Exploratory Research on Promoting Learning among Local Residents through Coastal Conservation Activities using Citizen Science

論　文

Exploratory Research on Promoting Learning among Local Residents through Coastal Conservation Activities using Citizen Science

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Abstract

In recent years, citizen science has emerged in various regions, and they conduct investigations and accumulate local data that is beyond the reach of governments and experts. This research examines the applicability of citizen science methods that have been developed in Thailand—which involve experts and local residents working together—to the context of Japan. Moreover, we examined the possibility of implementing coastal conservation activities that children and adults can participate in. Based on the coastal conservation activities practiced in Thailand, we conducted 1）coastline monitoring surveys, 2）the provision of ocean education at an elementary school with the aim of cooperating with local communities and schools, and 3）seminars for citizens. As a result of examining the possibility of implementing these activities using the interview and questionnaire survey with targeting participants for these activities, it became clear that there is potential for expanding these activities while raising interest from children and adults.

Ⅰ Introduction

In recent years, citizen science has emerged in various regions. These citizen scientists are local residents who investigate and accumulate region-specific data that is beyond the reach of governments and experts. Citizen science does not just involve accumulating data; it can also enhance local residents' interest in nature and their sense of ownership It also enables long-term involvement in environmental conservation（Harada, 2018; Maruyama, 2007）. In Japan, the new educational guidelines implemented in 2020 call for systematic and continuous

collaboration and cooperation between communities and schools based on the philosophy of "creating a better society through better school education." These guidelines emphasize the harmony between the natural environment and human life, as well as the use of science and technology（Ministry of Education, Culture, Sports, Science and Technology, 2017）. However, the importance of such citizen science methods and cooperation between communities and schools has not permeated society. In this study, we will examine the applicability of the citizen science method developed in Thailand—which involves collaboration between experts and local residents—to the situation of Japan. We will also introduce new knowledge to Japan and examine the possibility of implementing coastal conservation activities in which both children and adults can participate.

Ⅱ Methods and Results

The coastline of Japan has a total length of about 35,000 km, making it the sixth longest coastline in the world. Coastal management has been proposed as a method of protecting the baseline of the territory and territorial waters, improving disaster prevention and its ability to protect the lives and property of the hinterland, and creating a coast that is familiar to the region（MLIT Ministry of Land, Infrastructure, Transport and Tourism, 1998）. In particular, sandy beaches are buffer zones that protect the country from the sea, and they serve as habitats for a variety of aquatic organisms while also enabling various leisure activities, such as sea bathing, sightseeing, and field observation. However, although environmental problems such as coastal erosion are increasing on sandy beaches, there is insufficient region-specific data on changes in coastlines. However, activities based on citizen science are locally oriented, and citizens take the initiative to collaborate with specialized researchers and local residents, leading to the conservation of sandy beaches in a manner that is more in line with the actual conditions and needs of the region（Suda, 2017）.

In this study, referring to the coastal conservation activities practiced in Thailand, we will conduct １）monitoring surveys of the coastlines, ２）providing ocean education at an elementary school, ３）and conducting seminars for citizens. Subsequently, we will interview participants, receive feedback from them, and verify the possibility of implementing these activities from interview surveys targeting participants.

1 Beach Monitoring

1）Monitoring Area

The target area of this survey was Goshikigahama Beach in Noto Town, Ishikawa Prefecture（**Fig. 1**）. Most of the sandy beaches along the coast of Noto Peninsula, including Goshikigahama Beach, show signs of erosion, which is a problem. The coastline of Noto Peninsula is dotted with so-called "pocket beaches," which are sandy beaches surrounded by cliffs and rocky shores. Therefore, countermeasures, including the installation of facilities such as jetties and artificial reefs to stabilize the sand beaches, as well as beach nourishment, have been taken（Ishikawa Prefecture, 2016）. A detached breakwater has been built off coast of Goshikigahama Beach, and convenient facilities have been developed to enhance the beach, granting it an extremely high tourist value.

