Presence the marine waste on the natural coast: Aouchtam, Morocco

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Abstract: The natural coastline is exposed to the accumulation of marine waste on the beach although of not exist human activities, but there are other factors. In this study on beach Aouchtam the results showed the high percentage of waste plastic 86% Glass comes in second place 5% (318,5 g) and then lumber (192,8 g) and paper (215,9 g) 3%, metal 2% (161,7 g) and finally the Cloth 1% (103,2 g) of total marine waste which collected in the year 2015. The high quantitive for the marine waste it was the session 4 (October - December). The micro waste it was less on beach Aouchtam, there is the high percentage of the gravel in the soil this may result in the loss of a lot of small waste due to the washing process of the wave's movement by Tidal. There are significant Variations of Macro debris in Aouchtam beach between four seasons; the variation of the studied variables shows the existence of the variations according to the seasons of sampling.

Keywords: Marine waste, Natural coast, Plastic, Micro waste, Aouchtam. Morocco.

1 Introduction

The coastal on Mediterranean Sea cities exert strong pressures on the environment as a whole and especially on marine ecosystems. They also represent complex systems and hot spots that require special attention. In this respect, Mediterranean cities need to be reinterpreted as unique systems, which encompass the marine and land domains, together with the human activities carried out there in [1]. Most studies of marine litter in the Mediterranean have focused on beaches, floating debris and the seabed [2,3]. They show that there is more marine litter in bays than in open areas [4], and it is concentrated in shallow coast- al areas rather than deeper waters [5].

There are effects for increasing coastal population around the globe effect outpacing the environment's capacity to assimilate human and industrial wastes. Point-source discharges of untreated wastewater and sewage, as well as industrial and agricultural effluents, continue to pollute estuarine and coastal systems of land-based [6]. The direct impacts of human activities on the coastal zone have been more significant over the past century than impacts that can be directly attributed to observed climate change [7,8].

known marine litter has been defined by as any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment, marine debris consists of items that have been made or used by people and deliberately discarded into the sea or rivers or on beaches; brought indirectly to the sea with rivers, sewage, storm water or winds accidentally lost, including material lost at sea in bad weather (fishing gear, cargo) or deliberately left by people on beaches and shores [9].

The United States of America Academy of Sciences estimated the total input of marine litter into the oceans, worldwide, at approximately 6.4 million tons per year [10]. Recently calculated that 275 million metric tons (MT) of marine waste was generated in 192 coastal countries in 2010, with 4.8 to 12.7 million MT entering the ocean [11], one of the fastest- growing threats to the health of the world's seas, oceans is the accumulation and disposal marine litter on the beaches [12].

In all marine habitats, Marine debris is present, from densely populated regions to remote points far from human activities [9], from beaches and shallow waters to the deep-ocean trenches [13]. There are differences between at density of marine debris varies greatly among locations, influenced by Hydrological and meteorological conditions, geomorphology, entry point, anthropogenic activities, and the physical characteristics of debris items. At recent study presented data on detectable floating plastic accumulation with visual observation in the North Atlantic and the Caribbean from 1986 to 2008, the highest concentrations (> 200,000 pieces per square kilometer) [14].

Based on data from about 12,000 satellite-tracked Computer modeling simulation floats deployed since the early 1990s as part of the Global Ocean Program. These data confirm that marine wastes are transported across by oceans currents [15,16].

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The majority of marine debris (approximately 80 percent) entering the seas and oceans is considered to originate from land-based sources including sewage treatment, combined sewer overflows, people using the coast for recreation or shore fishing, shore-based solid waste disposal, inappropriate or illegal dumping of domestic and industrial rubbish, poorly managed waste dumps, street litter which is washed, blown or discharged into nearby waterways by rain, snowmelt, and wind [17]. And can be the others litter attributed to maritime transport, industrial exploration and offshore oil platforms, fishing and aquaculture [9]. The big Spreading of debris in the marine environment is a cause for concern. It is known to be harmful to biota, it is aesthetically detrimental, and it may have the potential to transport contaminants over long distances [18].

