# Distributive Relevance between Marine Litter and Coastal Plants in Itoshima Peninsula

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## 1.Introduction

Natural coasts have been rapidly reduced because of erosion, direct destruction, human disturbance and pollution in recent years. In particular, marine litter that is discharged directly or indirectly on to the coast every year is also an important factor that cannot be ignored. In addition, with the increasing frequency of human activities on the coast, coastal plants have also been extensively and severely affected. Without coastal plants, beach sand would be more easily carried away by wind and maintaining the current dune terrain would be impossible; it can also be said that the current dunes were created by coastal plants. Marine litter and coastal plants are distributed on the coast together, necessitating an understanding of the distributional relevance of marine litter and coastal plants.

The Genkai-nada coast in Itoshima Peninsula is an important coastal area in western Fukuoka Prefecture within the administrative jurisdictions of Itoshima City and Fukuoka City. The present research investigated the quantity and types of marine litter and the coverage and types of coastal plants on Nagahama Coast, Fukuoka City and Niginohama Coast, Itoshima city over an entire year to understand the distribution characteristics of marine litter and coastal plants, and then analyzes the distribution relationship between the two based on their distribution characteristics. Finally, effective suggestions are made to deal with marine litter and protect coastal plants in order to optimize the coastal environment.

## 2.Surveys and results

### 2.1 Pre-investigation of survey sites

The two survey sites in this study are the Nagahama Coast and the Niginohama Coast in Itosima Peninsula **(Fig. 1)**. The Nagahama coast faces the semi-open bay of Hakata Bay, which is greatly affected by tidal currents, the coast is about 3 kilometers long. The Niginohama coast faces the open bay of Karatsu Bay, which is about 6 kilometers long, and the dynamic changes of the coastal environment are more intense. Reference table for selection of monitoring area through the pre-investigation **(Table 1)**, with reference to various factors on the coast, five monitoring areas were identified at the two survey sites, and each area has its own characteristics **(Fig. 2)**.


**Fig. 1** Location of two survey sites

**Table 1**. Reference table for monitoring area selection

| 1）Use area | 2）Plant distribution area |
|---|---|
| ① used all ② partial used ③ no used<br>Coasts where① **Used all** ( all areas can be used) ② **Partial used** (no swimming areas or restricted activity areas or coasts where some areas are forbidden to enter) ③ **No used** | ① mostly distributed ② partly distributed ③ no distribution<br>The distribution area of beach plants (accounts of the beach area) ① **Mostly distributed** (more than 50%) ② **Partly distributed** (less than 50% ) ③ **No distribution** (less than 5% ) |
| **3）Facility configuration**（Ⓟ **parking lot** Ⓐ **river exit**） | **4）Entrance configuration** |
| ① adjacent configuration ② isolation configuration ③ no facility<br>The facility is ① **Adjacent configuration** (adjacent to the coast or within the coast) ② **Isolation configuration** (separated from the coast by a road) ③ **No facility** (no facilities on the coast and surrounding areas) | ① full area configuration ② partial area configuration ③ no entrance<br>① **Full area configuration** (All coastal areas can be accessed ) ② **Partial area configuration** (parts of the coast can be accessed) ③ **No entrance** (no direct access to the coast) |

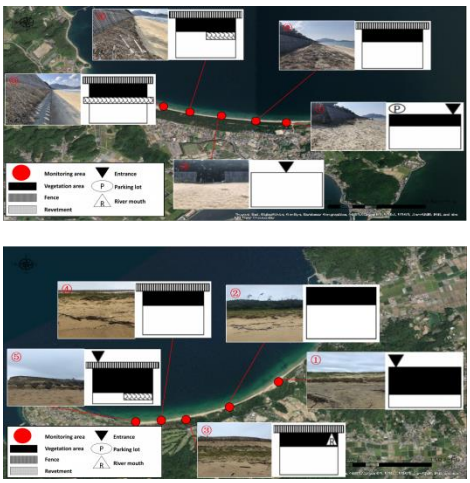

**Fig 2**. Characteristics of monitoring area on Nagahama Coast (up) and Niginohama Coast (down)

### 2.2 Surveys of the survey sites

There are four times surveys on Nagahama Coast and three times on Niginohama Coast from March to November 2020. Referring to the ICC card, we divided marine litter into

common litter such as hard plastic debris, plastic bag debris, styrofoam debris and uncommon litter such as plastic bottle's caps, straws, oyster farming tube, plastic pipes, cigarette butt and others are surveyed and counted. The three common types of marine litter are also different in size (< 0.5 cm, 0.5 ~2.5 cm, > 2.5 cm). As for the coastal plants, such as *Carex kobomugi, Artemisia capillaris, Zoysia, Calystegia soldanella (L.) Roem, Ixeris repens, Glehnia littoralis* are also surveyed and counted.

We divided each monitoring area from back of beach to shoreline into a number of 1×1m square observation point, and recorded the quantity and types of marine litter and plant coverage and quantity of types in each point.