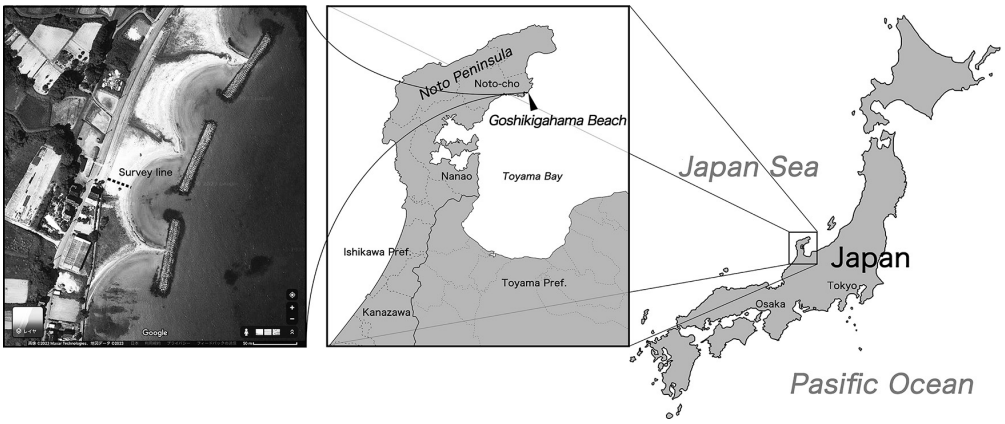

Fig.1 Location of beach monitoring: Goshikigahama Beach, Noto Town, Ishikawa Prefecture

Note: The survey line in the left figure indicates the location where the monitoring was conducted.

2）Monitoring Method

This survey applied a method developed by Ritphring Sompratana at Kasetsart University, Thailand. The profiling method used in the survey is based on the physical principle of fluid. According to Ritphring and Tassanee (2022), the beach monitoring survey brings about a better perception of coastal management by providing quantitative data on the spatial and temporal evolution of beaches. Since this is a citizen science approach for beach monitoring, the method should be simple and take the capability of all participants into account who have different backgrounds of education. All simple and low-cost homemade instruments are made

by citizen scientists at the initial stage. This method involves local residents monitoring the coastline. As of 2022, this monitoring method was being used by local residents in Thailand to monitor 15 coastlines using a smartphone application. The data helps the local residents understand the changes in the coastline, and the data was also used in the formulation of coastal zoning plans proposed to the government in collaboration with researchers and local residents. Accumulated data was utilized by Ritphring to understand and predict future coastline changes（Ritphring and Tassanee, 2022）. The monitoring survey involves measuring the distance to the shoreline from a marked point every 2 meters; this data is then inputted into the smartphone app BMON（Beach Monitoring）, and the length of the coastline is calculated throughout the year. Participants also take pictures of the coast at four directions and track how the coast changes in response to factors such as storms, sea level rise, and human activity. A feature of this method is that the tools used for the monitoring are simple, low cost, and easily available to local residents. In fact, for this study, we were able to locally procure all the materials , and the cost is about 2,200 JPY. However, we could not find a level that was reasonably priced and suitable, so we used one procured from Thailand. The supplies needed for this study included a drill and scissors, and it took two people about 30 minutes to make the measuring apparatus. The materials used included polyvinyl chloride pipe（1.3 m x 2 m; outer diameter 2.5 cm）, two tape measures, a 5-meter plastic tube, a 2-meter cord, eight screws, and six rubber bands. The completed tool is shown in **Figure 2**.

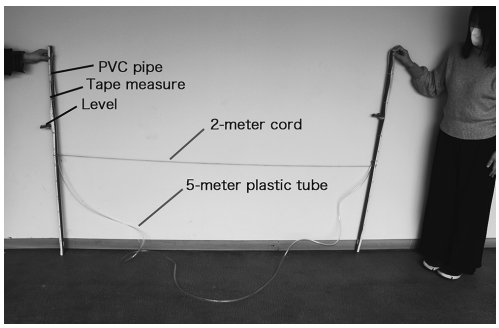

Fig.2 Tool for monitoring survey

Fig.3 Beach monitoring

3）Monitoring Results

At the beginning of the monitoring survey, we explained the significance and necessity of coastal monitoring as well as the survey procedure through classroom lectures. After that, we went to Goshikigahama Beach, the site of the field survey, and conducted a monitoring survey. The participants included three university students, one university instructor, and two

staff members of the local ocean education organization. The first monitoring session was conducted in December 6, 2022, and a second session was conducted in January 12, 2023, as shown **Figure 3**.

