STUDY OF BEACH LITTER ON REMOTE ISLAND, CASE STUDY: AINOSHIMA ISLAND, JAPAN

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Abstract

Ainoshima Island is a Remote Island located north of Kyushu Island, which is also known as a popular tourist attraction named Cat Island. The island is inhabited by a small population but is frequented by tourists to enjoy nature and fishing. The coastline is in the form of cliffs and sandy beaches, but there is much marine debris on the sandy beaches. In addition, its location allows waste from the surrounding area to be carried by currents to this island. This research examines the diversity of categories and types of macroplastic litter trapped on the sandy beach of Ainoshima Island. Survey transects were conducted in the spring of 2023 via visual observation based on a survey method developed by NOAA in 2012. The survey results were then categorized based on a photo guide database from the OSPAR Maritime Area for Active Monitoring of Marine Debris on the Beach. Data on the types of waste found are divided into artificial polymer materials (plastic), rubber, cloth, paper/cardboard, processed/finished wood, metal, glass, and ceramics. As a result, the plastic category is the dominant category of the total type of waste trapped in sandy beach areas.

Keywords: *beach litter, transect survey, remote island, OSPAR*

Introduction

Coastal waste has become a global threat today and is considered a critical issue of public concern. Coastal waste monitoring is an essential part of identifying marine pollution. Marine debris is anything that is continuously produced or discarded or left behind in the marine and coastal environment (Coe & Rogers, 1997) (Galgani et al., 2013) (Di-Méglio & Campana, 2017) that is intentionally discarded, accidentally lost, or carried by winds and rivers, into the sea and washed ashore (*Gesamp.Pdf*, n.d.).

Marine debris is divided into various categories of materials, such as metal, glass, rubber, paper, and plastic, representing about 80% of the waste accumulating on coastlines, sea surfaces, or seabed (Barnes et al., 2009). Plastic has been produced since the mid-1950s, and production rates have steadily increased and are expected to continue in the coming decades; in 2019, annual production increased nearly 230-fold, reaching 460 million tons (Ritchie & Roser, 2022). Evidence indicates that plastic pollution will

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soon become a persistent global environmental problem (Adyel, 2020).

In fact, due to the influence of ocean waves, large amounts of marine debris eventually end up on beaches worldwide, even in very remote areas (Barnes et al., 2009), because they will be trapped by sand and coastal vegetation. The increasing amount of beach litter will threaten ecological life, the economy, and beach recreation. In addition, there are physical impacts on marine biota, such as attachment to and consumption of plastic waste. This global threat worried the public (Gall & Thompson, 2015). A decrease in the aesthetic value of the beach, especially the beach used as a tourist object, will cause a bad image and an impact on decreasing tourist visits, which will cause a loss of revenue from the tourism sector. In addition to internal costs, beach cleaning will increase. Therefore, a study regarding the diversity of beach debris is essential to support coastal monitoring activities by identifying beach litter and providing valuable information for establishing an efficient cleaning strategy in the future.

Ainoshima Island is a small heart-shaped island around 7.5 km off the coast of Shingū Town north of Kitakyushu City, Fukuoka Prefecture, a tourist island known as Cat Island. Ainoshima is one of the Remote islands in North Kyushu Island, with its position facing neighboring country. This island is inhabited by a small population but is frequented by tourists to enjoy nature and fishing. Unfortunately, this beautiful sandy beach has a lot of marine debris. In terms of location, garbage from the surrounding area may be carried by currents to this remote island.

Monitoring beach litter uses a visual monitoring approach through surveys with a transect method along the coastline. Surveys like this can provide an accurate picture of the categories and types of waste on the beach. Classification of beach litter requires surveyor judgment and skills. This research aims to investigate the types of litter categories on remote islands. This study will be a baseline survey to investigate the type and abundance of macro litter trapped on the sandy beach of Ainoshima Island, which will be helpful to add insight into the beach debris of a globally remote island.

Research Methodology

Research Location

This research is located on Ainoshima Island, Kitakyushu City, Fukuoka Prefecture, Japan (Longitude = 130.81232719123625 E, Latitude = 34.00108115976109 N) as shown in **Figure 1**.

