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## The generation of marine litter in Mediterranean island beaches as an effect of tourism and its mitigation

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With a coastal population of nearly 150 million inhabitants, the influx of freshwater from densely populated river catchments and a contribution to 30% of the global shipping activity, the Mediterranean Sea has been recognized as one of the world most affected areas by marine litter. Moreover, the countries surrounding the region yearly attract about one third of the world tourism. Taken together, these pressures make this semi-enclosed sea an accumulation zone for marine litter. This high contamination goes hand to hand with a stream of adverse effects to marine ecosystems, public health or socio-economic costs. The beaches are one of the main land-based sources for litter to enter the oceans. The Mediterranean Sea is not an exception as during the summer, the beaches are a hotspot for leisure. This is particularly true for the Mediterranean islands, which due to their attractiveness will host a far greater population during the summer. In this study we evaluate the seasonal variation of marine litter as an effect of tourism on sandy beaches of Mediterranean islands and we assess the effectiveness of pilot actions in order to reduce the amount of marine litter.

147 surveys were conducted in 2017 during both the low and high touristic season. For each of the eight participating islands (Mallorca, Sicily, Rab, Malta, Crete, Mykonos, Rhodes and Cyprus), three different beaches were selected: a touristic beach, a beach mainly used by locals and a remote beach. For each beach, a periodic monitoring was performed on the same fixed 100m portion. Here, any item found was collected, characterized and properly disposed of. We included the mesoplastics (0.5 – 2.5cm), large microplastics (0.1 – 0.5cm) and pellets (raw plastic material). In 2019, a monitoring of 11 of the selected beaches was conducted following the implementation of pilot actions (mainly awareness campaigns). To test their effectiveness, the results are compared to those of 2017.

Our results show that tourism in Mediterranean island beaches is a main driver of marine litter generation. Popular beaches (touristic and locals) are clearly the most impacted sites. Every day, during the high touristic season peak (July-August), visitors will leave (i.e.: cigarette butts, drink can, etc.) or generate (i.e.: MePs and MPs) 950 – 1190 items on every 100m of beach. This amount falls to 60 items for the remote beaches. At the region scale, we estimated that during July-August, visitors could be responsible for the accumulation of about  $47.5 \cdot 10^6 \pm 13.5 \cdot 10^6$  items/day on the

beaches of the Mediterranean islands.

The awareness campaigns is an efficient tool to reduce the amount of litter generated by visitors on the beaches. We observed an average decrease of 52.5% of the accumulation of the items abandoned by the visitors after the implementation of the pilot actions. These encouraging results probably benefit from the growing attention of the public to the plastic pollution issue. However, this reduction has a price: the average cost of the pilot actions for the whole high season would be of 111.6 k€ per km of beach.