, control and enforcement measures and allows the effectiveness of mitigation strategies to be measured. It should also help us to understand the level

of threat posed by marine litter to biota and ecosystems[6].

The EC Decision of 1st September 2010 on criteria and methodological standards on good environmental status of marine waters established that the characteristics of litter in the coastal environment should be evaluated. The evaluation should allow for the assessment of trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, special distribution and, where possible, source[7].

For this study were selected 8 sites having a length of 100, there where is possible, with clear access to the sea and accessible to survey teams year round. These cover the whole area between the water edges to the back of the beach.

The Romanian sampling sites are:
-   Vama Veche, S: 43°44′51.9″N 28°34′42.6″E, N: 43°44′54.9″N 28°34′41.2″E; area – 2012 m^2 (Fig. 1);
-   Saturn, S: 43°50′01.1″N 28°35′26.5″E, N: 43°50′04.4″N 28°35′26.5″E, area – 9200 m^2 (Fig. 2);
-   Costinești, S: 43°57′14.4″N 28°38′24.5″E, N: 43°57′17.8″N 28°38′26″E, area – 1540 m^2 (Fig. 3);
-   Eforie, S: 44°02′42.8″N 28°38′43.9″E, N: 44°02′46″N 28°38′42.9″E, area – 2902 m^2 (Fig. 4);
-   Constanța, S: 44°11′35.3″N 28°39′18.6″E, N: 44°11′38.6″N 28°39′18.4″E, area – 10 963 m^2 (Fig. 5);
-   Mamaia Nord, S: 44°16′48″N 28°37′18.7″E, N 44°16′51.2″N 28°37′18.5″, area – 7806 m^2 (Fig. 6);
-   Năvodari, S: 44°18′33.2″N 28°37′48.9″E, N: 44°18′36.2″N 28°37′50.3″E, area – 3302 m^2 (Fig. 7);
-   Corbu, S: 44°22′00.2″N 28°42′15.4″E, N: 44°22′03.2″N 28°42′17″E, area – 3822 m^2 (Fig. 8).

Fig. 1. Vama Veche.

Fig. 2. Saturn.

Fig. 3 - Costineşti.

Fig. 4 - Eforie.

Fig. 5 - Constanţa.

**Fig. 6** - Mamaia Nord.

Fig. 7 - Năvodari.

Fig. 8 - Corbu.

The survey periods are: Spring, in April and Autumn, in October. All the items on the sampling units are entered on the survey forms. On the survey forms, each item has a unique identification number. The survey forms were adapted for the Romanian beach situation. There is no upper size limits to litter recorded, but was established a lower limit of 2.5 cm, being included the caps and lids and cigarette butts in any counts. The litter is removed and disposed of properly and the larger items are marked and photographed.

RESULTS AND DISCUSSION

The 8 sampling units covered 41 547 m^2 and had a relative degree of cleanliness, avoiding the very clean and the very dirty ones. In this way, the data are representatives and can be extrapolated for the whole seaside. Marine litter was classified in 8 categories and 157 types. Starting from 2014, when Mare Nostrum NGO begun to monitor the sampling units, the results exhibited predominance of artificial polymer materials (80,6%) (Fig. 9).

Abundance of marine litter
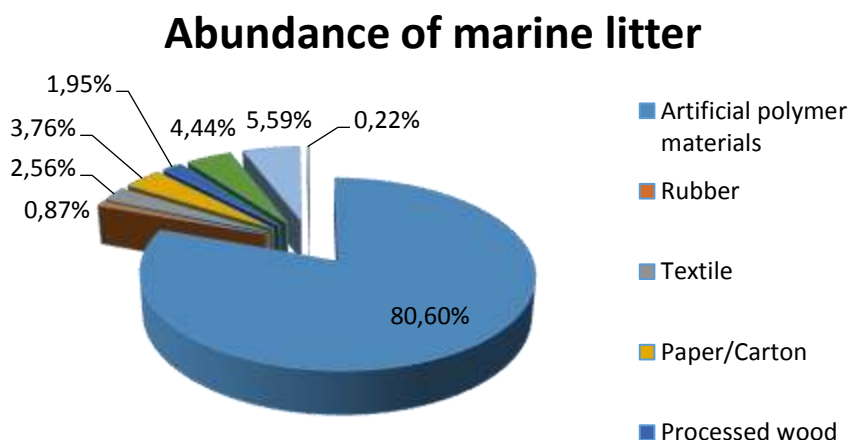
**Fig. 9.** Abundance of marine litter.

The dirtiest year was 2016 (April and October) with 31 060 items identified and eliminated, being followed at a considerable distance by 2017 (9003 items), mentioning the fact that these items were recorded just in April.

