A STUDY ON OCCURRENCE CHARACTERISTICS OF MARINE DEBRIS IN THE YELLOW SEA OF KOREA

Seon-Woong Jang[1] and Hong-JooYoon[2]

[1] Dept. of Spatial Information Engineering, Pukyong National University, (608-737) 599-1, Daeyeon 3-Dong, Nam-Gu. Busan, Korea; Tel: +82-51-629-6656; Fax: +82-51-629-6653

E-mail: beards@pknu.ac.kr

[2] Dept. of Spatial Information Engineering, Pukyong National University, (608-737) 599-1, Daeyeon 3-Dong, Nam-Gu. Busan, Korea; Tel: +82-51-620-6656; Fax: +82-51-625-6653

E-mail: yoonhj@pknu.ac.kr

KEY WORDS: Yellow Sea**,** Marine debris monitoring, Occurrence characteristics, Marine environments.

ABSTRACT: The aim of this study knows to occurrence characteristics of marine debris through analysis for change of marine environments and compositions of marine debris. For the distribution and characteristics of marine debris analysis collected in the region of 2000 ㎡ on the Daekwang Beach in the Yellow Sea of Korea. In the results of monitoring from 2008 to 2009, the total number of the marine debris was 2,207(Number) in this site. Also analysis for seasonal changes of marine debris used observed value, Topex/Poseidon data concerning tidal current, sea surface wind, and sea surface circulation. Tidal currents appeared that southwest flow in around survey area. Sea wind was the dominant wind of north direction. In addition, sea surface circulation that appeared in form connected with the north wind. This studied results is expected to that change of marine environments affect occurrence of marine debris.

1. INTRODUCTION

The amount of marine debris is keep increasing and inflowed marine debris are threatening marine environments and ecosystem. And this problem is also becoming a serious social issue problem because this marine debris damages fishery and causes huge economical loss. Moreover, due to the expansion of international flow of the floating debris which are inflowed through beaches, the coastal states are seriously damaged by those pollutants and it might creates diplomatic conflicts between countries. In the early 2000, initiative approach on international flow of the floating debris was made in international level by UN. And, in Korea, various study activities are on the move such as study on distribution and composition characteristics of the marine debris(Park & Kang, 2005) and study on estimation of amount of marine debris generation(Lee, et al, 2007). However, a scientific approaches on identifying features of the generation and flow of marine debris are still inadequate. Thus, to introduce solutions for rising problems of international marine environment and for efficient policy for marine debris management, it is necessary to establish a practical national policy by acquiring of detailed and clear basic data for marine debris drifted into coast.

2. DATA AND METHODS

2.1 Study Area

Target area for this study is Daekwang Beach, Imja-do, Sinan-gun, Jeollanam-do which located near by the Yellow Sea of Korea. The reason for selecting this area is because it has high generation ratio of marine debris drifted into coast. and high chances of influx of marine debris drifted from China. The area has relatively simple coastal lone and it is open towards the North. It also has 200~300m width of gentle sand beach along with 7~8km of its coastal line(KIGAM, 2003). This study is to identify the characteristics of generation of marine debris through analyzing the change of marine environment and composition of marine debris by selecting certain territory in the above target area(Fig 1).

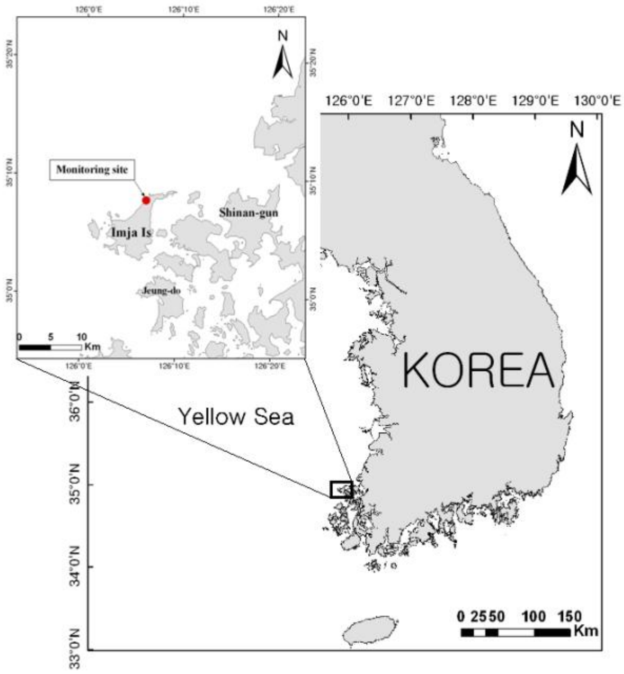


Figure 1. Location of the study area.