Pollution by Marine debris, and accumulation of debris, has been identified as a global problem alongside other contemporary key issues, such as climate change, ocean acidification and loss of biodiversity [19]. Many of the effects are caused by Marine waste on beaches and beach water quality, and much of it ends up on our shores and in our lakes, rivers, and oceans, where it kills marine life, poses navigational hazards, and impacts local economies and potentially human health. [20,21,22,23,24,25]. The enclosed seas that are surrounded by developed areas, such as the Mediterranean Sea, are likely to have particularly high concentrations of marine debris [22]. In the North-Western Mediterranean, a survey of large debris, which was floating, was conducted using visual inspection of the ocean surface). In 1997, a density of 15 to 25 items/km2 was observed and in 2000 a lower range of 1.5 to 3 items/km2 was recorded, It was suggested that the difference could be due to meteorological conditions, variability in marine currents of a change in debris input [26]. And in 2003 it was resulted A visual survey of the seafloor by scuba divers around coastal sites of Greece (Eastern Mediterranean) reported a mean of 15 items of debris per km2 (range 0 to 251 items/km2) [27]. Large concentrations have been found of debris were found in bays compared to open areas and in areas where fishing boats anchor [28,29,30].

2 Material and Methods

2.1 Study area

Aouchtam is an a village between tetouan – oued laou In the region Tangier-Tetouan which is located in Morocco on Coordinates N 35° 30.238 W 005° 09.123 Figure (1)Average Width of the beach (Avg T1:T4) 15 – 30 meters where the survey was performed, There are few rocks and was observed grazing activity, at the top of the site there is a drainage channel for flood waters.

Fig 1. Aouchtam beach in Morocco where samples were

Collected by se son for each (Source Google Map)

2.2 Samples collection

A – Macro debris

To good results in the future, we collected (16) samples during four seasons in the year 2015. In each season, we took (4) samples we chose on the part from each transect (A-B-C-D) randomly. There were a number of volunteers, each one collected all solid wastes that found at their parts and they were placed in large bags and titled (part, sector, number and collection date). The choice of type of marine debris is referred to the National Oceanic and Atmospheric Administration [31],fig(2).

Fig 2. Random sampling from the Aouchtam

coast (transects 4 = 4 samples/season).

B – Micro debris

Samples of micro debris sediment in beach were collected in each season. In every time we took three samples from one of the four transects (A-B-C-D). The area of sampling beach site was from low tide shoreline, the high tide and the end of the beach. All samples were (12,5 L) sediment consisting of sand and gravel, were scooped using a small shovel within (50 x 50

cm2) quadrant to a depth of approximately (5cm).Sampling sites were determined with a portable global positioning system (GPS). This method of sampling is according to [32].

3. Experimental analysis

A – Macro debris

After the process of collection, we classified all marine wastes found on the beach as plastic, metal, glass, paper processed lumber, cloth and other. Then we sorted each class to its components. Then they were weighted and the results were to input data card.

B – Micro debris

The first procedure was continuing during large amounts of samples contained seawater because of taking them from low tide and high tide sites. All samples were dried in the oven for an hour at (65°C) and by sunlight. The second procedure was sampling sieving. The sieve aperture size employed (4,75mm, 2,5mm, and 1,25mm) fig (3).

Fig 3. (a) Process drying in the oven for an hour at (65°C) (b) the sampling sieving.

After drying and sieving the plastic samples in each size class of sieve we separated, identified and classified into six types: plastic film, foam, fragment, line, pellet and other. Then we weighted and put them in containers.

4. Cluster analysis

All data obtained from the samples were statistically calculated, analysed and compared using Microsoft excel software. We used this analysis to know variations, sources and types of plastic debris during the four seasons of the year 2015.In the second step, to assess of the homogeneity of variances (ANOVA)with dependent variable (Total plastic fragment) by the multiple comparison of Games-Howell and Bonferroni. The Results were analysed using a software package IBM SPSSv23 (Moore et al., 2014, Beatriz et al., 2000). In additional, we used the principal components analysis (PCA) which is a multivariate statistical method to determine a system of reference axis prioritised while decreasing the number of dimensions of the space in which it is projected the points-observations and The Results were analysed using a software package IBM SPSSv23 [33].

5. Results and discussion

The results of the study showed that the majority of Aouchtam site marine waste collected during the year 2015 were of plastic, where the increase of 86% (5908,6 g), Glass comes in second place 5% (318,5 g) and then lumber (192,8 g) and paper (215,9 g) 3%, metal 2% (161,7 g) and finally the Cloth 1% (103,2 g) fig (4 and 5).

