

BASELINE OF BEACHED MARINE DEBRIS IN THREE SITES, RED SEA – ERITREA

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ABSTRACT

Marine macro debris are increasingly deposited on beaches and are exposed to future micro plastics which are far more dangerous. The transboundary nature of the debris makes it a global case. This study is carried out on the Eritrean coasts of the southern Red Sea. Three sites selected according to their anthropogenic pressure difference and the result implies the difference of the sites. A total of 1500m² beach is surveyed. The result ranges from 0.1 to 0.35 items/m⁻². The average density is 0.18 debris/m². Plastics dominate the debris followed by cloths and foamed plastic. environmental seminars and cleaning campaigns can raise the awareness and bring an improved result. Base line will motivate future studies and generate debris management plan.

Keywords: Eritrea, Red Sea, litters, Beached debris, plastics.

1. INTRODUCTION

Marine debris is defined as solid materials of human origin discarded at sea or reaching the sea through waterways (Zhou et al., 2011). Marine debris is primarily the result of human actions such as ineffective or improper waste management, dumping and littering, or storm water runoff (NOAA Report (2006)). Marine litter, primarily plastic pollution, can have serious and even deadly impacts on marine life (Kühn et al., 2015), as well as negative effects on human health and economy (Newman et al., 2015). Nowadays plastic debris can be found in almost every environment. More and more consequences regarding plastic debris are being discovered. Starting with the visual pollution of coastlines over to direct and indirect adverse effects on coastal ecosystems, up to threats on human health, the implications of marine debris are growing and are harming large number of living beings (STAP, 2011; OSPAR Commission et al., 2009; Barnes et al., 2009; Derraik, 2002; Gregory & Andrady, 2003). It is widely recognized that pressures and demands on marine resources are often excessive, and that action must be taken in order to minimize negative impacts on the marine environment (Barnes and Metcalf, 2010).

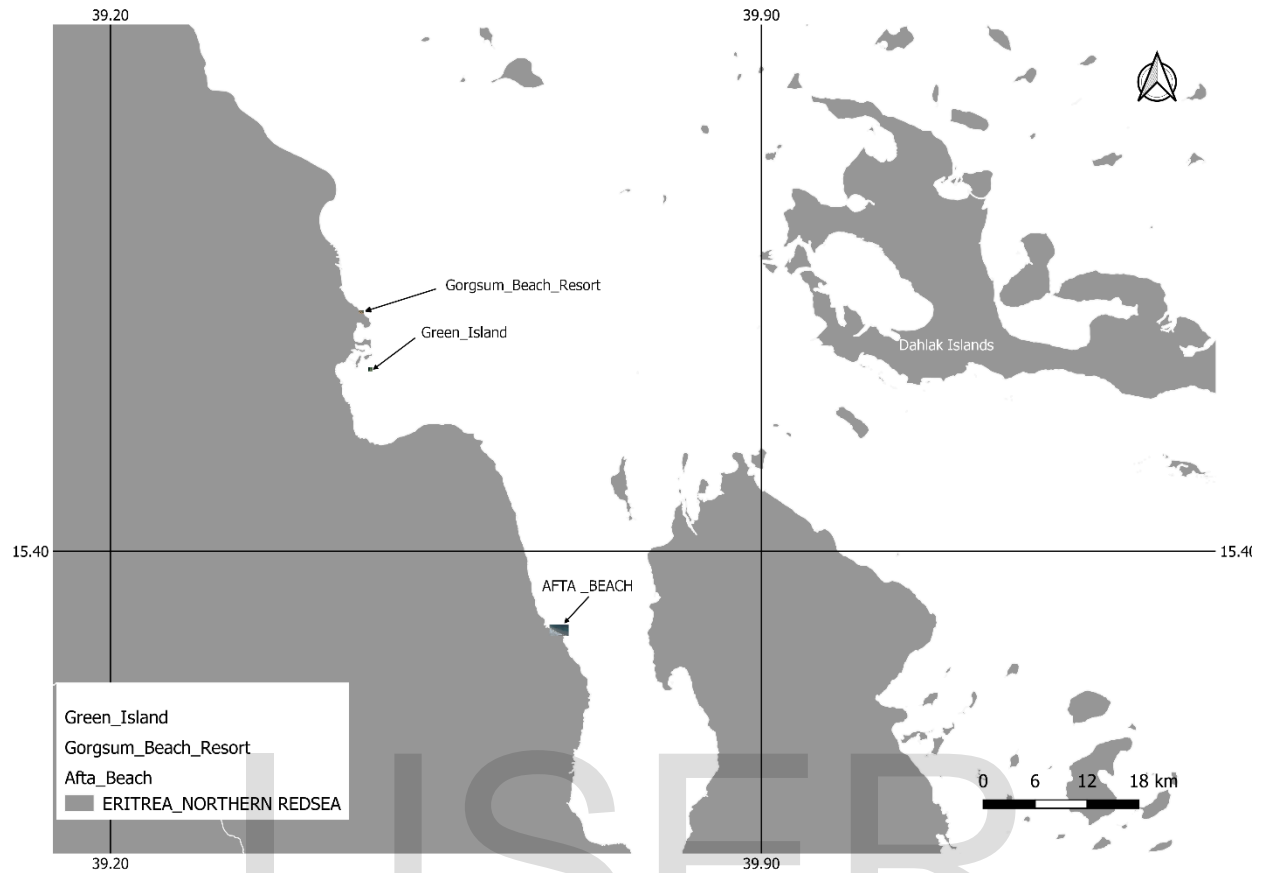
Eritrea, bestowed with more than 1,350 km of mainland coastline (18 % of the Red Sea) and more than 350 islands and islets with an additional coastline of more than 1,950 km, is characterized by an array of highly distinguished marine and coastal ecosystems. These ecosystems incorporate a variety of habitats which are represented by extraordinarily spectacular creatures that are of high interest for the tourism industry; the sandy beaches and the colorful coral reef communities that attract tourists for snorkeling and diving (ECMIB, 2007). Research suggests that litter on beaches detracts from visitors' enjoyment and reduces the amount and value of recreation on coastal beaches (Ofiara and Brown, 1999; Brouwer et al., 2017; Krelling et al., 2017; Leggett et al., 2018).

