



Short communication

First observations on the abundance and composition of floating debris in the North-western Black Sea

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ABSTRACT

The occurrence of marine litter in the Black Sea region is poorly known and even less data have been reported on the abundance of floating debris. Here we present results from a ship-based visual survey carried out in the North-Western part of the Black Sea, providing the first preliminary data on the characteristics of floating debris in Romanian waters. High litter densities peaking to 135.9 items/km² were found in the study area (mean 30.9 ± 7.4 items/km²). Probably due to the proximity of the Danube delta, natural debris were on average, much more abundant than anthropogenic litter in most surveyed locations (mean 141.4 ± 47.1 items/km², max 1131.3 items/km²). Most of the 225 objects we sighted consisted of pieces of wood and other riparian debris (75.5%), however plastic items remained undoubtedly the most abundant type of litter, representing 89.1% of all sighted man-made items. The Black Sea is not exempt from the global invasion of floating debris, however data are still lacking and a basin-wide survey is urgently needed to identify accumulation areas and develop regionally effective solutions to the problem of marine litter.

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1. Introduction

The ubiquitous presence of anthropogenic litter in the marine environment is now recognized as one of the most pervasive pollution problems affecting the world's oceans (Barnes et al., 2009; Eriksen et al., 2014; UNEP, 2009). Yet, the spatial coverage of the global survey effort is still markedly uneven, and in some regions, litter occurrence, abundance and distribution have been so far only scantily investigated. The Black Sea is one of these areas. Preliminary observations from local NGOs, governmental and private institutions seem to suggest pollution levels as heavy as the rest of the world seas (BSC, 2007; CIESM, 2014). However a systematic monitoring activity has not been carried out yet, and reliable scientific data are still scarce (UNEP, 2009; Kershaw et al., 2013).

Here, we briefly present results from a ship-based visual survey of floating macro-debris (>2 cm size) conducted in the north-western part of the Black Sea, with the main goal of providing a first snapshot on the local abundance and distribution of floating litter. Such data, apart from raising public awareness, are urgently

needed to develop regionally valid and effective solutions for managing litter pollution in the entire Black Sea basin (BSC, 2009). Moreover, collection and dissemination of these data represent a first contribution to Black Sea monitoring under the guidelines required by the EU to achieve Good Environmental Status in European Waters by 2020 (Descriptor 10), as outlined under the Marine Strategy Framework Directive (MSFD 2008/56/EC).

2. Methods

The visual survey was conducted on board R/V Mare Nigrum during the research cruise CoCoBLAS 2014 (24–29 June 2014) run within the EC Project CoCoNet. The study area was located off the Romanian coast in the north-western part of the Black Sea, between the Danube delta and the port of Constanta (Fig. 1). As recommended by the Black Sea Commission (BSC, 2007), densities of floating debris were estimated using the line transect methodology (Buckland et al., 2005). Observations were all made by the same observer during daytime navigation (mean speed 7 knots) and in good weather conditions only (i.e. wind speed <20 knots). The observer surveyed the sea surface from the bow of the vessel (~4 m above sea level) and recorded size, type, position and perpendicular distance of all floating macro-debris (>2 cm) sighted on the ship