Figures and Tables

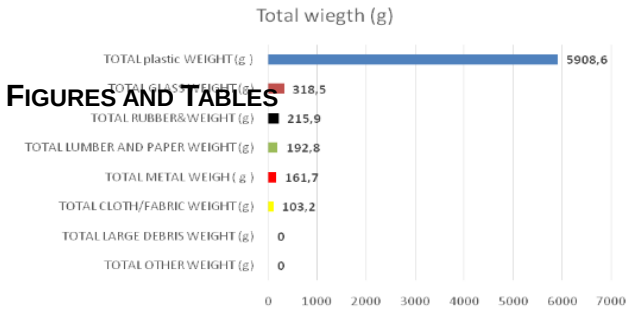

Fig 4. Total amount of marine debris collected at beach sorted by type in Aouchtam

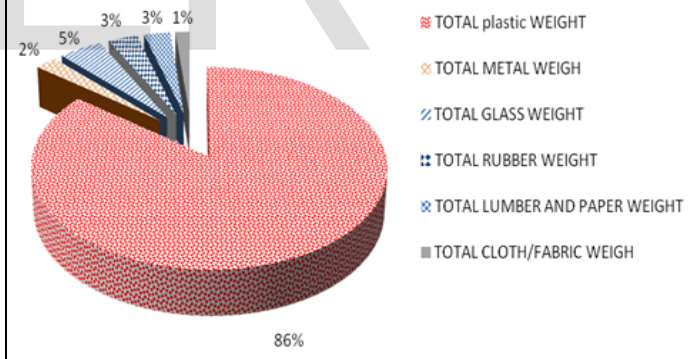

Fig 5. Percentages of total amount of marine debris (g) collected at beach sorted by type in Aouchtam

This high percentage of plastic marine waste Confirms what has been published by many studies that found that the plastic debris is the most widespread at beaches world. Although the only plastic waste substance that is illegal to dump anywhere in the oceans or seas [34,35,36,37,38,39].

It was the vast majority of marine waste which were collected through session 4 (October, November, December) total (5908,6 g). Many of items don't find in Aouchtam's site at sessions 1,2 and 3 such as: Metal, Glass, Rubber and Lumber fig (6).

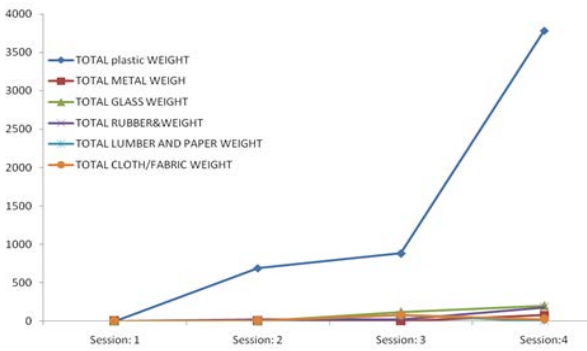

Fig 6 . Seasonal variations of total amount of macro debris collected at beach sorted by type

But this result is different from another coast example beach martil which was high percentage of marine waste at session first or oued laou [40,41]. this variances we can that be reason to location geography, activities human, the sea waves tab(1).The micro waste it was that the majority of Fragments (3,668 g), foam (2,687 g), film (1,75 g), line (0,44 g) and other (4,8 g) fig(7). For sorting by size Small waste size 5 mm was the most then size 2,5 – 4,75 mm and finaly size 1-2,5 mm.

Table 1.Variation seasonal of Macro debris in Aouchtam beach by season

	S 1	S 2	S 3	S 4	Total wiegth g
plastic (g)	557.5	687,9	880,4	3782,8	5908,6 g
METAL (g)	85.7	-	-	76	161,7 g
GLASS (g)	-	-	117,5	201	318,5 g
RUBBER (g)	-	16	22,4	177,5	215,9 g
LUMBER (g)	117.6	-	75,2	-	192,8 g
CLOTH (g)	-	5,6	76,6	21	103,2 g
ALL Categories (g)	760,8	709,5	1172,1	4258,3	6900,7 g

*s: season

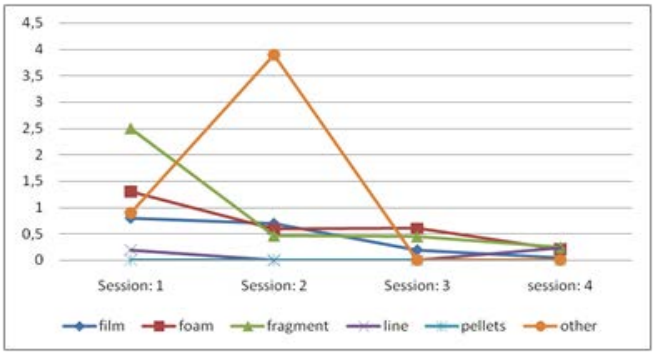

Fig 7. Variation seasonal of Micro debris in Aouchtam beach by type

The micro waste it was less on beach Aouchtam, there is high percent of the gravel in the soil This may result in the loss of a lot of small waste due to the washing process of the Tides movement, It can also be after the beach for industrial areas cause a small amount of micro debris or coastal harbours, tab (2).