Currently, the majority of the tourist-oriented activities along the coastal area are confined within the Northern Red Sea Region. The current case study mainly focuses in the Massawa area, as to assess the impact of the beached marine debris on the environmental situation and recommend a pollution management strategy.

2. METHODOLOGY

2.1 Study area

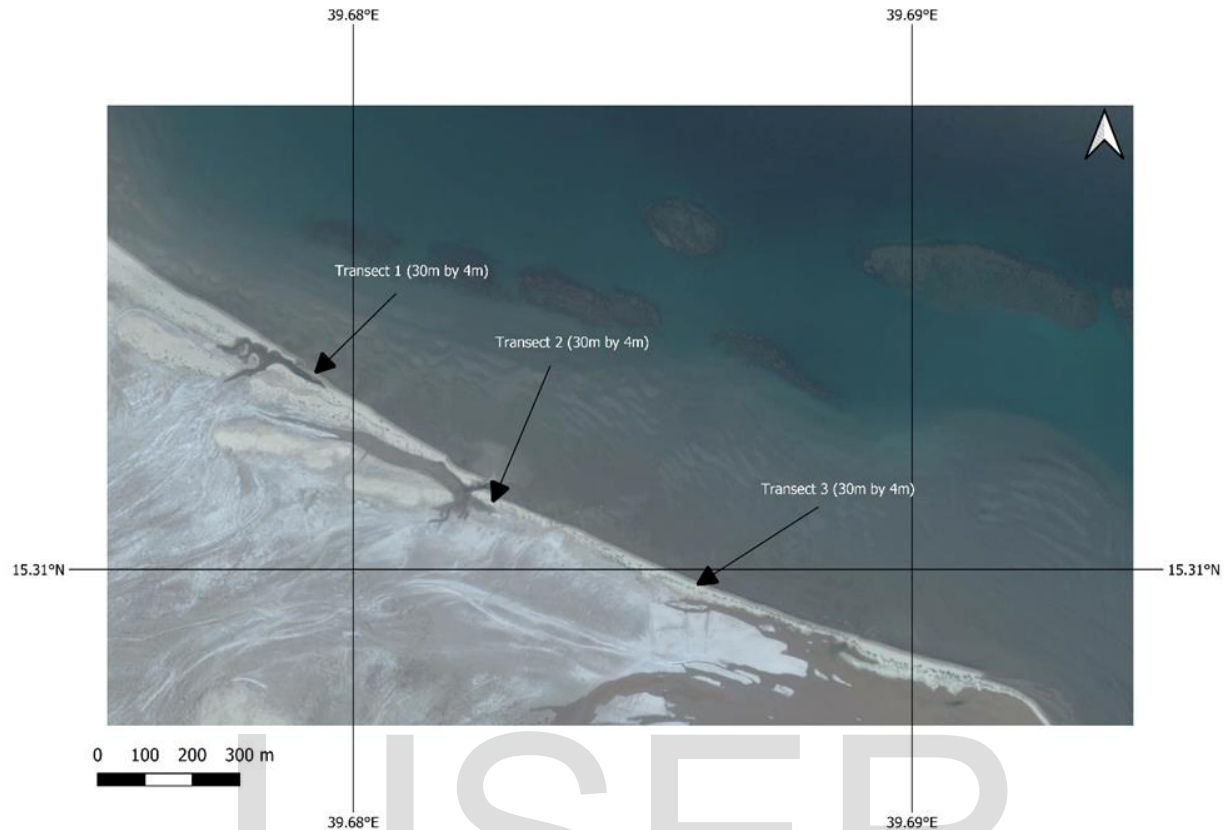
The study sites are Afta, Green Island and Gorgusum beach Resort all located around the southern red sea of the Eritrean coast. These sites are chosen according to their difference in the access and pressure of anthropogenic effect.