Figures 4 and 5 show screenshots of the BMON smartphone application that visualizes the monitoring results. **Figure 4** shows the results of the first monitoring session, and **Figure 5** shows data for two months, with the pale line representing December 2022 and the strong black line representing January 2023. It visualizes the movement of sand every month and the change in the distance from the coastline to the beach. The following responses were obtained from those who participated in the monitoring survey.

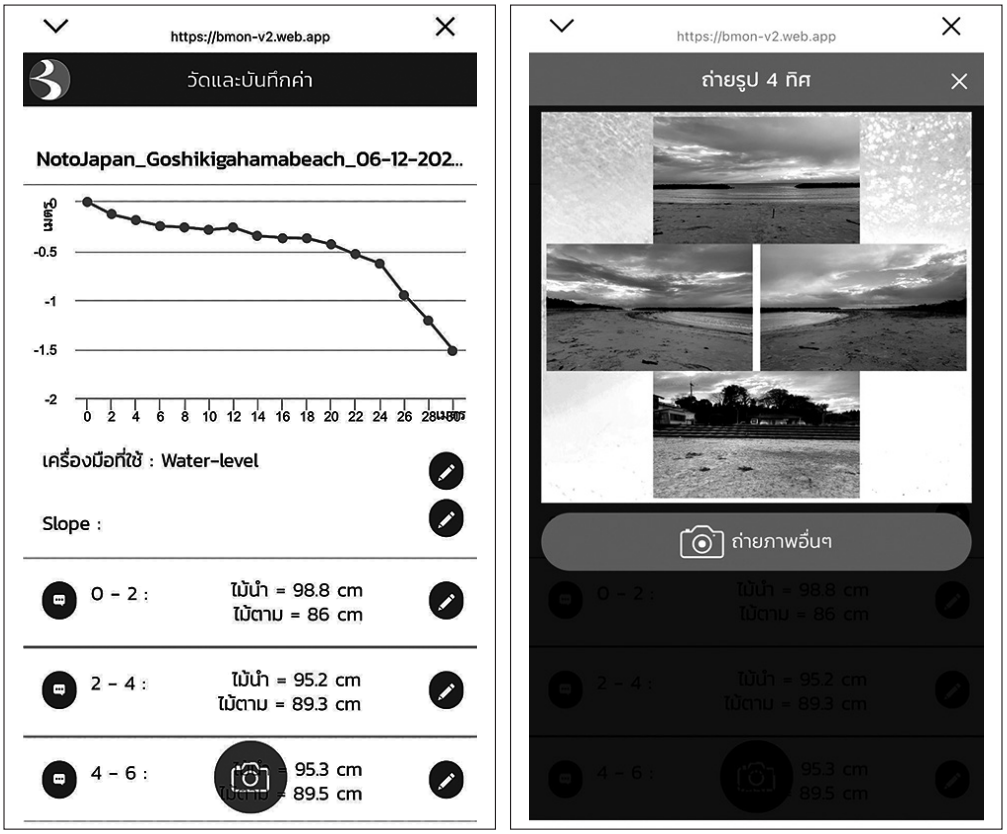

Fig.4 Survey results of coastline monitoring using the data accumulation app BMON in December 6, 2022

Note: The X-axis in the left figure represents the distance from the starting point to the beach (m), and the Y-axis represents the height (m) when the starting point is 0 m. The figure on the right shows the front, rear, left, and right photographs that were taken during the survey.