2.2 Marine Debris Monitoring

In this study, to identify the generation characteristics of marine debris we utilize monitoring data which was performed from 2008 to 2009 by KOEM(Korea Marine Environment Management Corporation). The monitoring was initiated in the same areas of 100m×20m(=2000 ㎡) in Jan, Mar, May, Jul, Sep and Nov and quantity, weight and volume were estimated by the type of collected debris. Also, extra sorting and evaluation were performed for the debris inflowed from foreign country.

2.3 Analysis for Marine Environments

To identify the influx route of marine debris in the research area, we analyzed marine environment of the Yellow Sea such as tidal current, onshore wind and the flow of surface layer. To analyze the effect of tidal current we utilize data from 2008 to 2009 which was obtained by observatory that is operated by KHOA(Korea Hydrographic and Oceanographic Administration) and is located near by our research area. To identify what kind of distribution does velocity and direction of fluid have, we expressed the data as Scatter plot. And to consider onshore wind that mainly affects object movement on the surface of the sea, we utilized observation data/hour which is collected from 2008 to 2009 by Mokpo Meteorological Office and we expressed it as seasonal Wind Rose Diagram. Lastly, we identify the seasonal flow of sea surface from 2008 to 2009 by using TOPEX Monthly Data; observation satellite for change of sea surface.

3. RESULTS

3.1 Characteristics and Seasonal Changes of Marine Debris

The result of analyzing the monitoring data from Mar, 2008 to Dec, 2009 is as Fig. 2. Total 2,207 pieces of debris were collected and the majority of them were plastic(955), Styrofoam(654), wood(125) and glass(57). 90% of them were generated domestically and we think the main causes of this are the inflow of debris through rivers which was originally discarded from the land and dispose of debris from fishery and fishing boat etc. The amount of debris by season was the highest in both Jul.(570) and Nov.(565) which are summer and fall season, respectively.

On the other hand, in Fig 2, the number of marine debris that are caused by foreign country was 227. This can be translated that not only the domestic causes but also an inflow from foreign country also has huge effect on movement of the marine debris.

In Fig 3, You can see the marine debris' composition factors and its features of generation by seasons. More than 90% of them are plastic which are so easy to float around on the surface. Bottles including PET bottle are 70% among those plastics and 20% are fishery buoy. The amount of debris by season was the highest in both Nov.(58) and Jan.(50) when the overall generation rate of marine debris was relatively high. But, considering the fact that there was no monitoring on Jan, 2008, we can assume that the ratio of Jan. could be similar with Nov. or even more than Nov.

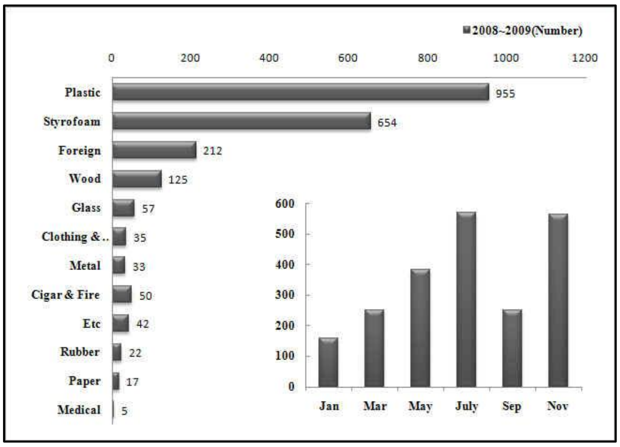


Figure 2. Characteristics and Seasonal changes of total marine debris collected from the monitoring site.