Map 1. Study area

Afta

A remote site which is located in Zula bay and doesn't have anthropogenic pressure. This site is chosen to show the transboundary nature of the debris.



Map 2. Afta Beach

Green Island

Located near to the port of Massawa, this site carries out different tourist related activities throughout the year, and it's also known for its fauna and flora diversity surrounded by reach coral diversities which is a center of snorkeling for numerous tourists.



Map 3. Green Island surveyed site

Gorgusum beach Resort

popular beach resort of the country, most visited site.it has high anthropogenic pressure throughout the year.



Map 4. Gorgusum beach surveyed area

2.2 Sampling and analysis

Beach surveys were conducted in three coastal areas, 3*30m transect laid in each site, then all the litters greater than 2.5cm are collected and recorded as Plastics, Foamed plastic, Cloth, Glass and ceramic, Metal, Paper and cardboard, Rubber, Other, Sanitary (Cheshire et al. 2009). Litters of each site were compared. The collected litters are represented in tables and graphs.

Beach cleanliness assessed through Clean Coast Index (CCI): $CCI = (\text{Total litter on transect} / \text{Total area of transect}) K$ where the CCI is the number of litter m^2 , the total area of transect is the product of the transect length and width, and K (constant) = 20. Beaches cleanliness classified from “Clean” to “Extremely dirty” according to the scale provided by Alkalay et al. (2007) as shown in Table 1.

Table 1: Clean Coastal Index

Quality	Value	Definition
Very clean	0–2	No litter is seen
Clean	2–5	No litter is seen over a large area
Moderate	5–10	A few pieces of litter can be detected
Dirty	10–20	A lot of litter on the shore
Very dirty	20+	Most of the beach is covered with litter

Debris concentration or debris density calculated using (Ippiat et al 2013) for each site.

$C = n / (l * w)$ Where **n** is the number of debris **L** length of the transect **W** width of the transect. The result is represented in tabular form and present study is compared to other studies.

3. RESULT AND DISCUSSION

A total of 3 beaches were surveyed, 276 debris were collected from 1500m² beach area. the composition of the debris is dominated by plastics which is 83% followed by cloth 6% and foamed plastic constitutes 5%, metal, glass and ceramics, paper and cardboard and rubber represents 2%,1%,1% and 1% respectively. There was composition difference throughout the sites.