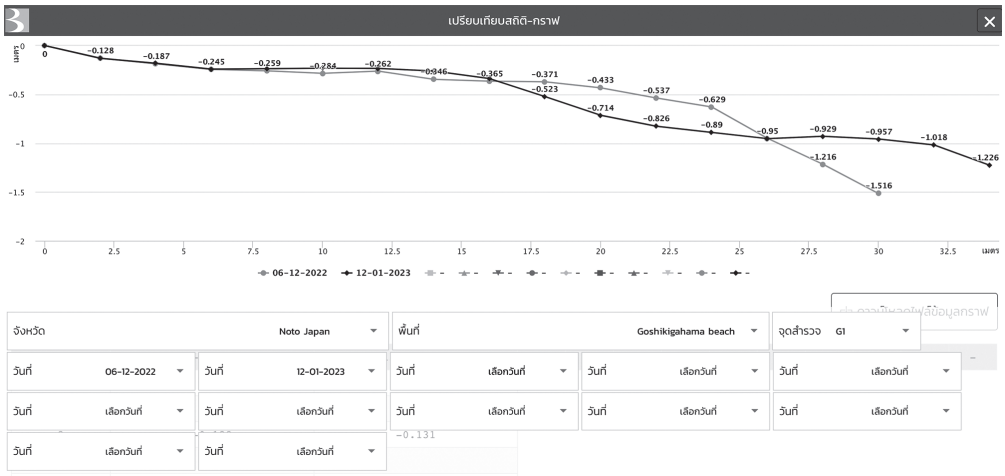

Fig.5 Survey results of two months of beach monitoring in December 6, 2022 and January 12, 2023

- I visit Goshikigahama Beach several times a year to swim and walk, and when I go, I look for and interact with living creatures. This survey, however, was an opportunity to learn about another aspect.
- The monitoring itself is very easy. After listening to a simple lecture, the participants were able to do the rest by themselves.
- Monitoring has only been done twice so far, and therefore, we would like to see the accumulation of additional data on changes in the coastline and coastal erosion.
- In this region, there are not many opportunities for adults to go to the beach. So, if there is an opportunity, such as a monitoring survey, I think it would be a good opportunity to go to the beach.

As shown in **Figures 4 and 5,** the data and photographs illustrate the beach profile changes that occurred during the sedimentation process on the sandy beach and the impact of structures, such as detached breakwaters designed for disaster prevention. From these results, it is conceivable that local residents will think about what should be prioritized in terms of the environment, as well as the protection and utilization of the coast. In the future, it is expected that repeated surveys will make it possible to more accurately understand the changes in beach profile throughout the year. It is also anticipated that this will foster a sense of ownership of the coast and awareness of disaster prevention.

2　Ocean Education during Elementary School

1）Implementation Overview

With the intention of fostering cooperation between local communities and schools as part of coastal conservation activities, a total of 23 fifth and sixth graders at Elementary School A in Noto Town, Ishikawa Prefecture, participated in an education program about the ocean in Thailand（**Fig. 6**）. Elementary School A was certified by the town as a designated school since 2015, and it has introduced a "satoumi" course（ocean education）as part of a project to revitalize educational activities. The satoumi course utilizes a special curriculum that makes use of local resources, such as the coastline of Noto Town, which is inhabited by a rich diversity of organisms; the unique fisheries industry. Besides, there are a lot of history, cultures and facilities related to the sea. Moreover, it aims to help children become more attached to the local region（Noto Town, 2019）. The lecturer was given by Ritphring, who developed BMON. In the lecture, Ritphring discussed the comparative lengths of the Thai and Japanese coastlines, the difference in coastal scenery, the topography and seasonal changes of the coast, and the jobs related to the sea. In addition, time was set aside for the children to look at and compare ten sand samples, including samples from Noto Town, Goshikigahama Beach, and the beaches of Thailand. The children were challenged to identify the sand that came from the coast of Noto Town from among various sand samples.

Fig.6 Ocean education at Elementary School A

2）Results

The children learned that, similar to their hometown in Japan, there is also squid fishing in Thailand. They also learned about the traditional fishing methods particular to Thailand. They

seemed to be interested in the problem of ocean garbage. By engaging in a dialog with the lecturer during the class, the children were able to gain a new perspective not only on the Thai sea but also on the coasts in their immediate surroundings. In particular, the elementary school where the class was held is a special school for ocean education; therefore, compared to schools in other areas, this school offers more opportunities for students to come into contact with the sea, and many families make a living in jobs related to the sea. Additionally, because the environment of this area is relatively similar to that of Thailand, the class content made students feel that the sea is closely connected to life.

We had an interviewed the homeroom teacher of the ５th-grade elementary class after the lecture. He stated that the teaching unit of the moral education "under the same sky" was taken up before giving this lecture, and it was a good opportunity to promote international understanding and think about issues that are common to Japan and other countries. By having foreign instructors show students pictures of various beaches, students were able to think about how foreign coasts are different from the coasts in their own region. The homeroom teacher stated that the students were able to pick up and compare coastal sand and their understanding of the differences in the size, fineness, color, and shape of the sand. In addition, there is a class that takes up strata, sedimentation, and erosion using sand as a theme as part of the ５th-grade science unit "How Water Works." It was suggested by the homeroom teacher that so far, river erosion has been the subject of discussion; however, the possibility of taking up coastal erosion in the future was also suggested. The impact that the sea has on people's lives can present opportunities to learn about tsunamis from the perspective of disaster prevention.

