Plastic and anthropogenic debris mapping and modeling

Hargun Kaur
San Diego State University
Geography Department
Mentor - Dr. Trent Biggs
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Abstract

The increasing use of plastic is having a detrimental impact on the environment. It has been a major source of pollution specifically to water bodies. This research addresses the issue of marine debris in the water bodies. It discusses the source of trash. This paper also analyzes the surveying methods of trash data from the San Diego River Park Foundation.

Introduction

Marine debris is human-made litter that has been released into natural water bodies. Marine debris is said to be unsafe for marine organisms as well as human health (Iniguez., et al, 2016). Over 1,400 marine animal species have been found to suffer adverse effects as a result of marine litter (Galgani., et al, 2018). The number of species that are known to have ingested or become entangled in marine anthropogenic litter doubled from 267 to 557 species between 1997 and 2015 (Woods., et al, 2021). Marine litter causes economic threats as well. (Newman., et al, 2015). In 2017, 348 million of plastic pollution were produced and the largest producer of it was China (Barcelo and Pico, 2020). Through rivers and coastlines, 80 percent of the world's ocean plastics enter the ocean (Ritchie, 2021). The remaining 20% originate from marine sources like fishing fleets, ropes, and nets (Ritchie, 2021). It is estimated that rivers currently release between 1.15 and 2.41 million tonnes of plastic waste into the ocean annually, and most of the emissions occur between May and October (Lebreton et al., 2017; Schmidt et al., 2017). After storms,

debris, microbes, and other pollutants are washed into urban rivers and toward the coast, deteriorating the water quality along the Southern California coastline (DiGiacomo et al., 2004). These pollutants create pollutant plumes that can extend several kilometers offshore (DiGiacomo et al., 2004).

The San Diego River (SDR) is polluted by urban stormwater runoff and litter and waste flushed into river canyons by a large homeless community. According to data from the 2010 United States Census, approximately 520,000 people live in the San Diego River Watershed (Project Clean Water). The watershed is plagued by a number of pollutants brought on by humans due to its dense population (Project Clean water). These pollutants have the potential to have a negative impact on how locals, business owners, and tourists use and interact with water bodies (Project Clean Water). San Diego River Park Foundation is an organization that is involved to improve SD river conditions by doing clean-ups. They also collect data for trash collection. For instance, the location, pictures, material, and quantity of the trash found along the SD river floodplain. For reducing the amount of litter going into the Oceans via the river, it is important to understand the trash load coming into and out of the river and the amount of trash that is buried and never mobilizes. The surveying techniques for collecting trash data is very essential in order to get a better understanding of the quantities of trash ending up in the oceans. Currently, the SDRPF volunteers go around the SD river floodplain and trace their path using the app ‘Mappler’ and also collect information about the coordinates of the places where heaps of trash are present. In order to compute the input and output trash load, it is necessary to compute the percent area of the San Diego floodplain that has been surveyed. The purpose of this paper is to analyze the San Diego River Park Foundation surveying techniques. The research question of the paper is “What

is the area of the San Diego River floodplain being surveyed while collecting the trash data by San Diego River Park Foundation volunteers?”

Methods

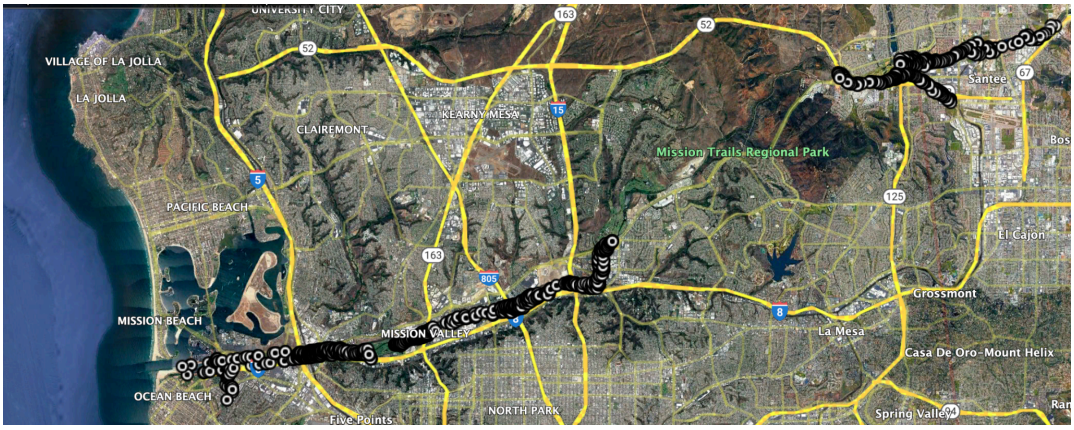


Figure 1.1 Showing the whole survey area with trash collection coordinates.