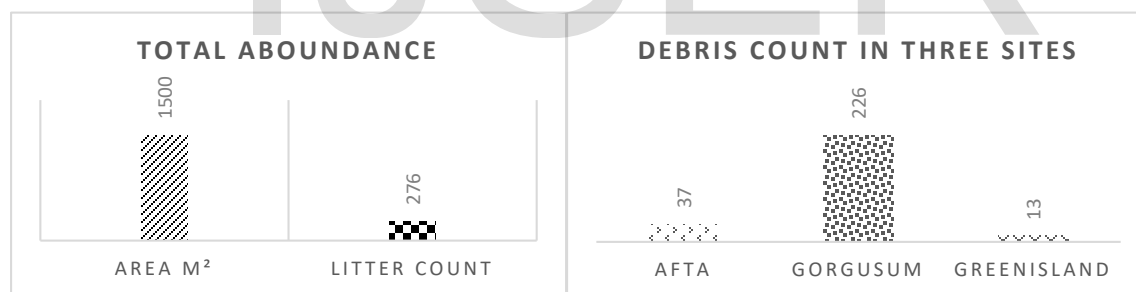


Fig.1. marine debris abundance

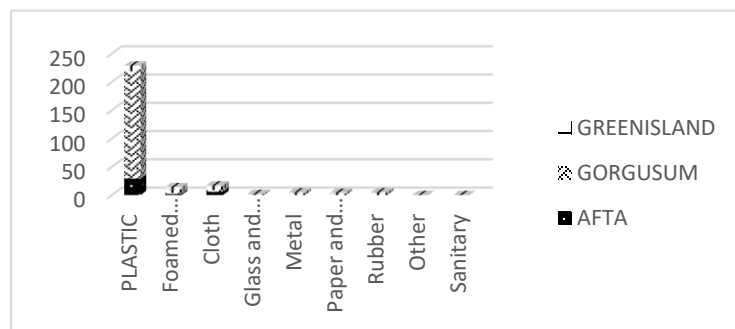


Fig.2. litter composition

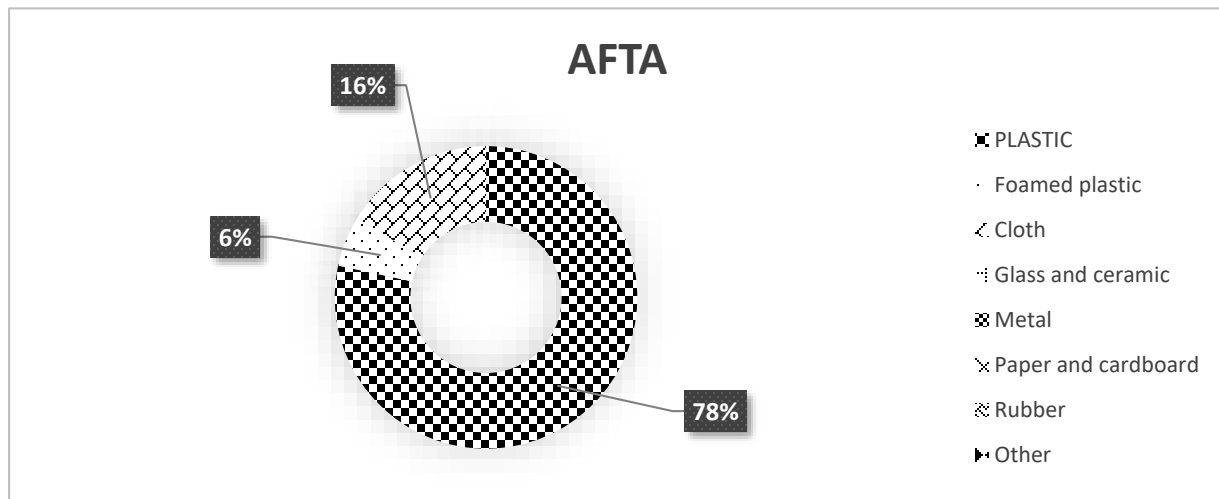


Fig.3. litter composition of AFTA

Afta debris are dominated by plastics were they are composed of plastic shoe,ropes and floater,then followed by clothes and foamed plastics. Here the village that could possibly impact the result is far from this study are and they don't consum plastic bottles.this demonstrates the tranboundary nature of marine debris.



