

PRELIMINARY STUDY ON THE EMERGING MARINE LITTER PROBLEM ALONG THE EASTERN COAST OF LESVOS ISL., GREECE

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Abstract

A preliminary study has been undertaken on the assessment of the extent of littering of the coastal waters of eastern Lesvos isl. A UAV was used combined with diving and underwater camera drops for ground-truthing in two areas of different environmental conditions. The results show that litter concentrations varied along the coastline in terms of their distribution over the dry beach and the nearshore seabed. Areas with poor or no access show small quantities of litter on the dry beach but extensive littering on the nearshore seabed. The seabed off cliff coasts was found to be full of diverse litter probably due to local hydrodynamics. Specialized geophysical equipment are needed for the quick and precise detection of the deeper-seated debris so as to implement clean-up and protection actions.

Keywords: Aegean Sea, Mapping, Coastal waters, Pollution

Introduction - Methodology: In the last year, the Greek islands of the eastern Aegean Sea have been the main entrance points used by refugees arriving in the EU. The crossing of the straits between Turkey and the Eastern Aegean Sea islands is carried out using mostly small inflatable boats but also wooden and plastic vessels of various sizes; these are abandoned at the beaches upon arrival together with other items such as lifejackets, inflatable tubes and clothing. In beaches with good access, most of the litter is removed by regular clean-ups of the "dry" beach. Some of these items remain on site (both sub-aerially and at the nearshore seabed) and may progressively fragment into smaller pieces making their removal much more difficult at a later stage. Some of these items will inevitably end up either buried in the nearshore seabed or as floats dispersing in the Aegean Sea. Sunk boats can also cause significant short- and medium-term pollution due to their bunker oils or even by highly toxic chemicals as some of the outboard engines have been found to be powered by large batteries. It has been estimated that the associated litter amounts to about 8 tons per 1000 arrivals [2]. Although there is no specific study on the impacts of this type of coastal litter, there have been many reports in the scientific literature on the impacts of marine litter on biodiversity, economy and human health [1,3]. Economic costs of marine litter are associated with actual expenditure for beach cleanups, damages to or loss of fishing gear and boat motors, welfare costs, loss of revenue from tourism and fishing and losses associated with the deterioration of coastal landscape aesthetics [4]. The objectives of this preliminary study were to assess: (i) the extent of this new type of marine litter problem along the eastern coast of Lesvos; and (ii) the efficiency and cost-effectiveness of new technologies to provide quick, accurate and quantitative assessments of the marine litter distribution. Following visual inspection/recording of the marine litter problem along large stretches of the eastern and northern coast of Lesvos, 2 pilot areas (Kratigos and Tsonia) representing diverse coastal environments in terms of physiography and accessibility and also characterized by large number of arrivals, were finally selected for further investigation. Kratigos beach is close to the city of Mytilene (approximately 10Km) and easily accessible by car. Tsonia is an isolated coastal stretch, parts of which are accessible only by boat. The pilot surveys were carried out using aerial images collected by a Vertical Take-off and Landing (VTOL) quadrotor configuration (UAV) and they were validated by underwater "ground truth" data. Five autonomous survey missions were carried out: 2 for video-producing and 3 for beach surveying. HD videos were produced, whereas the beach survey image resolution (GSD – Ground Sample Distance) was set to 2.96cm. Geo-referencing of ground control points was by an RTK GPS. A series of dives and underwater camera drops operated from a shallow-hull boat were undertaken in order to identify 'ground truth' targets selected from the UAV imagery.

Results and Discussion: UAV imagery from Kratigos beach showed large quantities of litter on the dry beach and, particularly, on the nearshore seabed. This area, which is associated with a large number of arrivals, is easily accessible and the dry beach litter is regularly cleaned by volunteers, NGOs and the municipal refuse service. However, this is not the case with

the nearshore seabed, which appears to be very significantly polluted by a variety of litter including plastic parts and outboard engines of sunk inflatables as well as plastic containers and discarded lifejackets and clothing. In Tsonia area although there was substantial littering on the dry beach, the nearshore seabed has shown to be quite litter free (at least down to water depths of 3 to 4m), with the major exception of a partially submerged shipwreck. It must be noted that this beach is not easily accessible by cleanup operators, which may explain the proliferation of the "dry" beach litter. Nevertheless, as there has been no record of a cleanup operation of the nearshore seabed, the apparent absence of litter in a shallow submarine part of a beach may suggest that they have either been buried under the nearshore sediments or, more likely, moved offshore (in deeper water depths), where would be undetectable by aerial imagery; it might also be possible that the litter has been dispersed along the neighboring coast. In order to answer this question both the offshore waters and two neighboring areas were surveyed by divers and underwater camera drops. These surveys showed that there are significant amounts of litter both in the deeper waters (down to water depths of about 10m) as well as on the nearshore seabed suggesting alongshore transport of the litter due to hydrodynamic processes (waves and currents); here, there is no landing beach as the coast is formed on steep coastal cliffs. Our results suggest that an integrated effort should be undertaken as soon as possible to efficiently remove the underwater litter before this results in irreversible degradation of the coastal environment/waters of the eastern and northern coast of Lesvos, where most of the sea arrivals are concentrated, with very detrimental long-term consequences for the local economies through cleanup expenditures and large losses of income (from tourism and fishing). Urgent and well planned action is required to avert a long-term environmental and socio-economic disaster at the Eastern Aegean Sea islands facing the same problems. UAV surveying proved to be a very accurate, efficient and low cost method to obtain the geo-spatial information needed for quantifying the litter problem along the coast that is a prerequisite for the efficient planning/implementation of remediation responses. However, the results showed that for deeper than 3-4m waters additional sea surveys are required using specialized echosounding (side scan sonars, multi-beams) and visual inspection (ROVs) equipment.

References

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