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## Illegal immigration in the eastern Aegean Sea: a new source of marine litter

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### Abstract

The maritime area dominates the current increasing wave of illegal immigration to Europe. The Greek islands of the eastern Aegean Sea are the main entrance points of immigrants arriving from the coasts of Turkey. Immigration to the Greek islands is mainly conducted with inflatable boats, which are abandoned upon arrival along the coasts together with other items such as life-jackets, inflatable tubes, and clothing. This novel type of marine litter dominates many beaches and becomes increasingly abundant. Two beaches in Lesvos Island were surveyed for marine litter, and immigration-related items were found to account for more than 97% of marine litter by weight. Immigration-related littering adds pressure on marine biodiversity and the local economy, impacting the recreational value of beaches.

**Keywords:** Immigrants, refugees, marine litter, marine pollution, Greece, Mediterranean, Turkey, tourism.

### Introduction

The number of displaced persons in the world is constantly rising mainly because of war, conflict, and persecution at their home countries. Europe is close to many war zones leading to a massive inflow of immigrants. Land borders used to be the main pathway of immigration in the European Union since the 2000s but due to the strengthening of land borders and checks on specific crossing-points, such as along river Evros in the Greece-Turkey borders, it is now the maritime area which dominates the current wave of illegal immigration (Giuliani, 2015). According to the United Nations High Commissioner for Refugees (UNHCR; [www.unhcr.org](http://www.unhcr.org)) the number of immigrants (mainly refugees) arriving in the Greek islands continues to rise, averaging 1,000 people daily during the summer (UNHCR, 2015). Since the beginning of 2015, 77,100 people have arrived to Greece (as of 3 July) of which almost 60% are refugees from Syria.

The Aegean Sea is now the main crossing point for illegal immigrants (UNHCR, 2015). The islands of the eastern Greece close to the Turkish coast, especially the islands of Lesvos, Chios, Samos, Leros, and Kos, are the ones most severely affected. One recent technique applied by criminal networks of Turkish and Greek traffickers to transfer immigrants to the Greek islands is based on the use of small, fast inflatable boats. After completing their trip, most of these inflatable boats are abandoned along the coastlines of the Greek islands and are soon destroyed and shred into pieces by the waves. Immigrants wear lifejackets or inflatable tubes, which they abandon on arrival at the coast. As the immigrants often have to walk for many kilometers to arrive at a police station to get registered, they often abandon on the coast or along their way part

of their clothing to reduce the weight they carry. In some other cases, when these inflatable boats are intercepted by the coast guard, the immigrants rip the boat to make it sink and force the coast guard to rescue them instead of forcing them to turn back.

Hence, huge amounts of “novel” marine litter appears along the coastlines, on the seabed, or floating on surface waters of many eastern Aegean islands, consisting mainly of inflatable boats (intact or in pieces), life jackets, plastic tubes, and clothing (Fig. 1). In many beaches, these items dominate the composition of litter, and as they are very large (especially in the case of the remains of inflatable boats) greatly reduce the aesthetic and recreational value of the beaches besides their ecological impacts.

Surveys of litter on beaches are a primary tool for monitoring the load of litter in the marine environment. Counting the number of individual items provides the best, easiest and cheapest information for formulation of management measures, and is an approach that has been used world-wide to quantify and describe marine litter pollution (Galgani *et al.*, 2011). To quantify the amount of marine litter due to illegal immigration, beach surveys were conducted in two sites along the coastline of Lesvos Island. Both were pebble beaches, the first (Site A: 39.015N, 26.612E) located at the southeastern part of the island, and the second (Site B: 39.376N, 26.290E) at the northern coastline. Disembarkation of immigrants was very frequent on site B, while it was less common on site A.

At each site, a 100-m long beach stretch was surveyed from the tide line to the back border of the beach. All litter items found on the beach were registered, using a standard list of items, and counted. The mass of the litter items was estimated by collecting and weighing all small items, rep-

representative samples of medium-sized items (e.g., life-jackets) and by an online investigation of the specifications of the very large items (i.e., inflatable boats).

The items directly or most probably related to illegal immigration accounted for the 24.6% and 65.4% of the total number of litter items found in sites A and B respectively (Table 1). However, many of the litter items related

to illegal immigration were heavy (life-jackets, clothes, shoes) or very heavy (inflatable boats), and thus the contribution of immigration-related litter in terms of mass was much higher, exceeding 97% in both sites (Table 1). Life-jackets were the most abundant items (283 pieces) in site B, while styrofoam was the most abundant item in site A (40 pieces). In terms of mass, inflatable boats dominated



**Fig. 1:** Life jackets, tubes and clothing abandoned by illegal immigrants on arrival along the coast (A, B). A pile of litter mainly consisting of life jackets, tubes, and remains of inflatable boats after a beach cleanup (C). The remains of inflatable boats along the coast (D, E). Huge piles of immigration-related litter collected after beach cleanups in northeastern Lesvos (F). Surveyed site B (G). An inflatable boat sunk on a seagrass (*Posidonia oceanica*) bed, at 5 m depth, ~100 m off the coast (H). All photos are from Lesvos Island (Greece). The land seen in the background of photos C and D is Turkey.