Figure 1. Map of Location of Study

Tools and Materials

The equipment used in this research is survey maps, GPS for finding coordinates, packages worksheets, a camera, tape, a clipboard, and a pen. The worksheets consist of beach location Information Sheets, Coastal Transect Data, route data, a list of types of waste for each sub-transect, and several guidelines, including a catalog list of waste types with their respective codes according to the OSPAR catalog photo (Street & Wc, n.d.).

Data Collection

This research focuses on the sandy beach of the northern part of Ainoshima Island, which is the location of the research sample. Before starting sampling, we mapped the coastline of Ainoshima Island and divided it into three categories: Sandy Coast, Rocky Coast, and Port.

The survey method in this study was the transect method developed by NOAA in 2012 (Burgess, 2021). Survey transects were conducted in spring (April) 2023. The survey area is a sandy beach area with a 100 m horizontal transect. The transect is then divided into five lanes with a length of 20 meters each. The five lines are A1 (101.66 m2), A2 (129.35 m2), A3 (152.36 m2), A4 (133.15 m2) and A5 (137.82 m2). From these five lines, a square box is randomly made with a size of 3m x 3m, called a sub-transect. Macro litter found on the sub-transects was collected, sorted, and analyzed into several categories. The survey transect distribution map is shown in **Figure 2**.

Figure 2. Data Collection Visual Survey Process

Fig. 3. Survey transects distribution map for a sampling of Visual Survey.

Data Analysis

The surveyor collects beach waste in the sub-transect box and then sorts and records it, as shown in **Figure 3**. Digital photos are taken to facilitate correct categorization. Debris visible to the naked eye found during the survey is cataloged. Analysis of the type of waste found in the sub-transects was then categorized with the OSPAR ID code from the OSPAR photo catalog. Carefulness and skills are required in recognizing each type of waste found to be cataloged.

Result and Discussion

In the spring of April 2023, after conducting a site survey and data collection, 29 types of waste were found on the sandy beaches of Ainoshima, which were then grouped into nine categories according to **Table 1** and **Figure 4**.

Waste that leaks and enters waterways on land can flow into river estuaries and the open sea, becoming marine and coastal waste that can directly threaten the condition and productivity of water areas (Koly et al., 2021).

The position of Ainoshima Island, one of the northern outer islands that almost faces neighboring countries and other regions, allows the plastic to be carried by ocean currents. The influence of the tides makes much plastic waste trapped on sandy beaches.

Abundance of Macro-Litter on Ainoshima Island

Based on the type, 15 types of polystyrene were found on the sandy beaches of Ainoshima Island, and these are the most diverse types compared to other types of litter on the beaches of this island. Human activities continue to develop in line with developments in science and technology as well as economic prosperity, which impact the type and amount of waste generated for the environment (Koly et al., 2021).

Categorically, it can be concluded that the discovery of types of waste on the sandy beaches of Ainoshima Island revealed that the most common types of waste found were those related to food consumption, such as (shopping) bags, drinks (bottles, containers), food containers including fast food containers, packaging crisp/sweet, cups, cans, cartons (tetra pack). Furthermore, the other common types of waste are related to shipping and fisheries, such as jerry cans, syringe containers, ropes, fish boxes, nets, and boots. This type of goods is wasted during the shipping and fishing process, which is then carried by ocean currents to this remote beach location.

Table 1. List of finding Litter Items on Ainoshima Island

OSPAR ID	Items
Plastic • Polystyrene	
2	Bags (e.g. shopping)
4	Drinks (bottles, containers, and drums)
5	Cleaner (bottles, containers, and drums)
6	Food containers incl. fast food containers
10	Jerry cans (square plastic containers with handles)
11	Injection gun containers
15	Caps/lids
19	Crisp/sweet packets and lolly sticks
25	Gloves (typical washing-up gloves)
31	Rope
34	Fish boxes
40	Industrial packaging, plastic sheeting
42	Hard hats
46	Plastic/polystyrene pieces 2,5 cm > < 50 cm
Paper • Cardboard	
60	Bags
61	Cardboard
62	Cartons e.g. tetrapak (other)
65	Cups
Glass	
89	Other metal pieces < 50 cm
92	Light bulbs/tube
Sanitary waste	
102	Other sanitary items (diapers)
Medical Waste	
105	Other medical items (mask)
Metal	
78	Drink cans
89	Other metal pieces < 50 cm
Wood (machined)	
74	Other wood < 50 cm
75	Other wood > 50 cm
Cloth	
57	Shoes (leather)
Rubber	
50	Boots