Plate .1.Afta debris



Though this island is dominated by tourists and used to accumulate numerous debris the impact of lockdown because of the COVID-19 outbreak makes the visitors less. After plastics foamed plastics were the second dominant category, thus items are used for floating as a boat of foot fishermen and are drained from it after time, find their way on the beach. Beached dolphin was also found in this island. Several dolphins visit the eastern side of the island every morning.



Plate .2. Green Island Debris

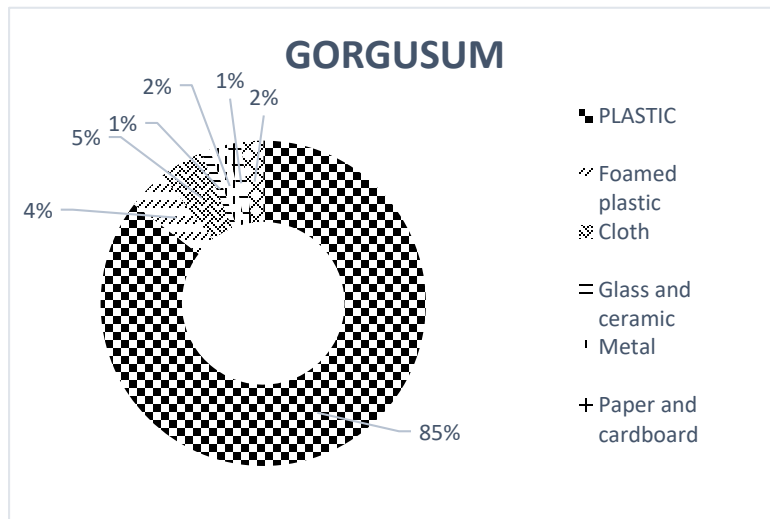


Fig.5. litter composition of Gorgusum

Plastics are also dominant here, very diversified kinds of debris. Cloths were the second abundant litters which represents beach activities. Foamed plastics are also among the litters in small quantity. The other categories represent a very small amount.



Plate .3. Gorgusum debris

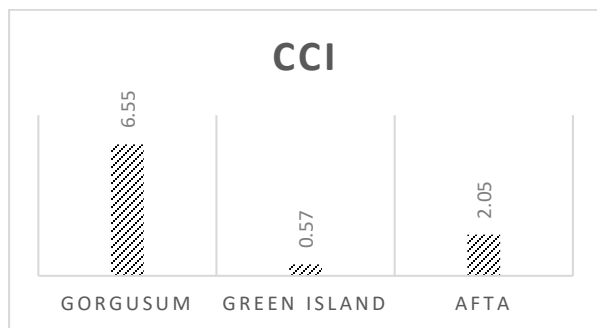


Fig.4. Clean Coastal Index

The Gorgusum CCI shows a moderate cleanness while Afta scores a clean value and Green Island is a very clean value. Here the value of Afta represents the behavior of debris, according to the characteristics of the site, the values should be less than of the green island however transportation of debris can reach even far unreached sites, thus careful monitoring is important.

The Macro litter density stretches from 0.1 to 0.35 that tells the number of litters seen in the study site are low. Average litter density is 0.18 (items/m²). Gorgusum is the site with most of debris which describes the unregulated disposal of garbage from the visitors. Garbage bins should be available throughout the beach and regular cleaning should be made.

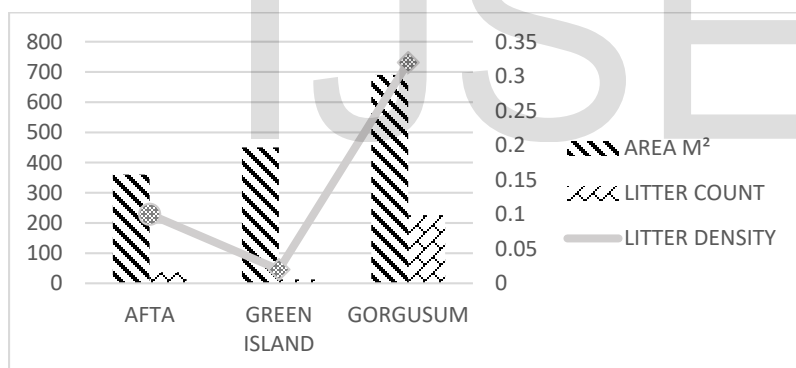


Fig.5. Macro debris density (Lippiatt et al.,2013)