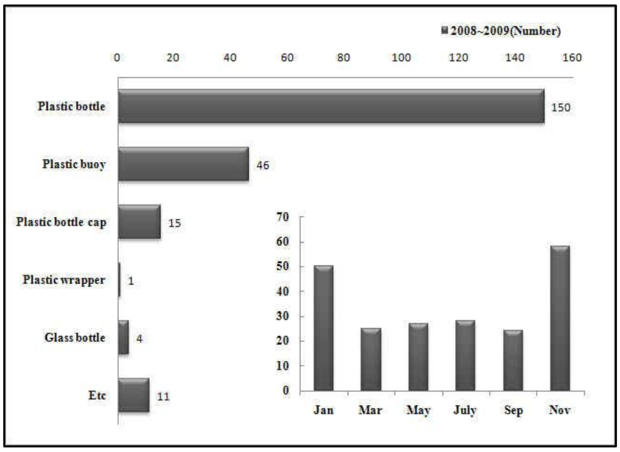


Figure 3. Characteristics and Seasonal changes of foreign marine debris collected from the monitoring site.

3.2 Characteristics of Marine Environments

3.2.1 Tidal current: The direction of transportation of floating objects on the sea surface can be various by each area's circulation of tidal current.(Jun & An, 1997). Fig 4 is a Scatter plot which identifies what kind of distribution does velocity and direction of fluid have. In flow of tidal current in 2008, all season except fall(Fig 4c) shows a back and forth movement of Northeast-Southwest way. If the sea surface of this area shows the flow that is inflowed into domestic sea from foreign sea, it can be assumed that the pollutants from foreign sea are gradually transported into domestic seashore along with Northeast-Southwest tidal current.

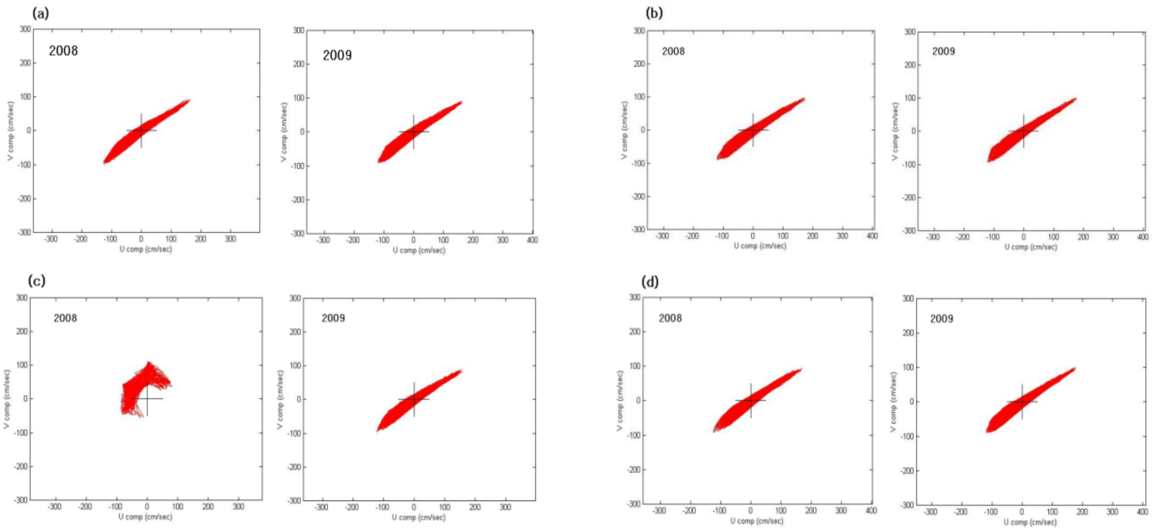
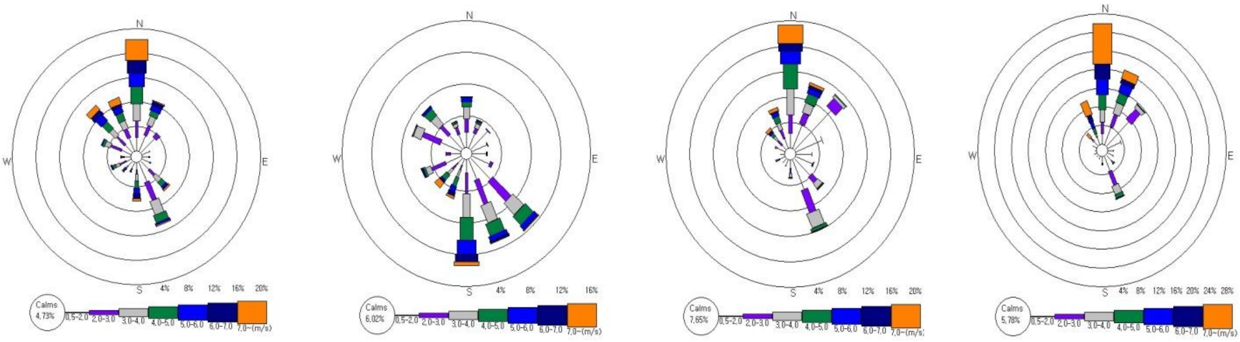