3　Open Seminar for Citizens

１）Implementation Overview

On December 10, 2022, at the Kanazawa Umimirai Library in Ishikawa Prefecture, an open seminar on citizen science and creating coastal spaces was held for citizens. It was sponsored by the Institute of Noto Satoumi Education and Studies（**Fig. 7**）. There were a total of ten participants, including staff members from organizations, high school students, schoolteachers, university teachers, staff from social education facilities, and tourists, all of whom were interested in the ocean. Ritphring gave the lecture, and it focused on community development by local residents living near the coast. The lecture focused on differences in coastline length between Thailand and Japan, natural environment and impacts on people's

Fig.7 Open seminar for citizen

lives from natural disasters, and activities for formulating coastal zoning plans created in collaboration with local people in Thailand.

2）Results

The participants actively discussed the importance and difficulty of coordinating with local communities to monitor not only coastal areas but also sea life and marine pollution. They also discussed potential methods for achieving such initiatives. Below is a brief description of the feedback given by participants.

・I think it would be good if monitoring activities involving citizens were more widespread.
・I want to continue learning about the sea.
・I want to learn about the environment, as well as the utilization and preservation of *satoumi*.
・It was interesting to learn about the differences between the Japanese and Thai coastlines.
・I think Thailand's bottom-up system（i.e., preparation of coastal zoning plans based on monitoring surveys with citizen participation）was great.

Ⅲ Discussion

It can be seen that coastal conservation activities that incorporate citizen science increased participants' awareness and interest in the coastal areas where the survey was conducted. Moreover, continuous changes in the coastline make it possible to visualize changes throughout the year. It is necessary to pay close attention to fostering awareness among participants by continuing to implement similar initiatives in the future. Coastline monitoring surveys using BMON can be carried out by local residents themselves, and interviews with school teachers suggest that even children may be able to conduct the survey.

Regarding school education, a 5th-grade class was taught a unit titled "the function of flowing water." It may be possible to develop experiential learning programs on the coast through BMON. Through hands-on lessons about the workings of flowing water, students can learn about disaster prevention, the protection of the natural environment, and the impact of activities meant to protect the natural environment and people's lives. In addition to learning about the geography of the region, coexistence with nature, and the history of disaster prevention for protecting human life, students can also learn about the impact that these initiatives have on the coast (Tokyo Shoseki Co., Ltd., 2020).

The above discussion clearly demonstrates that there is a possibility that children and adults alike can become interested in coastal conservation activities through coastline monitoring methods developed in Thailand, as well as through school education and citizen seminars. The themes of these activities that are highly compatible with school education can be conducted and introduced. However, there have been various discussions about the accuracy of citizen science data, and it is anticipated that intervention by experts will improve the accuracy of this data. Local residents interested in coastal conservation are expected to become increasingly interested; however, in order to direct citizen interest toward coastal conservation and disaster prevention, it is necessary to accumulate more accurate local data and utilize the methods and results of citizen science. It is necessary to establish a system for incorporating citizen scientists.

Acknowledgement

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市民科学を用いた海岸保全活動による地域住民の学びの促進に関する探索的研究

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要　旨

近年，行政や専門家だけでは手の届かない地域固有のデータを地域住民自身が調査し知見を蓄積する市民科学がさまざまな地域で実践されている。本研究では，タイで開発された専門家と地域住民が協働して関わる市民科学の手法及び子どもから大人までが参加できる海岸保全活動を日本に導入し活かすための新たな知見を示し，日本への展開の可能性を検証した。タイで実践されている海岸保全活動を参考に，１)海岸線のモニタリング調査，２)地域と学校との協働を目指した小学校での海洋学習の提供，３)市民向けセミナーを実施した。それぞれの参加者を対象としたインタビューとアンケート調査から検証した結果，これらの活動は子どもから大人まで関心を持って幅広い展開の可能性があることが明らかとなった。