Table 2: list of countries with average litter density i.e. item per meter square

Study area	No of surveyed beaches	Average litter density (item/m ²)	Reference
Adriatic & Ionian Seas	31	0.67	T.Vlachogianni et al,2018
Albania	3	0.22	T.Vlachogianni et al,2018
Australia	6	0.1	Cunningham and Wilson,2003
Bosnia &Herzegovina	2	0.17	T.Vlachogianni et al,2018

Brazil	10	0.14	Oigman-Pszczol and Creed,2007
Chile	43	1.8	Bravo et al.,2009
Croatia	4	2.9	T.Vlachogianni et al,2018
Eritrea	3	0.18	Present study
Greece	10	0.24	T.Vlachogianni et al,2018
Italy	5	0.2	Munari et al.,2016
Italy	7	0.28	T.Vlachogianni et al.,2018
Japan	18	3.4	Kusui and Noda,2003
Jordan	3	4	Abu-Hilal and Al Najjar,2004
Montenegro	2	0.37	T.Vlachogianni et al,2018
Russia	8	0.2	Kusui and Noda,2003
Slovenia	3	1.2	Palatinus,2008
Slovenia	6	1.51	Laglbauer et al.,2014
Slovenia	3	0.45	T.Vlachogianni et al,2018
South Korea	6	1	Lee et al.,2013
Taiwan	6	0.15	Kuo and Huang ,2014
Tasmania	9	0.28	Slavin et al.,2012
Turkey	10	0.88	TopÇu et al.,2013

4. CONCLUSION AND RECOMMENDATIONS

Overall result of the study denotes 0.18 debris per meter square which is low. However, since tourism industry and fishing pressures are yet to take place in this country, using this result as a baseline strong debris management policy should be drafted and amended. The composition of the debris is dominated by plastics and thus macro plastics will be soon micro plastics after a number of exposure to extreme weather conditions. Debris should be removed from beaches on regular basis. Usage of Foamed plastics as a boat for foot fishermen should be substituted with other alternatives. Pollution awareness is needed through seminars and medias specially for service providers. Fishermen gears should be disposed far from beaches otherwise they will find their way as a ghost net.

At a national level, future tourism in Eritrea heavily relies on the coastal environment. The establishment of different tourism centers, hotels, resorts, ecotourism opportunities and related supporting facilities; diving center, marinas and recreation centers pulls in the tourism activities towards the coastal environment. Those pressures will affect the environment and this baseline will be a base for the coming studies and generate future management plan.

5. AKNOWLEGMENT

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Annex

	SITES		
LITTER	AFTA	GORGUSUM	GREEN ISLAND
PLASTIC			
Bottle caps	6	66	0
Bottles	11	26	3
Cutlery	0	0	0
Food containers	1	15	2
Plastic bags	1	60	1
Toys	0	0	0
Gloves	0	0	0
Cigarette lighters	0	0	0
Cigarettes butts	0	0	0
Syringes	0	0	
Crates	0	0	0
Mesh bags	0	1	0
Fishing gears	0	0	0
Monofilament line	0	0	0
Rope	1	13(9.5m)	1(1m)
Fishing net	0	0	0
Buoys	0	1	0
Unrecognizable pieces	9	10	0
Foamed plastic			
Packaging (pieces)	2	9	3
Cloth			
Clothing, shoes, etc.	6	10	1
Glass and Ceramics			
Light globes/bulb	0	0	0
Glass fragments	0	2	0
Metal			
Drink cans	0	4	1
Gas bottles	0	0	0
Paper and Cardboard			
Paper	0	3	0
Boxes and fragments	0	0	1
Cigarette packs	0	0	0

Rubber			
Toys	0	0	0
Flip-flops	0	0	0
Gloves	0	0	0
Rubber sheets	0	0	0
Condoms	0	0	0
Wood	0	4	0
Corks	0	0	0
Ice-cream sticks	0	1	0
Other	0	0	0
Sanitary	0	0	0
site sum of litters	37	226	13
Total sum of all litters	276		

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