Fig 4. Scatter Plot from 2008 to 2009: (a) from March to May, (b) from June to August, (c) from September to November, (d) from December to February.

3.2.2 Sea Surface Wind: Wind has strong effect on mid & long term movement of the floating objects along with tidal current. Because the sea water is moved by the direction of the wind it has huge effect on objects transportation on the sea surface. The Yellow Sea, which includes our research area, is affected by monsoon. Thus, the direction and speed of the wind keep changing by seasons. In Fig 5, we identify size and direction of the dominant wind in research area by each season through the monthly average strong wind from 2008 to 2009.

Although the major direction and speed of wind was different from each season in the research area, the Northern type of wind was dominant in their direction only except summer season. And the frequency of wind speed of over 3.0m/s was 13.5%(spring season), 18%(summer season), 13.5%(fall season) and 21.5%(winter season), thus the wind speed was relatively strong in both winter and summer season.



(a) from Mar to May (b) from Jun to Aug (c) from Sep to Nov (d) from Dec to Feb

Fig 5. Wind Rose of Seasonal from 2008 to 2009.

3.2.3 Sea Surface Circulation: The Yellow Sea and East China Sea are affected by monsoon so its circulation of sea water can be changed by each month. The surface flow of the Yellow Sea has fluctuation of time and space and, mostly, it can be compared by its summer and winter structures. In this study, to identify the spread of pollutants around the target area, we utilized TOPEX Monthly data from 2008 to 2009 and confirmed the flow of sea surface and the change of sea surface height by seasons(Fig 6).

