ANALYSIS OF COMPOSITION AND SOURCES OF MARINE LITTER IN ITOSHIMA PENINSULA, FUKUOKA, JAPAN

Graduate School of Eng., Kyushu University Student member of JSCE Yawen SONG[1]
Graduate School of Eng., Kyushu University Member of JSCE Satoquo SEINO[2]

1. INTRODUCTION

Marine litter can be divided into two categories, one is primary litter; the other is secondary litter, generated by the fragmentation of large litter, and the latter is the way plastic litter fragments are mostly generated in the environment. Large litter, especially plastic litter, can be broken into medium-sized plastics of various sizes, small plastics, and even microplastics through the weathering effect of the environment. To effectively identify the sources of marine litter occurrence on the peninsula, the relationship between the abundance, correlation, and morphology of plastic of

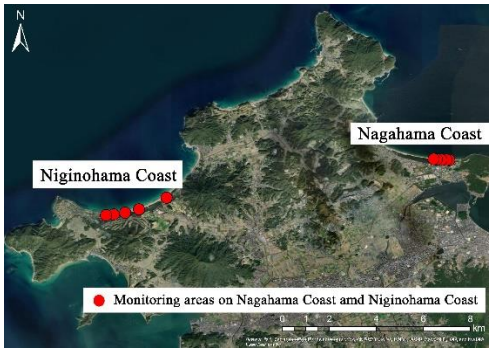

Fig. 1 Monitoring areas on survey coasts

different sizes on Nagahama Coast (Later omitted as NA) and Niginohama Coast (Later omitted as NI) were investigated to identify the sources of plastic litter on the peninsula and to provide suggestions for effective solutions to the marine litter problem.

2. SURVEY METHOD

The survey on the distribution characteristics of marine litter and coastal plants has been completed from March to November 2020. According to the Line Transect Method, each monitoring area was divided from the hinterland to shoreline into several 1×1m observation squares and recorded the quantity and types of marine litter and coverage and quantity of types of coastal plant in each square as shown in **Figure 2.**

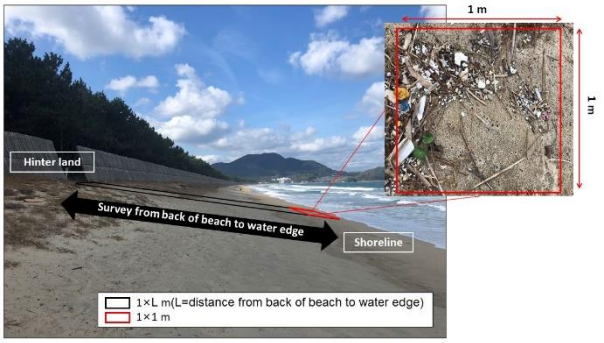

Fig. 2 Field survey method

3. SURVEY RESULTS

3.1 Composition, abundance, and sources of marine litter

The classification of the marine litter of various sizes on NA and NI is shown in the table. In addition to the most common plastic litter fragments, fishing nets, oyster farming tubes, and other fish farming-related litter; as well as lighters, straws, cigarette butts, and other household litter were found on both coasts.

Table. 1 Classification of marine litter on NA and NI

Size	>2.5cm		0.5~2.5cm		<0.5cm	
Coast	NA	NI	NA	NI	NA	NI
Type	Hard plastic Plastic bag Styrofoam Straw String Lighter Plastic lid Wire Fishing net Paper fragment	Hard plastic Plastic bag Styrofoam Cigarette butt String Fishing net Plastic lid PET bottle Straw Glass bottle	Hard plastic Plastic bag Styrofoam Oyster farming tube(1.5cm)	Hard plastic Plastic bag Styrofoam Oyster farming tube(1.5cm)	Hard plastic Plastic bag Styrofoam	Hard plastic Plastic bag Styrofoam

The type and composition of marine litter on NA and NI are shown in **Figure 3.** The abundance proportion of polystyrene foam debris was the largest in the composition of marine litter on both coasts again. In the composition of marine litter >2.5cm, 0.5~2.5cm, <0.5cm, the abundance proportion of styrofoam debris was the largest, even up to 97%.