**Table 1:** Number of marine litter items and their estimated mass in two beaches along the coastline of Lesvos Island.

	site A (100 x 7 m)		site B (100 x 9 m)	
	No of items	estimated mass (kg)	No of items	estimated mass (kg)
<b>Litter directly related to illegal immigration</b>				
inflatable boats, intact	2	244.00	8	976.00
inflatable boats, pieces	-	-	5	170.00
life-jackets, intact	8	4.33	283	153.10
life jackets, pieces	14	0.63	19	0.75
plastic tubes	1	0.62	48	29.66
fuel tank	1	4.54	-	-
fuel cable	1	0.65	-	-
<b>sub-total</b>	<b>27</b>	<b>254.77</b>	<b>363</b>	<b>1329.52</b>
<b>percentage of grand total</b>	<b>15.8%</b>	<b>95.8%</b>	<b>56.8%</b>	<b>96.7%</b>
<b>Litter most probably related to illegal immigration</b>				
clothes	12	3.64	36	11.17
backpacks	-	-	3	3.64
shoes	3	0.93	16	5.46
<b>sub-total</b>	<b>15</b>	<b>4.57</b>	<b>55</b>	<b>20.27</b>
<b>percentage of grand total</b>	<b>8.8%</b>	<b>1.7%</b>	<b>8.6%</b>	<b>1.5%</b>
<b>Litter most probably unrelated to illegal migration</b>				
plastic bottles	37	1.11	54	1.62
plastic caps	3	0.00	6	0.01
plastic bags, intact	7	0.06	24	0.19
plastic bags, pieces	6	0.02	20	0.06
plastic pipes	-	-	3	0.24
ropes	5	0.55	5	1.12
fishing lines	1	0.07	-	-
styrofoam	40	0.18	28	0.14
baloons	5	0.06	2	0.02
diapers	-	-	19	0.87
other plastic items, large	6	3.15	5	8.24
other plastic items, small	5	0.03	37	0.44
aluminum cans	2	0.03	3	0.05
cigarette packets	3	-	3	-
cartons	3	0.08	2	0.05
other paper/cardboard	3	0.02	4	0.04
wooden items	1	1.12	3	12.23
other	2	0.12	3	0.21
<b>sub-total</b>	<b>129</b>	<b>6.60</b>	<b>221</b>	<b>25.52</b>
<b>percentage of grand total</b>	<b>75.4%</b>	<b>2.5%</b>	<b>34.6%</b>	<b>1.9%</b>
<b>TOTAL</b>	<b>171</b>	<b>265.94</b>	<b>639</b>	<b>1375.31</b>

in both sites, followed by life-jackets. Among items non-related to immigration, plastics dominated, as is common on Mediterranean beaches (Galgani, 2014).

In popular beaches, most of the immigration-related litter is removed by regular clean-ups. However, in many other beaches these items remain for long and may progressively fragment into smaller pieces (Thompson *et al.*, 2004), making their removal at a later stage much more difficult. Many of these items will end up on the seabed (see Fig. 1H) or will remain floating on surface waters, with important consequences for marine life (Katsanevakis, 2008; Deudero & Alomar, 2015). Large items on the seabed such as plastic pieces from inflatable boats (Fig.

1H) can cause substantial damage to flora and sessile fauna by smothering, while smaller pieces can impact marine life through entanglement, ingestion or even by assisting the secondary spread of invasive species (Katsanevakis & Crocetta, 2014). Marine litter is a serious affront to the visual and other aesthetic sensitivities of tourists and local visitors to beaches, and may also be a cause of injuries (Katsanevakis, 2008). Tourists tend to avoid beaches with high marine litter concentration, with important consequences on the local economy. The cost of regular clean-ups of beaches and the seabed but also of terrestrial areas should be added to the total cost of immigration-related littering for the local economy.

The total daily amount of litter due to illegal immigration (assuming ~1000 immigrants daily) is estimated at ~8 tonnes. In the Mediterranean Sea, where a few hundreds or thousands tonnes of plastic enter the ocean daily from waste generated on land (Jambeck *et al.*, 2015), illegal immigration appears as a marine litter source of low overall significance (taking also into account that most of the litter is recovered). However, locally this type of litter can dominate and its impacts on the economy and the environment are significant.

The issue of marine litter appears of less importance in comparison to the drama of the millions of refugees and the social implications of large-scale immigration in recent years. Nevertheless, the ecological and economic impacts of immigration-related marine litter are not negligible, and proper mitigation measures are urgently needed. The marine and coastal environment of the Mediterranean Sea is already heavily impacted by cumulative impacts (Bianchi *et al.*, 2012; Micheli *et al.*, 2013), and any new pressure should be properly evaluated and confronted, to protect marine biodiversity and sustain the flow of marine ecosystem services.

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