The dirtiest sector is Constanța, with 10 983 items, followed by Năvodari (7 793) and Mamaia Nord (7 436). At the opposite pole, we have the sampling units from Corbu (2 580) and Vama Veche (2 050) (Fig. 10).
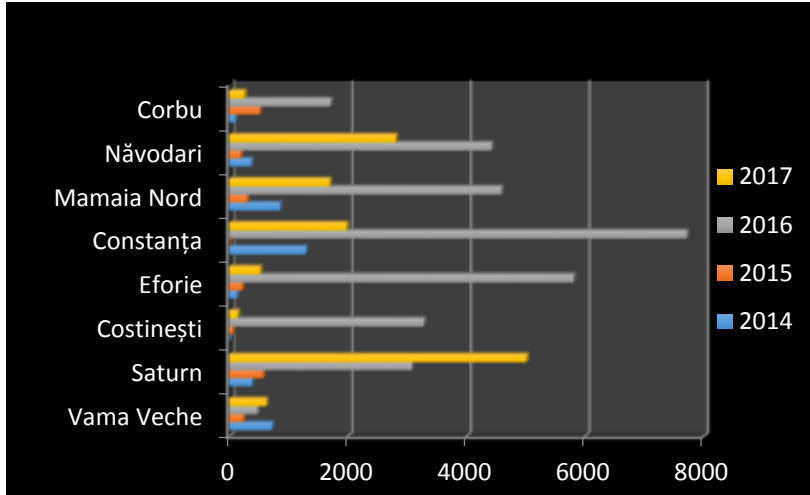
Fig. 10. Marine litter situation at the Romanian seaside.

The most common litter registered was the cigarette butt, reaching 18 836 items. Constanța is the sector that rank first at this category, with 8 382 cigarette butts, followed by Eforie (3 679) and Mamaia Nord (1 856). Most of the recordings took place in 2016, with 16 295 records (Fig. 11, 12, 13). Each cigarette contains more than 3 900 chemicals, including nicotine, cyanide, ammonia, cadmium, acetone and arsenic. Cigarette butts contain the toxic residue of these. Studies have shown that even one cigarette butt put in a liter of water with fish killed about half of the exposed fish[8].
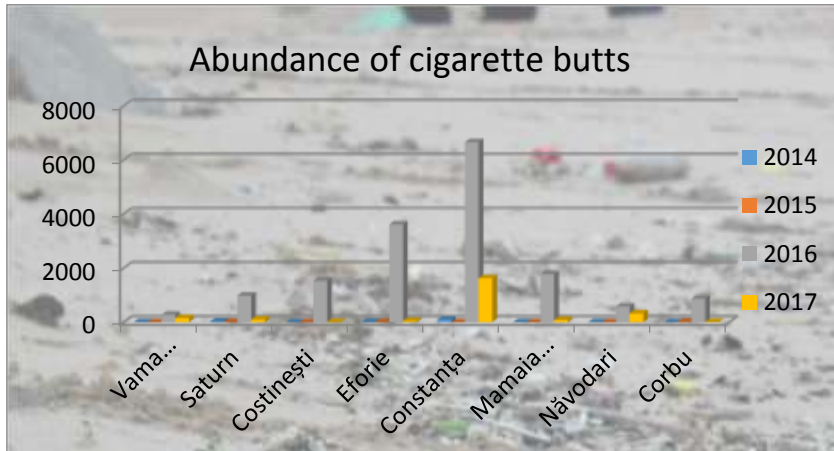
Fig. 11. Abundance of cigarette butts.

Fig. 12. Cigarette butts on the beach.   **Fig. 13.** Inventory of butts.

Besides cigarette butts, among the common items were plastic packs, straws and sticks for mixing, lids, but also bags, plastic bottles, food containers, ear stick, foam/sponge, etc. Then, were recorded some uncommon elements, but that carries various pathogens: syringes, fresheners for toilets, plums, diapers, medication blisters, condoms and their packing, shaving devices (Fig. 14).

Fig. 14. Medical waste.

In terms of the component of the other categories, litter such as paper glasses, food packing, lamps, tax vouchers, paper napkins, faience, bricks, different processed wood, cans, etc. were recorded during monitoring.

The removed items were weighted and we reach a total of 932 kg of marine litter and the Mamaia Nord occupies first place at this category.

CONCLUSIONS

In the last four years, Mare Nostrum NGO monitored, twice per year, 8 sampling units, totaling 41 547 m^2, representing approximately 1.50% of the total beach areas on the Romanian seaside. The total number of items of marine litter was 46 024. The dirtiest year was 2016, with more than 30 000 items identified and removed and the dirtiest sector, Constanta. Artificial polymeric materials (various

varieties of plastic) predominated each year and the most common waste was cigarette but (Fig. 15).

Fig. 15. #plajecurate.

Marine debris left on beaches for a long time is a danger to birds and other animals that can ingest them. Moreover, there is a risk that their decomposition will release harmful pollutants to human health. Litter as syringes, diapers, pads are carriers of pathogens. Unless appropriate measures are undertaken to address this problem, the abundance of marine litter in the area is likely to increase. Just as multiple initiatives are needed to tackle the marine litter problem, diverse approaches are required to monitor the abundance of marine litter and how this affect marine environments.

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