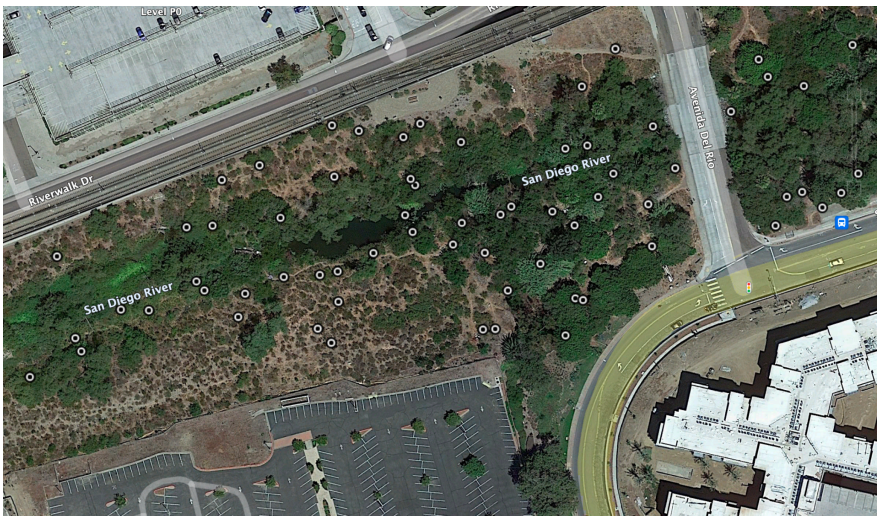


Figure 1.2

First, the coordinates of the trash collection data were visualized in Google Earth Pro. In figure 1.1, those coordinates can be seen as white dots. Figure 1.2 shows the zoomed-in image of one of those survey areas with the trash collection data points.

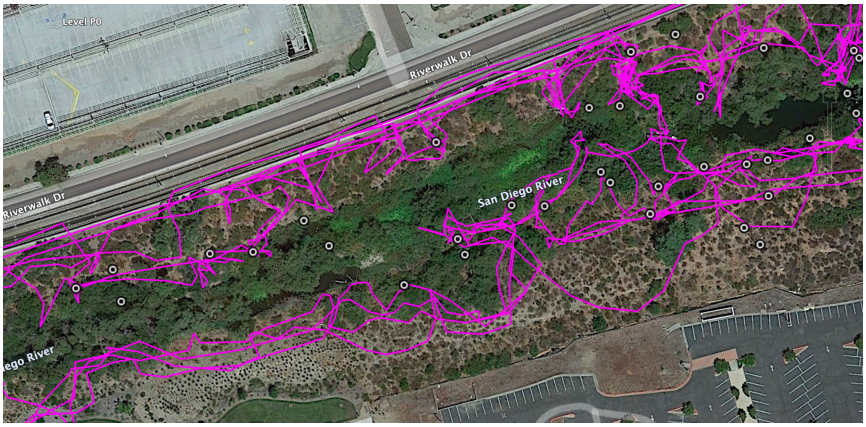


Figure 1.3

Transect data XML file for the year 2021 survey was uploaded to ArcGIS pro to visualize the path of SDRPF volunteers which can be seen in pink lines in figure 1.3.



Figure 1.4 Showing the buffers created using the transect

Then, those transects shown in Figure 1.3 were used to create buffers (12.5 meters on each side) around them. 12.5 meters was chosen as it was assumed that a person would be able to collect data for 12.5 meters each while walking. Buffered polygons represent the area that must have been covered while the surveys.

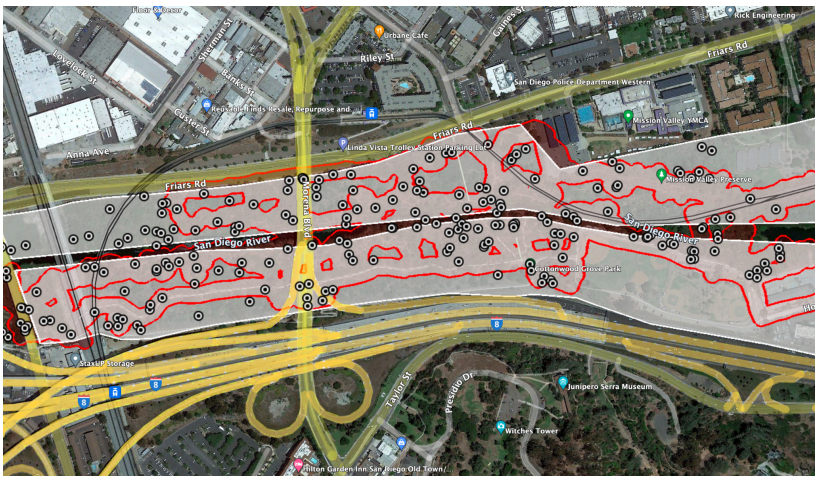


Figure 1.5 Shows the buffered polygons in red, San Diego River vegetative floodplain area as white polygons.