Figure 4. List of Finding Litter Debris on Ainoshima Island (The numbering follows the OSPAR ID)

The trend of anthropogenic waste found after the Industrial Revolution was dominated by inorganic waste such as plastic, cans, glass, cloth, and others (Koly et al., 2021). However, post-COVID-19, the amount of medical waste, such as masks, continues to increase and grow, and then it is carried by ocean currents to sandy beaches on remote islands. A type of medical waste in the form of a mask was found on Ainoshima Beach, carried away by the ocean currents or perhaps thrown away by visiting tourists. Different reports from the coastal area in Cambaya Village, Indonesia (Anggraini et al.,

2021) report that there is still more organic waste, namely 58%, and inorganic waste, 42%. Most residents do not have access to communal shelters, so they have the potential to dispose of waste directly into water bodies.

The most common litter category is found on Ainoshima Island

There was a category of waste with the highest order found in all locations, namely polystyrene (50%), paper (14%), followed by wood, glass, and metal (7%). Details of the percentage of each type of marine litter can be seen in **Figure 5**.

The Plastic (Polystyrene) category is the first category most found on the sandy beaches of Ainoshima Island. Since the mass production of consumer plastic products began in the 1950s (Armitage et al., 2022), plastic waste has reached the natural environment, accounting for 60-80% of marine debris globally.

The most common category of litter found on Ainoshima Island is plastic (polystyrene); this is in line with findings that plastic still dominates litter on the Indonesian island (Koly et al., 2021) and is found in almost all beaches in the world such as Teluk Kemang Beaches, Malaysia (Koly et al., 2021) and is found in almost all beaches in the world such as Teluk Kemang Beaches, Malaysia (Khairunnisa et al., 2012), Southeast coast of India (Perumal et al., 2021) and Lanao Del Norte Coast, Philippines (Pacilan & Bacosa, 2022).

In addition, plastic is the most dominant item not only because of its wide use and durability but also because its buoyancy (Moore, 2008) In addition, plastic is the most dominant item not only because of its wide use and durability but also because its buoyancy (Gall & Thompson, 2015).

Tourism and fishing activities can affect the amount of waste on the coast if not appropriately managed. The position of Ainoshima Island facing the territorial waters of neighboring countries also influences the presence of coastal litter.

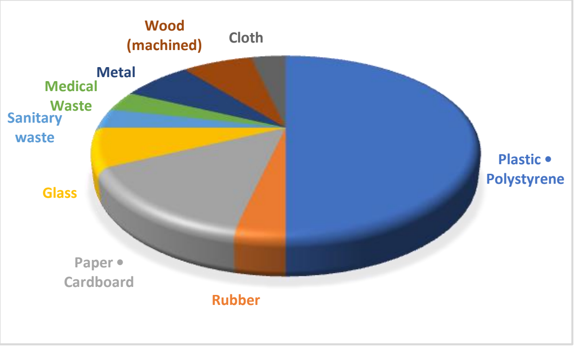

Figure 5. The most common litter category is found on Ainoshima Island

Efforts that can be made to prevent pollution of the coastal environment do not have to focus on continuous mechanical cleaning, which is the end of the pipe solution. However, a massive global effort is needed to reduce the use of single-use plastics on land. Globally, limited land-based waste management facilities also trigger the discharge of various types of waste into water bodies.

Conclusions

The results showed that 29 types of waste were found on the sandy beach of Ainoshima, which were then grouped into nine categories. The categories of waste with the highest order were found in all locations, namely polystyrene (50%). It can be concluded that the findings of waste on the sandy beaches of Ainoshima Island are mostly related to food consumption, shipping, and fishing. However, medical waste, such as masks, was also found. Special attention is needed for routine mechanical cleaning, so this beautiful beach is not polluted by garbage. Strong attention needed to reduce single-use plastics globally will be the best solution to reduce marine litter. Further research is needed to identify and monitor litter sources in different seasons.

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