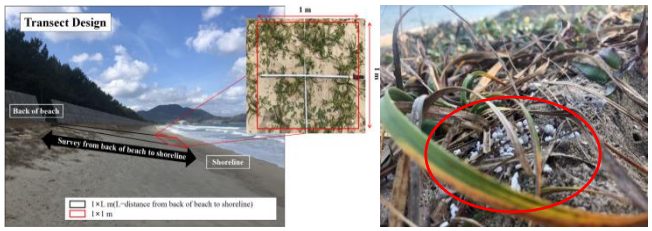


**Fig 3**. Transect design (left) Styrofoam debris trapped by *Carex kobomugic* (right)

2.3 Monitoring data analysis and results

Through the monitoring data, we found that on Niginohama Coast, except for the autumn and winter data of monitoring area 5, the coverage of *Carex kobomugic* is the largest, and the styrofoam debris in small size can be found in almost all areas where *Carex kobomugic* is distributed **(Fig. 3)**. Then we use regression analysis to analyze the linear correlation between the marine litter and coastal plants distribution monitoring data. The analysis is divided into two parts. In the first part, the coverage and diversity index of coastal plants are used as independent variables, and the quantity and quantity of types of marine litter are used as the dependent variables, the analysis results separated by seasons are shown in **Table 3**. In the second part of the analysis, the independent variables remains and the dependent variables are the three common marine litter in different size, the analysis results of each monitoring area on the two coasts separated according to the season are shown in **Table 4**.

2.4 Discussion

Different sizes and materials of marine litter are accumulated on coast in different ways under the external force, and also different types of coastal plants have different distributions on various sand dunes. Therefore, there may be a correlation between the distribution of marine and the specific plants. Through the regression analysis of the first part, there is a linear correlation between the amount of marine and the diversity index of coastal plants. From the results of the second part, the linear correlation between different sizes and types of common marine litter and coastal plants coverage occurs most frequently, especially styrofoam debris. For instance, when a large amount of styrofoam debris accumulates in the coastal plants distribution area (such as *Carex kobomugic*), it will not only hinder the absorption of water by the roots of the vegetation, but also prevent the seeds from contacting the beach in time during dispersal and affect reproduction.

**Table 3**. Data analysis results of first part

| Survey site | Independent variables | Spring | Summer | Autumn | Winter |
|---|---|---|---|---|---|
| Nagahama Coast | MLQ | | | | |
| | MLSQ | | | | |
| Niginohama Coast | MLQ | | | | |
| | MLSQ | | | | |

**Table 4**. Data analysis results of second part*

| Season | Survey site | Monitoring area | HPl | HPm | HPs | PBl | PBm | PBs | Sl | Sm | Ss |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Spring | Nagahama Coast | 1 | | | | ▼ | | | ● | ▼ | ▼ |
| | | 2 | | | | | | | | ● | ● |
| | | 3 | | | | | | | | ▲ | ▲ |
| | | 4 | | | | ▲ | | | ● | ▼ | ▲ |
| | | 5 | | | | ● | | | ● | ● | |
| | Niginohama Coast | 1 | | | | | | | | | |
| | | 2 | | | | | | | | | |
| | | 3 | | | | | | | | | |
| | | 4 | | | | | | | | | |
| | | 5 | | | | | | | | | |
| Summer | Nagahama Coast | 1 | | | | | | ● | | | |
| | | 2 | | | | | | | | | |
| | | 3 | | | | | | | ● | ● | ▲ |
| | | 4 | | | | | | | | | |
| | | 5 | | | | | | | | | |
| | Niginohama Coast | 1 | ● | | | | | | ● | ● | |
| | | 2 | | | | | | | | | |
| | | 3 | | | | | | | | | |
| | | 4 | | | | | | | | | |
| | | 5 | | ▲ | | | | | | | |
| Autumn | Nagahama Coast | 1 | | | | ● | | | | ▲ | |
| | | 2 | | | | | | | | ▲ | |
| | | 3 | | | | | ▲ | | ● | ● | |
| | | 4 | ● | | | | | | ● | | |
| | | 5 | | | | ● | | | ● | | |
| | Niginohama Coast | 1 | ▲ | ● | ▲ | | | | | | |
| | | 2 | | ▼ | | | | | | ● | |
| | | 3 | | | ● | | | ▼ | ▲ | | ● |
| | | 4 | ▲ | ▲ | ▲ | | | | | | |
| | | 5 | ▲ | ● | | | | | | | |
| Winter | Nagahama Coast | 1 | | | | ▼ | | | | ▼ | ▼ |
| | | 2 | | | | | | | | | |
| | | 3 | | | | | | | | | |
| | | 4 | | | | | | | ▼ | | ● |
| | | 5 | | | | ● | | | ● | ▼ | ● |
| | Niginohama Coast | 1 | ● | ● | | | | | ● | | |
| | | 2 | | | | ▲ | ● | | | ▲ | |
| | | 3 | | | | | | | | ▲ | ▲ |
| | | 4 | | | | | | | | | |
| | | 5 | | | | | | | | ▲ | ▲ |

(*The common marine litter of various sizes as the dependent variable from left to right are: hard plastic debris in large, medium, small size; plastic bag debris in large, medium, small size; styrofoam debris in large, medium, small size.)

3.Conclusion

After clarifying the distributive relevance of marine litter and coastal plants, in future marine litter cleaning and recycling activities, we should pay more attention to the marine litter that is easily trapped by coastal plants. While improving the efficiency of marine litter recycling, it can also protect coastal plants, optimize the coastal ecological environment.