Seeking beautiful, trash-free oceans

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1. Introduction

The amount of trash that drifts along and onto the shores of the East China Sea and Sea of Japan has been increasing in recent years. This trash, which drifts into sea areas around Japan and then onto its coastlines, is causing problems that include degradation of marine and coastal environments. Much of the trash is made of artificial materials that do not exist in the natural world, such as plastic. Because it is not biodegradable, once the trash enters the environment, it will exist as semipermanent drift trash unless it is recovered. This phenomenon occurs not only in the East China Sea and the Sea of Japan. In the North Pacific Ocean near Hawaii, there is a high concentration of trash called the Great Pacific Garbage Patch that is roughly twice the size of Texas.

There are many cases where regions faced with serious drift trash problems are also grappling with the problem of declining population. In such regions, the cost of disposing of onshore drift trash is an excessive burden on local government finances. And even if no financial problems exist, trash that drifts ashore tends to remain where it is because it cannot be reached by people, to say nothing of heavy equipment. Moreover, it is clear that some of the trash that drifts ashore comes from other countries.

Given these circumstances, Japan enacted a "Law for the Promotion of Marine Litter Disposal" in July 2009 to preserve favorable coastal sceneries and environments and to promote smooth disposal and control generation of driftage. In addition to requiring coast managers and others to take necessary measures to dispose of driftage, the law enables the government to quickly enact laws and implement necessary financial measures to promote countermeasures against driftage. The law's enactment represents a significant step toward resolving the drift trash problem, and it is expected that even further measures will be taken in the future.

To solve the drift trash problem, it will be important to reduce the amount of trash that washes out to sea as well as to collect trash that is already in the sea. Accomplishing this will require clarification of trash sources and drift processes together with continuous monitoring. The Coastal and Marine Department is engaged in research in these areas in cooperation with concerned organizations. The content of this research is presented below.

2. Drift trash prediction experiment in the East China Sea

Implemented under the Ministry of the Environment's Global Environment Research Fund, this research is a collaborative undertaking involving researchers from Ehime University, the University of Tokyo, NILIM, and AIST as well as an NGO (Japan Environmental Action Network [JEAN]) and local citizens (Goto City). The main research objectives are: 1) identification of places of origin, seasons, and amounts of drift trash; 2) prediction of drift seasons and locations based on the results; and 3) preparation of recommendations on methods for continuous trash survey. Figure 1 provides a research outline.

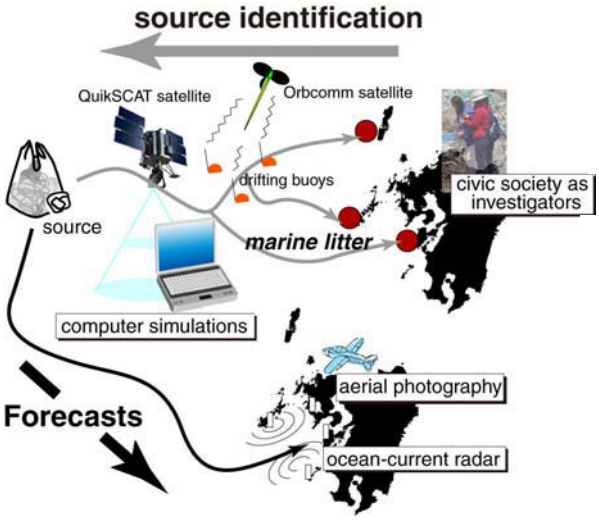

Figure 1: Research outline[1)]

To begin, drift trash is collected on Fukue Island of the Goto Island chain. The trash is then sorted, counted, and weighed. The origins of PET plastic bottles, lighters, and other items are deduced from labels and other clues with the help of the NGO and local residents. Then the locations of origin, seasons of origin, and amounts are back-calculated from a simulation that is based on data obtained in this way. From this, predictions of trash drift to the Goto Islands are made using these calculations as boundary conditions. To identify areas where trash accumulates, which is information necessary for trash collection on the sea, sea areas of accumulation are deduced in real time from surface flow distribution data that are obtained from high-frequency (HF) ocean surface radar for the areas off the west coasts of the Goto Islands. Web camera-based technology for monitoring drift trash is used to verify the accuracy of season and location predictions.

From this research, it has become apparent that large amounts of trash drift ashore during the winter, and that there are clear seasonal fluctuations in locations of origin and deduced by-country drift amounts. Moreover, the researchers successfully performed inverse-estimation based on simulations of drift trash. At the present time, research is focusing on one-month prediction of drift trash with forecasted wind patterns issued by the Japan Meteorological Agency, using the inverse estimates as boundary conditions. Furthermore, the researchers developed methods for identifying trash accumulation regions using the results of HF radar observations, and a method for quantifying movement speed and coverage area by analyzing digital images of trash that is scattered over marine surfaces.

3. Issues for the future

The researchers believe that the "drift trash prediction experiment in the East China Sea" produced value data and developed useful methods for resolving problems associated with drift trash. They also intend to make proposals on regional and long-term trash monitoring in the future based on the developed image-analysis technologies and correlations among the amounts of various trash types that were actually collected.

It should be noted that many organisms—including drifting seaweed, juvenile fish, and floating larvae—gather in marine areas of accumulated trash, and thus the possibility exists that collecting all floating matter could have a serious impact on organisms that, for example, use the junction between two currents in their life cycles. Consequently, it may be necessary to engage in technical development that goes one step beyond "effective collection" to "appropriate collection."

Furthermore, hazardous substances such as PCB and DDT are absorbed in the surfaces of plastic drift trash in high densities. This suggests that drift trash is not only a problem in terms of scenic beauty but also a serious problem for the ecology. As a result, it is thought that efforts to tackle the drift trash problem will be required from the standpoint of transport of hazardous materials as well.

4. Conclusion

Everyone wants to see beautiful, trash-free oceans. There can be no doubt that the best way to achieve this will be to not release trash into the ocean.

Although we may prefer not to think about it, it is possible that hazardous substances attached to drift trash are becoming concentrated through the food chain and winding up in the fish on our dinner tables. Moreover, it is reported that much of the Great Pacific Garbage Patch is made up of trash originating from Japan. Thus, we must recognize that we are not only the victims of the drift trash problem but also its perpetrators. Each of us must understand the drift trash problem and do take whatever action we can to solve it.

At the same time, however, no matter how much we strive to reduce the amount of trash that is discharged into the ocean, some trash will always end up there nonetheless. Thus, in collaboration with various organizations, the researchers intend to continue their research toward development of technologies for appropriate collection and ascertainment of the effects of drift trash.

1) Isobe, Atsuhiko, "East China Sea marine-litter prediction experiment conducted by citizens and researchers", Ship & Ocean Newsletter, No.205, pp. 2-3 (2009)