Table 2 . Variation seasonal of Micro debris in Aouchtam beach by season and size

Sorting by size	S 1	S 2	S 3	S 4	Total weight (g)
5 mm	3,1	1,29	0,7	0,4	5,49
2,5 – 4,75 mm	0,3	0,42	0,5	0,3	1,512
1-2,5 mm	0,1	0,05	0,05	0,04	0,24
ALL Categories (g)	3,5	1,75	1,25	0,74	7,242 g

*s: season

6. STATISTICAL ANALYSIS

For doing a comparison between the results quarterly changes in the quantity and type of marine waste obtained, we used the multiple comparisons when one considers a set of statistical inferences simultaneously or infers a subset of parameters selected based on the observed values Table (3). With F= 9,363 and P value =,002 significant between groups, the multiple comparison shows many differences between season 1 and 4 (P value =0.003), season 2 and 3 (P value = 0,013) and season 3 and 4 (P value = 0,004). The Games-Howell doesn't present variation between S2 and S3.

Table 3 : Multiple comparison of ANOVA test

(I)season			Mean Difference (I-J)	Std. Error	P value	95% Confidence Interval	
						Lower Bound	Upper Bound
Bon ferroni	S1	S2	69,5	26,03	,122	-12,5	151,5
		S3	-31,1	26,03	1,00	-113,1	50,9
		S4	87,7	26,03	,033	5,6	169,7
	S2	S1	-69,5	26,03	,122	-151,5	12,5
		S3	-100,60*	26,03	,013	-182,6	-18,5
		S4	18,22	26,03	1,00	-63,8	100,2
	S3	S1	31,10	26,03	1,00	-50,9	113,1
		S2	100,60*	26,03	,013	18,5	182,6
		S4	118,80*	26,03	,004	36,7	200,8
	S4	S1	-87,70*	26,03	,033	-169,7	-5,6

		S2	-18,2	26,03	1,00	-100,2	63,8
		S3	-118,80*	26,03	,004	-200,8	-36,7
Games-Howell	S1	S2	69,5	22,37	,089	-12,3	151,3
		S3	-31,1	32,23	,774	-146,3	84,1
		S4	87,72*	22,88	,039	5,3	170,1
	S2	S1	-69,5	22,37	,089	-151,3	12,3
		S3	-100,6	28,83	,075	-214,8	13,6
		S4	18,2	17,77	,742	-43,4	79,8
	S3	S1	31,1	32,23	,774	-84,1	146,3
		S2	100,6	28,83	,075	-13,6	214,8
		S4	118,82*	29,23	,043	5,0	232,5
	S4	S1	-87,72*	22,88	,039	-170,1	-5,3
		S2	-18,2	17,77	,742	-79,8	43,4
		S3	-118,82*	29,23	,043	-232,5	-5,0

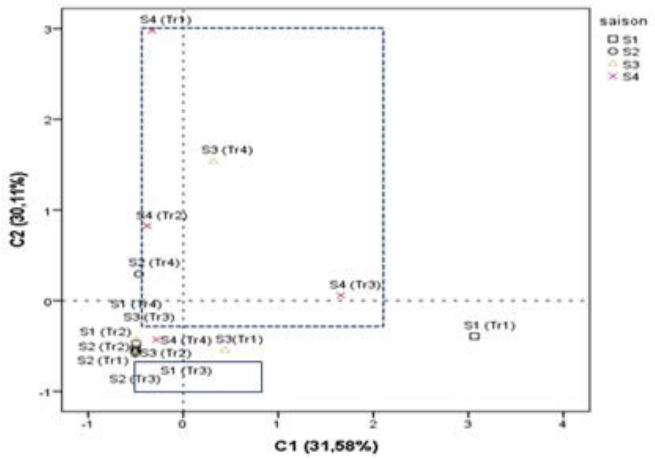

Fig 9. Projection to transect per season in the factorial plan 1 and 2 of the principal component analysis (PCA).