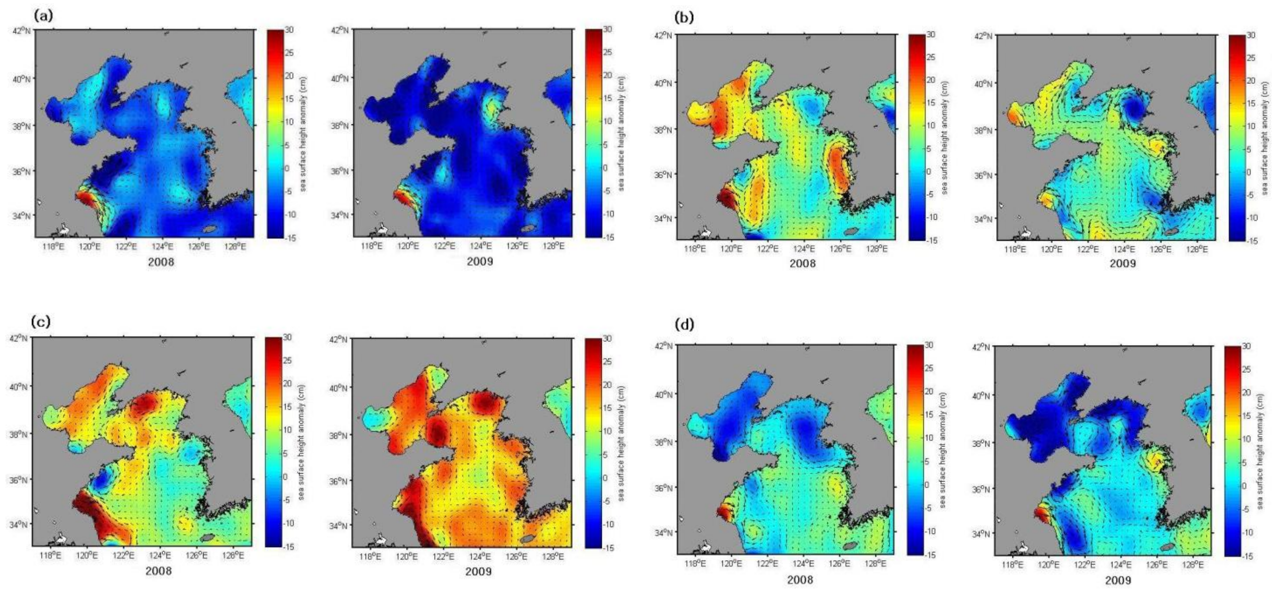


Fig 6. Sea Surface Height Anomaly and Sea Surface Circulation from 2008 to 2009: (a) from March to May, (b) from June to August, (c) from September to November, (d) from December to February.

Summer season(Fig 6b) shows the flow that is inflowed into research area from both East China Sea and Southwest Sea and it also shows the clockwise-rotational flow along with Northern coastal line of the Yellow Sea. Fall(Fig 6c) and Winter(Fig 6d) season shows the wide range of counter clockwise-rotational flow in center area of the Yellow Sea. And it also shows the fact that the flow which was heading towards South along with Chinese coastal line from the Bohai Bay is inflowed into Southwest Sea which includes research area.

4. CONCLUSIONS

In this study, we identify the features of marine debris in research area; Daekwang Beach, Imja-do, Sinan-gun, Jeollanam-do which located near by the Yellow Sea of Korea. Total 2,207 pieces of debris were collected in 2,000 ㎡ area from Mar, 2008 to Dec, 2009. As a result of the composition analyzation, majority of them was plastic(44%), which can be easily floating around on the sea surface. Also, recently, as the damage caused by international flow of the marine debris is increasing it is necessary to accumulate related data for the marine debris from foreign country. And the ratio of marine debris from foreign country takes 10% of total marine debris and 90% of them were plastics. On the other hand, we analyzed seasonal change of marine environment to identify the change of amount of generation of debris which are drifted into coastal line. In tidal current, all season except fall showed a back and forth movement of Northeast-Southwest way and the Northern type of onshore wind was more dominant than Southern type. Total generation was relatively high In Jul.(570ea) and the Southern type of wind was dominant and the flow of sea surface showed a clockwise-rotational flow from research area to Northern coastal line of the Yellow Sea. In Nov, when both total amount of marine debris generation(565ea) and the amount of foreign-caused marine debris(58ea) were high, the Northern type of wind was dominant but the flow which was heading towards South along with Chinese coastal line from the Bohai Bay was inflowed into Southwest Sea which includes research area. In further studies, we are planning to systematically identifying the route of influx of the marine debris by analyzing the factors of marine environment in more specified classifications along with monitoring data which will be accumulated for many years from now on.

REFERENCES

KIGAM, 2003. Study on the Coastal Geology of West Coast and the Terrestrial Wetlands; Study on the Coastal Geology of West Coast.

Lee, Y. B., Park, S., Ryu, C. R., Kim, H. and Yoon, H. S., 2007. Characteristics of Marine Debris collected from the Coastline of Sandbar in the Nakdong River Estuary. Journal of the Korean Society for Marine Environmental Engineering, 10(3), pp. 148-154.

Park, S. S., Kang, H. y., 2005. The Quantity and Characteristics of Marine Debris Collected from the Coastline in Jeonnam. J. Korea Society of Waste Management, 22(2), pp. 203-212.

ACKNOWLEDGEMENTS

This work was researched by the supporting project to educate GIS experts