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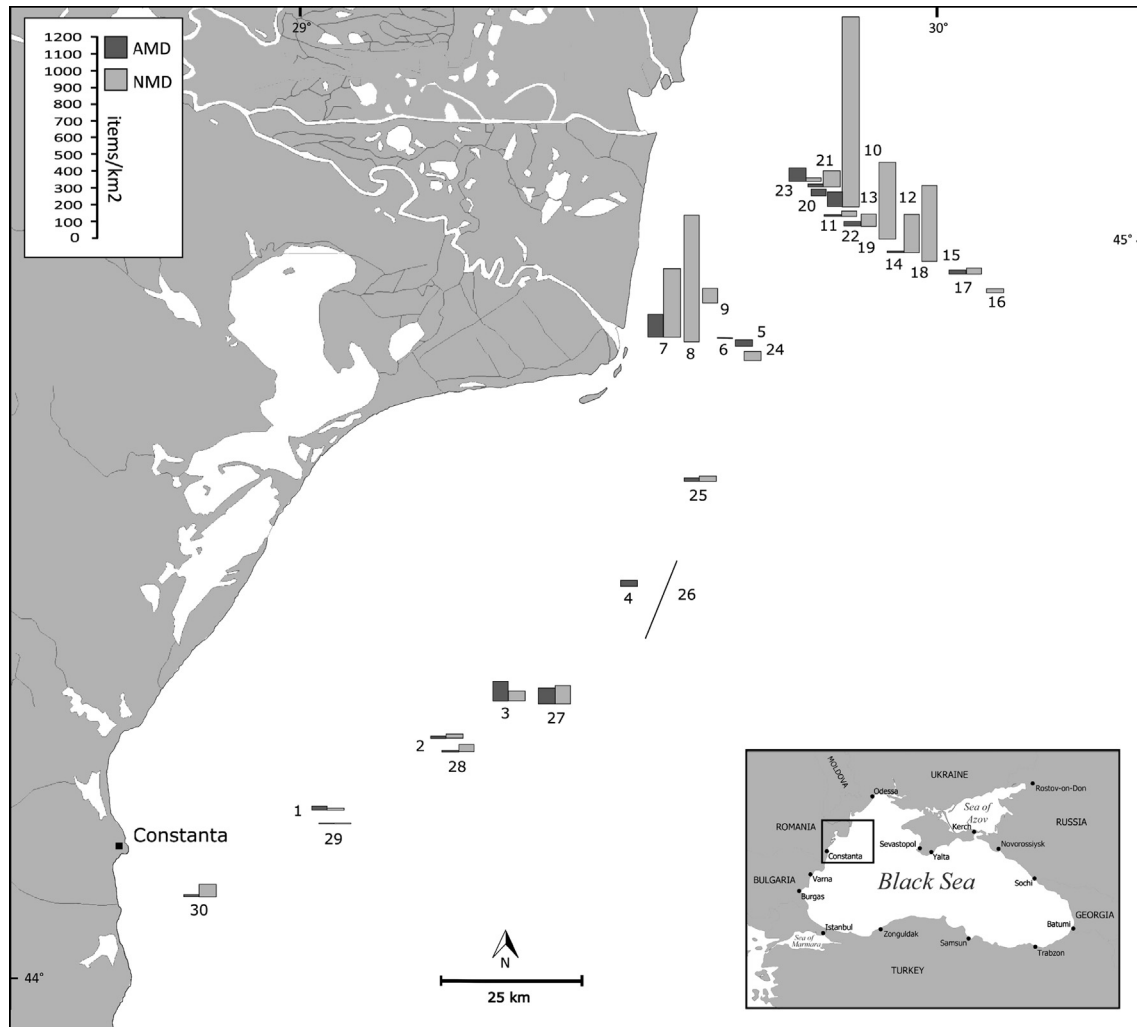


Fig. 1. Map of the study area (North-western Black Sea) showing the distribution of AMD (dark bars) and NMD (light bars) densities (expressed as number of items/km²) in all surveyed transects. Solid lines without bar plot represent transects where no floating items were detected.

side opposite to the sun position. 7×50 binoculars were used to check identification of distant objects. Length and duration of transects slightly varied according to the ship operational schedule (mean duration time 28.1 ± 13.1 min). The distance sailed by the ship during each transect was calculated from GPS start and stop positions (mean length 6.2 ± 3.9 km). The record of every sighted item was then allocated to one of two major type categories: Anthropogenic Marine Debris (AMD) and Natural Marine Debris (NMD). AMD was further subdivided into styrofoam (expanded polystyrene), plastic (mainly fragments, plastic bags, bottles and containers) and others (e.g. manufactured wood, aluminium cans, rubber strips, glass bottles, paper and cardboard). NMD instead was classified as wood (mainly logs, trunks, branches and canes), algae (mainly branches of *Cystoseira* spp.) or others (e.g. dead insects, leaves, flowers, seeds and bird feathers). AMD and NMD densities (expressed as number of items/km²) were computed over an area defined by the transect length and the Effective Strip Width (ESW) calculated through Distance Sampling analysis (Buckland et al., 2005) as reported in Suaria and Aliani (Suaria and Aliani, 2014). The ESW depends on the distance distribution of all items sighted along the ship track and takes into account the reduction of information due to increasing distance from the observer. During this survey, most objects were sighted within the first 10 m from the vessel (95% confidence interval 9.6–12.4 m) and an ESW of

10.93 ± 0.69 m) was obtained. Therefore this value was used for density calculations (i.e. the length of each transect was multiplied for an ESW of 0.011 km in order to obtain the effective surveyed area). Spearman's non-parametric correlation coefficient was used to test for significant correlation between the abundance of natural and anthropogenic debris across the study area. Results from AMD and NMD density calculations are reported in Table 1 and plotted in Fig. 1 for better visualisation.

3. Results and discussion

3.1. Abundance and composition of floating debris

A total of 30 visual transects were performed during the cruise, covering an overall survey length of 186.62 km. 225 floating items were sighted in the study area, the vast majority of which (75.5%) were natural objects (namely pieces of wood, canes, flowers, leaves, seeds, sedges, rushes and others typical riparian vegetation debris). Natural debris were on the whole, much more abundant than man-made litter in most surveyed locations, showing an average density of 141.3 ± 47.1 debris items/km² and maximum densities peaking to 1131.3 items/km² in front of the Danube delta. Litter densities were significantly lower and man-made items represented only 24.5% of all sighted objects. A mean of 30.9 ± 7.4 AMD items/km² and a

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