Combining with the geographical location, there are Karatomari fishing farms near NA and several Itoshima fishing farms near NI, it is presumed that the styrofoam

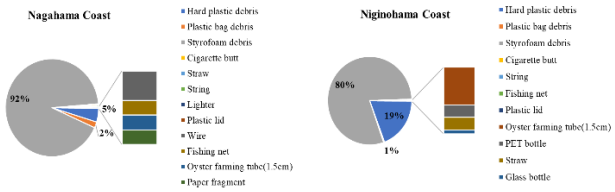

Fig. 3 Types and composition of marine litter on two coasts

litter is mostly boxes used in fishery farming, etc. From the above results, the styrofoam litter generated from farming activities is one of the important sources of marine litter in the Itoshima Peninsula. Because polystyrene foam has foaming pores inside, it is easier to break than other plastic litter, so it is abundant in 0.5~2.5cm and <0.5cm litter and microplastic litter, as shown in **Figure 4.**

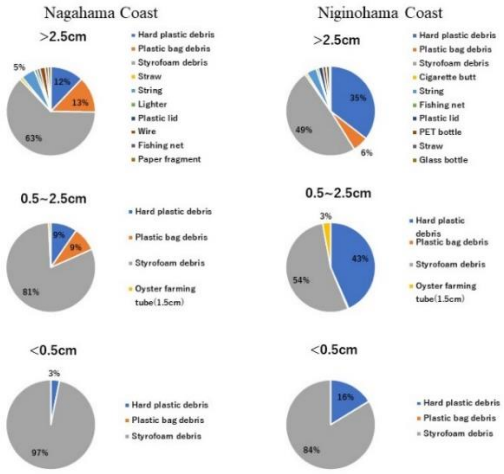

Fig. 4 Types and composition of the marine litter of different sizes on two coasts

In addition, as shown in **Figure 5**, plastic bags and rigid garbage fragments found at each observation point on both coasts accounted for a certain proportion of plastic bags, mostly transparent or white shopping bags, but also some food packaging bags; rigid plastic garbage fragments varied in color, and it was difficult to determine the original product type from the appearance. Therefore, in addition to farming-type garbage, plastic bags discarded in life is also another source of marine litter in the peninsula. By calculating the abundance of the three types of plastic debris litter with the main proportion in the two coasts, the average abundance of plastic for NA > 2.5cm, 0.5~2.5cm, and <0.5cm were 1.261/m^2, 1.797/m^2, and 14.319/m^2 respectively, and the average abundance of plastic for NI > 2.5cm, 0.5~2.5cm and <0.5cm were 1.211/m^2,1.659/m^2,22.076/m^2. According to the abundance results, the overall abundance of plastic debris increased with decreasing size, probably as a result of the fragmentation of large plastic after being washed ashore and subjected to environmental effects such as sunlight, wind, and tide for a long time.

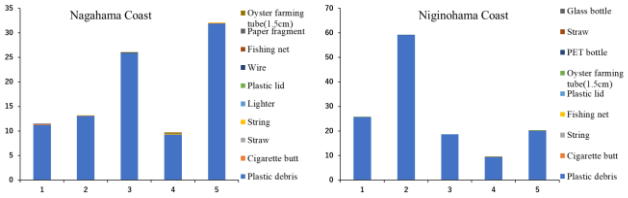

Fig. 5 Types and abundances of the marine litter of monitoring areas on two coasts

3.2 Correlation analysis of different sizes of plastic litter

The correlations between the abundances of >2.5 cm, 0.5-2.5 cm, and <0.5 cm in the plastic litter were analyzed and the results are shown in **Table 2**.

Table. 2 Correlation among abundances of plastic debris with different sizes on two coasts

Size	Hard plastic debris		Plastic bag debris		Styrofoam debris		Total	
	NA	NI	NA	NI	NA	NI	NA	NI
>2.5cm & 0.5~2.5cm	0.287	0.926*	-0.458	-0.597	0.920*	0.594	0.912*	0.149
>2.5cm & <0.5cm	0.844*	0.754*	#DIV/0!	0.354	-0.535	0.968*	-0.428	0.905*
0.5~2.5cm & <0.5cm	0.246	0.596	0.237	-0.387	-0.297	0.651	-0.508	0.013

The correlation analysis by different sizes of plastic litter showed that the abundance between >2.5cm and 0.5~2.5cm for NA and between >2.5cm and <0.5cm for NI were strongly correlated in terms of total abundance. In the abundance of rigid plastic debris, there was a strong correlation between >2.5 cm and <0.5 cm for NA and between >2.5 cm and 0.5~2.5 cm, >2.5 cm, and <0.5 cm for NI. For the abundance of polystyrene foam litter, strong correlations were found between >2.5cm and 0.5~2.5cm for NA and between >2.5cm and <0.5cm for NI. Especially, the correlation for the latter was as high as 0.968. While no correlation was seen between the abundance of each size in plastic bag debris.

4. CONCLUSION

The sources of marine litter on Itoshima Peninsula can be divided into two main categories: primary litter, mainly from farming and domestic waste; secondary litter, generated by the fragmentation of large litter, mostly seen as hard plastic litter and polystyrene foam litter, especially the latter. It is also very likely that secondary pollution is caused by the fragmentation of large pieces of trash washed up on the shore by waves under environmental effects (e.g., sunlight, gravel, wind and waves, tides, etc.).