The principal component analysis expresses 61.70% of the total variance (Fig 8). Axis 1 contributes 31.58% of the variance, positively correlated with Metal, Lumber and Glass. Axis 2 contributes with 30.11% of the positively correlated variance with Plastic, Rubber and Cloth. The projection of the stations in factorial plane 1 and 2 of the principal component analysis shows differences between the studied stations (Fig 9). Axis 1 (31.58% of the variance) differentiated a station S1 (Tr1) that contains Plastic, Metal and Lumber compared to other stations that have low Plastic continents. Axis 2 (30.11% variance) differentiated the stations that are characterized by significant amounts of plastic compared to plastic low-volume stations.

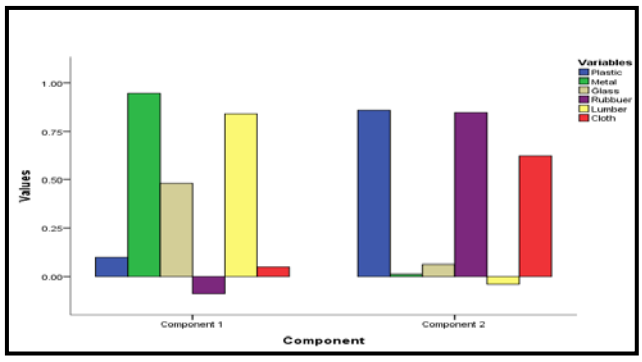

Fig 8. Principal component analysis differences between compositions marine

The results of the Pearson correlation test (table) show the existence of a significant correlation between Plastic and Rubber (r = 0.619, p = 0.01) and also a highly significant correlation between Metal and Lumber (r = 0.729, p = 0.001), Tab(4).

Table 4 : Relation of correlation between Variables marine waste.

	Plastic	Metal	Glass	Rubbuer	Lumber	Cloth
Plastic	1	,135	,097	,619*	-,014	,325
Sig		,618	,722	,011	,958	,219
Metal		1	,391	,011	,728**	-,109
Sig			,134	,969	,001	,688
Glass			1	-,096	,024	,111
Sig				,724	,930	,682
Rubbuer				1	-,095	,297
Sig					,726	,264
Lumber					1	,136
Sig						,616
Cloth						1
Sig						

*. Correlation is significant at the 0.05.

**. Correlation is significant at the 0.01.

The variation of the studied variables shows the existence of the variations according to the seasons of sampling. The Plastic is present at the level of the four seasons studied, but with an increase at the level of the season four. Metal is more present only at S1 and S4. The Lumber is present at S1 and S3. Glass is more present at S3 and S4 fig (10).

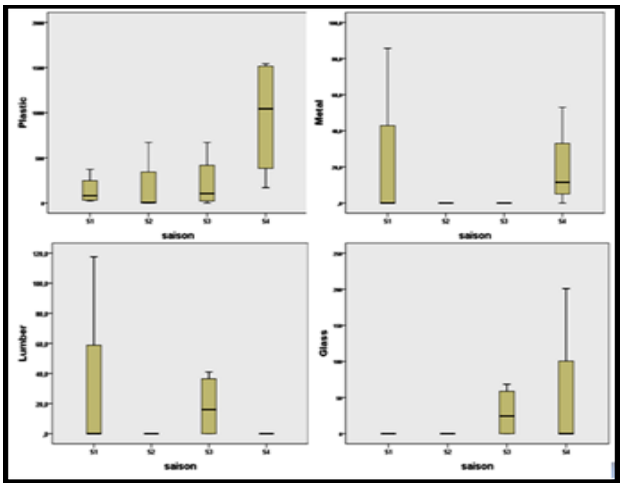

Fig 11. The variation of the studied variables the existence of the variations according to the seasons of sampling

CONCLUSION

Although there is not exist human activities on the Aouchtam beach there are a lot of marine waste which find through take a sampling, the plastic debris it was mostly of the waste at four-session. The nature of the rocky coast and the movement of the waves may be the cause of the existence of such waste this work shows the type and weight for the marine waste at Aouchtam beach in structuring the environment beaches characteristics and the differences in debris in year 2015.

ACKNOWLEDGEMENTS

First, we wish to express our sincere thanks to our colleagues in the laboratory who provided us with the working materials for this study: Group of Applied Algology and Mycology, and the group of Conservation Biological Systems. We are grateful to the volunteers who help in the collection phase of the data in the beach of Aouchtam. Without their efforts, the work will not have been performed.

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