Prediction of the giant-squid movement around Japan using the dataset of ocean current and temperature.

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The giant squid is one of the largest invertebrates in the world and is believed to mainly inhabit at depths of 650m to 900m. In Japan, they have been identified mainly in the areas around the Ogasawara Islands and near the Sea of Japan. However, because they are extremely rare in the number of individuals discovered, detailed studies on behavior and distribution have not been conducted. Their migration path/habitat distribution is roughly predicted with the data of the place where the giant squids were discovered, but the quantitative analysis has not been carried out.

The purpose of this study is to identify their movement routes and ecological distribution based on topographical data and to predict them more quantitatively than the research conducted in the past. The final goal is to establish a systematic method that can predict the behavior and distribution of organisms that are not currently studied, regardless of the species.

In this research, I will conduct research from the following two directions.

First, I compare the data of the ocean current and temperature with the location of the discovery and analyze the route and distribution from multiple planes. This time, using the Google Earth Engine (hereinafter referred to as GEE), the ocean current and ocean temperature data obtained from satellites are mapped on the map and compared with the data of the discovery location. As the data of the discovery place of the giant squid, the coordinate data at the time when they were discovered in extraordinary numbers in the Sea of Japan from January 2014 to March 2015 is used[1]. The data of the discovery place is visualized using Google My Map. In the previous researches, I made global predictions using surface data for all currents and temperatures, taking the variation in depth of each data collection location into consideration. The ocean current data was replaced with the HSV color space, and the hue represents the direction of the ocean current and the lightness represents the velocity of the ocean current. As a result, 57 individuals were found in the region where the velocity of the current is almost zero or slow. As for the seawater temperature, 48 out of 57 individuals were found in the region where the seawater temperature is relatively low. The following two were considered from these results. First of all, Squid is present in the region where the ocean current is slow in order to reduce energy consumption in the deep sea where the food is extremely low. Second, it was discovered that it had surfaced to a surface with a relatively large amount of biomass compared to the deep layer. However, because the operation of GEE was insufficient, the quantitative prediction could not be made. So, this time, I will collect data at each point using the method of acquiring the velocity of the ocean current and the temperature of the ocean at each point. The results obtained will be compared with the global forecasts made in previous studies to make new quantitative forecasts.

Secondly, based on the data of the ocean current and the temperatures well as hydrodynamics, I quantitatively forecast the migration path and habitat distribution of the giant squid. At present, the goal is to calculate and visualize the current flow. For this purpose, I’ m investigating how the Boltzmann equation that describes the microscopic behavior of fluid and the Navier-Stokes equation that describes macroscopically, correspond. The Navier-Stokes equation is a basic equation of fluid. Since the solution

of the Navier-Stokes equation does not indicate the existence, the correctness of the numerical solution obtained by performing the numerical simulation cannot be confirmed. I think that it is enough to use the differential equation obtained by discretizing in this scale. Finally, these are used to quantitatively predict how the giant squid will move from the location of the discovery.

By applying this research, it becomes possible to establish models of migration pathways and habitat distribution of not only the giant squid but also other creatures whose habitats are unknown, and it can be expected to be used for fishery and research.

References:
[1]Extraordinary numbers of giant squid, Architeuthis dux, encountered in Japanese coastal waters of the Sea of Japan from January 2014 to March 2015

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