**2. Research**

Our group conducted some literature search in order to identify how researchers have been trying to monitor coastal pollution and find the problems associated with it. Several studies have reported the abundance of plastic as a coastal litter through survey and citizen science. A 12-year dataset on coastal debris pollution in Taiwan using Citizen science also revealed that most debris items found were plastic (Walther et al., 2018). 19 categories of debris items were collected during the clean-up events. The five most commonly recorded debris categories were plastic shopping bags, plastic bottle caps, disposable tablewares, fishing equipment, and plastic drinking straws. There have been many other studies around the world regarding littering of the shores. A study in Western Japan and eastern coasts of Russia found out that 55% to 93.4% of items over the Japanese shores were plastic. The second most abundant item was resin pellet, which is a form of plastic too. For the eastern Russian coast plastic items were also the most abundant ~55% litter, with plastic fragments being the most abundant within the plastics category. The composition of litter was similar in the two countries, although the concentration of plastics was much higher in Japan (Takashi Kusui a,\*, Michio Noda, 2003). Further on the Asian upper east, hard plastic and Styrofoam were the dominant plastic types on Korean beaches. On average, hard plastic and Styrofoam comprised 32% and 48.5% (by number) of the total debris, respectively.

In an older study over the region of Caribbean the most common types of debris stranded on the Caribbean coast of Panama were plastic and Styrofoam, with plastics being household or consumer related. Styrofoam packing materials were also abundant, and may have come from trans-shipment activities of Colon's Free Zone, as well as from household trash or from offshore (STEPHEN D. GARRITY and SALLY C. LEVINGS, 1993). A recent annual study (2016/2017) on 8 beaches in Tenerife in Canary island also found that plastic was the most abundant litter. They also reported that there were more accumulated plastic debris in remote beaches compared to the beaches near the city indicating that more debris were transported by tides. More long term study is required to look at the changes in the results reported over time. (Reinold et al., 2020).

As one may easily observe there are quite a few variations in terms of how studies over litter accumulation have been conducted. The variation has to do with the time span of the research, the part of the beach from which litter was collected, as well as the categorization of littering. This creates a problem when researchers want to compare different studies. The problem basically amounts to assessing changes in accumulation rates and composition, trends over time and the effectiveness of management systems, a hard task without good monitoring methodologies. Although monitoring of marine litter is currently carried out within a number of countries around the world, the methods of survey and monitoring used tend to be very different, preventing comparisons and harmonization of data across regions or time-scales.

This is why the scientific community has been trying to create some common ground which has led to some initiatives joined by many countries worldwide. One of them and probably the most important one is the International Clean Coast (ICC) program which is a new, long-term approach for cleaner beaches by various activities to increase public awareness.

(Chesire et al. 2009). This initiative aimed at a comprehensive litter characterization scheme to be developed that uses both material composition and form. This allows Litter Monitoring Repeated surveys of beaches, sea bed and/or surface waters to determine litter quantities such that information can be compared with baseline data to see if changes occur through time and / or in response to management arrangements.

The ICC uses some specific developed categorizations of coast litter, with the most accepted one being the Clean Coastal Index (CCI) protocol, which is very useful, in terms of simplicity and information provided, allowing comparison between different times and places. The CCI protocol is very different from most others having a focus on operational clean-up of beaches as well. The CCI is suggested as a tool for evaluation of the actual coast cleanliness. It measures plastic debris as a beach cleanliness indicator, in an easy way precluding bias by the assessor. The CCI also proved to be a useful tool for measuring progress and the success of activities to raise awareness among the general public (Alkalay, Ronen & Pasternak, Galia & Zask, Alon. (2007)

A study in Israel followed the CCI protocol and found out that plastic is the most ubiquitous beach litter item. An important contribution of this study has to do with comparing its findings with other Mediterranean beaches showing that plastic might be the dominant pollutant, though non-plastic litter is highly specific to the region and cannot be treated universally. (Marine litter from beach-based sources: Case study of an Eastern Mediterranean coastal town M.E. Portman, R.E. Brennan / Waste Management). In another study on litter pollution in a region of India, once again the CCI protocol for the categorization of litter was followed. Once again plastic was the main source of litter ~45%, with plastic bags topping the index at ~33%, followed by food wrappers and then plastic cups. Cigarettes/cigar tips were scarcely found amounting to only 5.5%. (Kumar, et al.,2016). The use of the common protocol in these two studies allows for researchers to compare their findings and create common plastic pollution models, even though the two coasts are continents apart.

Another study conducted at the other side of the Mediterranean, in Cadiz, found that plastic bottles/containers were the most frequent items followed by plastic bags. This research points out that surveys are heavily affected by clean-ups performed at beaches. (Distribution of beach litter along the coastline of Cádiz, Spain (Williams et al., 2016). Even though this study reaches to some important conclusions on ways to clean coasts the correct way, it cannot be easily compared, or its conclusions easily applied even with the case of the study in Israel, which is also in the Mediterranean.

We can clearly see that there have been many studies done to monitor marine pollution using various different ways. One of the cost effective and easy method is the use of citizen science where the public can easily record any observations of marine litter. As discussed above, records without proper guidance could be unreliable. The Marine Debris Tracker (MDT) Initiative was started from 2010 in North America. This allowed anyone to record the marine debris observation through a mobile application. The only report using the data from this app is the original report by Tablada (2018) where data analysis was done on the data of 8 years and mainly focused on North America which also concluded that plastic was the main type of debris that was recorded with cigarettes being the top litter. Given the literature above, our group went on to work with a world-wide coastal littering dataset from the MDT website spanning a timeframe of a decade with an interest to see if its findings match the above: be it if plastic is the most abundant litter, within the plastic categories which are the most important subclasses found and could there be a way to computationally monitor the coastal littering problem. For this we followed the CCI categorization of litter.

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issn = "0025-326X",

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keywords = "Beach cleaning, Citizen science, Coastal conservation, Marine anthropogenic litter, Marine macro-debris, Plastic pollution",

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Characteristics of meso-sized plastic marine debris on 20 beaches in Korea

Jongsu Leea, Jongmyoung Leea,⁎, Sunwook Honga, Sang Hee Hongb,c, Won Joon Shimb,c,

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