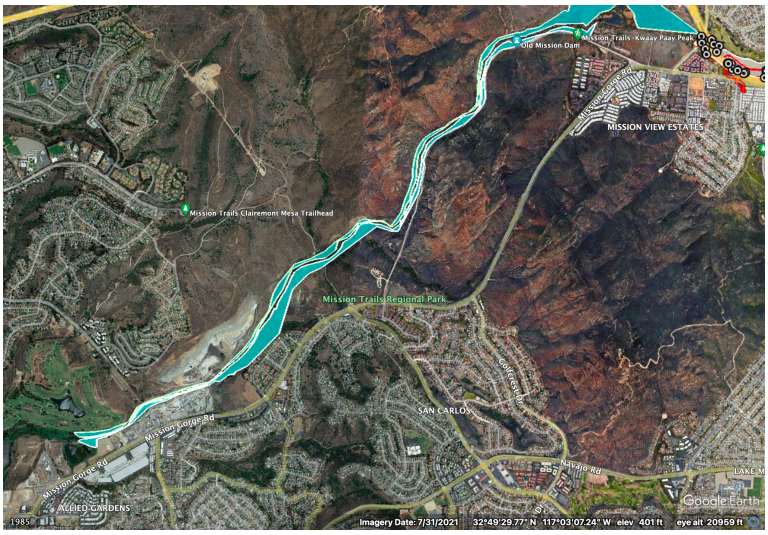


Figure 1.6 shows the area where no survey data was present

Then a polygon was created over the SD river floodplain vegetative area where there was no survey data present which can be seen as a cyan polygon in Figure 1.6

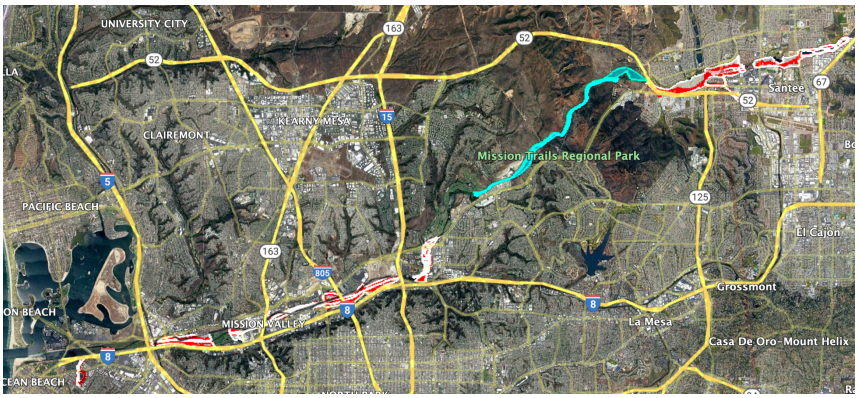


Figure 1.7 Shows the whole survey area extent.

Then the percent area surveyed was calculated using the equation

- Red polygon area / (white + cyan) polygon area *100

Results

The red polygon (the buffered transect polygon) area was calculated to be 1.86 km^2.

The white polygons (SD river flood plain vegetative area of where transect data was present) area was calculated to be 4.02 km^ 2. The cyan polygon (SD river flood plain vegetative area where transect data was not present) area was calculated to be 0.74 km^2.

So the percent area covered while surveying using the “Red polygon area / (white + cyan) polygon area *100” equation is 1.86/ 4.02+0.74 *100 = 40 percent.

Discussion

There are several reasons why the area being surveyed may not be near 100 percent. Private properties, for instance, cannot be accessed, which limits the overall survey coverage. Golf courses are usually kept clean, so there may not be a need to survey them. Additionally, dense vegetation can make it challenging to reach some areas, and steep slopes can also be difficult to access.

However, one limitation of this calculation is the possibility of missing data that was not properly recorded. Such omissions can significantly impact the accuracy of the survey results, and therefore, it is essential to ensure that data collection is comprehensive and accurate. Overall, a thorough understanding of the limitations and challenges associated with conducting surveys can help ensure that survey results are as accurate and reliable as possible.

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